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XIV INTERNATIONAL SYMPOSIUM

NEW BUSINESS MODELS AND SUSTAINABLE COMPETITIVENESS

SYMPOSIUM PROCEEDINGS

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FOREWORD

We are very pleased to present the Proceedings of the XIV International Symposium SymOrg 2014, traditionally organized every two years by the Faculty of Organizational Sciences, University of Belgrade. This year's Symposium continues its tradition of being the premier forum for the presentation of research results and experience on the latest issues in management theory and practice. SymOrg 2014 brings together people from various disciplines to discuss current and emerging issues within the business models arena, including business, social, technical and content-related management topics.

The topic "New business models and sustainable competitiveness" chosen for this year's Symposium sparked strong interest among the professional and scientific community and elicited great response to the call for papers. The Proceedings include around 250 papers and contributions from more than 500 authors. The international reputation of the Symposium was once again confirmed through the announced participation of speakers and guests from abroad.

The mission of the Symposium is to share novel business model solutions that meet the needs of sustainable competitiveness and identify new directions for future research and development. It brings together prominent experts from academia, corporate and public sector and other relevant organizations and institutions. It is a unique opportunity for the most competent individuals and organizations to present their theoretical knowledge, experience, and their forecasts with regards to new global and local trends of management development in the business environment.

The Symposium aims to provide a unique international forum to facilitate the exchange of cutting-edge information. It is acknowledged that SymOrg has positioned itself as one of the major conferences of its kind in Serbia, in terms of size, quality of content, and standing of attendees. The Symposium particularly encourages the interaction of research students and developing academics with the more established community.

The peer-reviewed papers in this volume span the scope of topics explored at the Symposium. The Proceedings are a vital reference for students, scientists and managers working in this field and will provide valuable guidance for developing new business models in practice and maintaining sustainable competitiveness.

The broad topic of the Symposium has allowed for exploration of different aspects of these areas:

- New Business Models
- Business Intelligence and Decision Making in Management
- Business Psychology
- Communication Management and Social Networking
- Corporate Social Responsibility
- Education Management
- Electronic Business
- Entrepreneurship and Management of Small and Medium Enterprises
- Financial Management
- Health Care Management
- Human Resource Management
- ICT and Management
- Innovative Organization and Management
- International Management
- Knowledge Management
- Marketing Management
- Operational Research and Quantitative Methods in Management
- Operations Management
- Organization of Business Systems

- Performance Management
- Project Management
- Public Administration Management
- Quality Management
- Strategic Management
- Sustainable Development and Environmental Management
- Case Study
- Technology and Innovation Management

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Belgrade, May 26, 2014

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CONTENT

NEW BUSINESS MODELS 1

MANAGING BUSINESS MODEL IN FUNCTION OF ORGANIZATIONAL DYNAMISM 2
Drakulevski Ljubomir, Nakov Leonid

INNOVATIVE APPROACH TO THE ANALYSIS OF THE SPA TOURISM IN VOJVODINA (SERBIA) 9
Harmath Peter, Ahmetagić Deniz

THE MODEL OF ORGANISATIONAL CAPABILITIES DEVELOPMENT 17
Stojković Dejan, Kovač Mitar, Mitić Vlada

NEW PUBLIC MANAGEMENT 22
Ristić Kristijan, Ristić Žarko

NEW COSTING MODEL IN MINING INDUSTRY 29
Manojlov Dragan, Stojanovic Cvjetko

BUSINESS INTELLIGENCE AND DECISION MAKING IN MANAGEMENT 37

META-HEURISTIC BASED WRAPPER ATTRIBUTE WEIGHTING TECHNIQUES FOR NAIVE BAYES CLASSIFICATION 38
Radovanović Sandro, Vukićević Milan, Suknović Milija

ANALYSIS OF ETL PROCESS DEVELOPMENT APPROACHES: SOME OPEN ISSUES 45
Turajlić Nina, Petrović Marko, Vučković Milica

THE DECISION MAKING IN PUBLIC E-PROCUREMENT BASED ON FUZZY METHODOLOGY 52
Bobar Vjekoslav, Mandić Ksenija, Suknović Milija

IMPROVEMENT OF MODEL OF DECISION MAKING BY DATA MINING METHODOLOGY 60
Istrat Višnja, Lalić Srdjan, Palibrk Milko

USING PROCESS MINING TO DISCOVER SKIING PATTERNS: A CLUSTERING APPROACH 67
Markovic Petar, Delias Pavlos, Delibašić Boris

DATA ANALYSIS AND SALES PREDICTION IN RETAIL BUSINESS 76
Đukanović Suzana, Milan Milić, Vučković Miloš

ACADEMIC DASHBOARD FOR TRACKING STUDENTS' EFFICIENCY 84
Isljamovic Sonja, Lalić Srdjan

ANALYSIS OF RUNTIME DIFFERENCE BETWEEN RAPIDMINER AND CUSTOM IMPLEMENTATION OF SIMPLE COLLABORATIVE FILTER BASED RECOMMENDER SYSTEM 91
Mihajlovic Milan

A DATA MINING MODEL FOR DRIVER ALERTNESS 95
Redzić Milena, Mijušković Mina, Mićić Anđela

RISK PREDICTION OF CUSTOMER CREDIT DEFAULT 101
Lazić Radomir, Proševski Tamara, Kovacevic Ana

APPLICATION OF ANP METHOD BASED ON A BOCR MODEL FOR DECISION-MAKING IN BANKING 107
Tornjanski Vesna, Marinković Sanja, Lalić Nenad

ERP SYSTEM IMPLEMENTATION ASPECTS IN SERBIA 117
Denić Nebojša, Spasić Boban, Milić Momir

AN APPROACH TO A SURVEY SYSTEM AS A CORPORATE TOOL 124
Ivanović Aleksandar, Vujošević Dušan, Kovačević Ivana

IMPLEMENTATION OF DATA MINING TECHNIQUES IN CREDIT SCORING 130
Sitar Marijana, Raseta Jelena, Klescek Anja

WALMART RECRUTING - STORE SALES FORECASTING 135
Stojanović Nikola, Soldatović Marina, MIlićević Milena

SENTIMENT ANALYSIS OF MOVIES REVIEW 140
Petrovic Nikola, Rastovic Zarko, Travanj Jelena

PREDICTION OF BOND'S NEXT TRADE PRICE WITH RAPIDMINER 144
Marić Ivana, Vuksan Milan, Vujic Katarina

STOCK MARKET TIME SERIES DATA ANALYSIS 151
Peric Nikola

PREDICTING BANKRUPTCY OF COMPANIES USING NEURAL NETWORKS AND REGRESSION MODELS 157
Marinković Dara, Nikolić Bojana, Dragovic Ivana

METHODICAL PROBLEMS OF COORDINATING ATTITUDES OF THE SUBJECTS OF ORGANIZATIONS IN THE GROUP DECISION-MAKING PROCESS 165
Blagojevic Srdjan, Ristić Vladimir, Bojanić Dragan

BUSINESS PSYCHOLOGY 172

OPERATIONALLY DEFINING CONCEPT OF WORK BEHAVIOUR: WORK BEHAVIOUR SELF-ASSESSMENT SCALE 173
Kovačević Ivana, Čizmić Svetlana, Mihailović Dobrivoje

PSYCHOLOGICAL CHARACTERISTICS OF LEADERS 181
Grubić-Nešić Leposava, Katić Ivana, Lalić Danijela

MOTIVATION LOYALTY AND VIRTUAL ITEM PURCHASE IN ONLINE GAMES 185
Petrović Pavle, Filipović Severina, Komnenić Darko

INFLUENCE OF PERSONAL FACTORS ON CAREER DEVELOPMENT OF EMPLOYEES 191
Katić Ivana, Grubić-Nešić Leposava

RESEARCH INTO ATTITUDES ABOUT SOCIAL CHANGE AND GLOBAL MODELS OF GOVERNANCE 198
Miladinović Slobodan

STORYTELLING AS AN ORGANIZATIONAL CHANGE MANAGEMENT TOOL 205
Pavicević Željana

WHAT MAKES AN EFFECTIVE TEAM MEMBER? 212
Nikodijević Ana, Mihailović Dobrivoje

INTERPERSONAL RELATIONSHIPS AS DETERMINANT OF FACULTY JOB SATISFACTION 220
Ljepava Nikolina, Selaković Marko

APPLYING PERSONALITY TESTS IN SELECTION OF EMPLOYEES - THE PROBLEM OF CRITERION VALIDATION 225
Petrović Maja, Mihailović Dobrivoje

LOCUS OF CONTROL AND LEVEL OF SELF-CONFIDENCE AS PREDICTORS OF STRIVING FOR POWER AMONG MANAGERS 230
Knežević Tatjana, Katić Ivana

APPEARANCE ON SOCIAL NETWORKS 238
Kreća Marija, Predrag Maletić

COMMUNICATION MANAGEMENT AND SOCIAL NETWORKING 245

MODEL OF CRISIS COMMUNICATION IN MILITARY ORGANISATIONS 246
Djuric-Atanasievski Ksenija

COMMUNITY MANAGEMENT IN SERBIA AND FACEBOOK INFLUENCE ON SERBIAN SOCIETY 251
Stojanović Katarina, Tasic Marijana, Šehović Marijana

NEW MEDIA IN INTERNAL COMMUNICATION 258
Okanovic Milan, Stefanovic Tijana, Suznjevic Monika

INFOGRAPHIC AS A MARKETING COMMUNICATION TOOL 266
Milovanovic Dragana, Ivanisevic Leo

CORPORATE SOCIAL RESPONSIBILITY 274

FAIR TRADE BUSINESS MODEL AS A FUNCTION OF SUSTAINABLE DEVELOPMENT 275
Nuševa Daniela, Dakić Stojanka, Uzelac Ozren

ANALYSIS OF THE LEVEL OF ALIGNMENT OF MARKETING OBJECTIVES WITH SOCIAL RESPONSIBILITY IN THE COUNTRIES IN TRANSITION 281
Krivokapic Slobodanka

EDUCATION MANAGEMENT 287

STUDENTS' PREFERENCES TOWARDS E-LEARNING ENVIRONMENT 288
Nikodijevic Ana, Kuzmanovic Marija, Anđelković Labrović Jelena

IDENTIFYING POTENTIALS OF INFORMAL E-LEARNING 2.0 296
Anđelković Labrović Jelena, Milosavljević Gordana

"FRESHMAN" TO "POSTGRAD" CHALLENGE: DIFFERENCES IN COLLEGE EXPERIENCES SATISFACTION AND LIFESTYLES AMONG STUDENTS OF FOS 302
Jovanovic Uros, Kovač Adam, Jeveričić Milan

MANAGING STUDENTS' VOCATIONAL TRAINING AT THE MEDICAL COLLEGE OF PROFESSIONAL STUDIES AS A METHOD OF GAINING SKILLS 311
Vasiljevic Blagojevic Milica, Krasulja Nevena, Radojević Ivana

USING „WHITE-BOX" CLASSIFICATION ALGORITHMS FOR PREDICTING STUDENTS' PERFORMANCE 318
Milinkovic Snjezana

LANGUAGE POLICY AND PLANNING IN EUROPE AND SERBIA IN THE CONTEXT – AN OVERVIEW 326
Novaković Marija, Anđelković Jelena, Jakic Gordana

RANKING OF CRITERIA TEACHERS USE WHEN SELECTING TEXTBOOKS 331
Pribićević Ivan, Tanasković Aleksandar, Stanojević Darko

LEADERSHIP SKILLS OF A HIGH SCHOOL PRINCIPALS A FIELD STUDY 338
Leskaj Etleva, Kasimati Mimoza, Shyqyri Llaci

PRACTICAL LEARNING OUTCOMES OF ADULT LEARNING INNOVATION IN U3A 347
Dvorackova Ruzena

ELECTRONIC BUSINESS 356

SOFTWARE DEFINED NETWORK INFRASTRUCTURE FOR AN E-LEARNING CLOUD 357
Šuh Jelena, Vujin Vladimir, Bogdanović Zorica

HADOOP INFRASTRUCTURE FOR EDUCATION 365
Marjanović Darko, Milovanović Miloš, Radenkovic Bozidar

IMPROVING E-LEARNING SERVICES WITH BIG DATA ANALYSIS 371
Milakovic Nemanja, Mijatović Dušan, Bogdanović Zorica

A MODEL FOR SMART E-LEARNING ENVIRONMENT 377
Simić Konstantin, Stevanović Mladen, Đurić Igor

LEVERAGING PLATFORM AS A SERVICE FOR SIMULATION LEARNING INFRASTRUCTURE 383
Milić Aleksandar, Kojić Slobodan, Petrović Pavle

A PLATFORM FOR LEARNING INTERNET OF THINGS 389
Đurić Igor, Simić Konstantin, Radenkovic Bozidar

MOBILE ADAPTIVE LANGUAGE LEARNING 395
Milutinović Miloš, Stepanić Đorđe, Despotovic-Zrakic Marijana

IMPROVING E-LEARNING PROCESS WITH WEARABLE COMPUTING 402
Stepanić Đorđe, Stevanović Mladen, Milutinović Miloš

ENHANCING STUDENT RELATIONSHIP MANAGEMENT WITH SOCIAL MEDIA MARKETING 410
Vojinović Iva, Labus Aleksandra, Kovacevic Borko

GATHERING AND ANALYSIS OF FACEBOOK FRIENDSHIP RELATIONS 418
Matejic Tijana, Mihailovic Djordje

APPLICATION OF THE INTERNET OF THINGS IN HIDROLOGY 426
Martać Rastko, Barać Dušan, Vujin Vladimir

IMPLEMENTING NFC SERVICE SECURITY - SE VS TEE VS HCE 434
Lepojevic Borko, Pavlović Bojan, Radulović Aleksandar

APPLICATION OF RFID TECHNOLOGY IN WAREHOUSE MANAGEMENT 440
Tomanović Ivana, Vojinović Iva

SUPPLY CHAIN MANAGEMENT IN FOOTWEAR INDUSTRY 448
Milinović Suzana, Đokić Dragan, Labus Aleksandra

APPLICATION OF VIRTUAL LOGISTIC CONCEPT IN SERBIAN ARMED FORCES 455
Nikolić Dejan, Milenkov Marjan, Kostur Vladimir

DOMAIN EXPERTISE OF THE SERBIAN ONLINE MARKET 461
Vukmirović Jovanka, Brbaklić Tepavac Marina, Vukmirović Aleksandra

INVESTIGATING WEB-BASED DECISION SUPPORT SYSTEMS SUCCESS IN ONLINE SHOPPING CONTEXT 467
Ayoub Mohammed

USING BIG DATA FOR CUSTOMER LOYALTY IN ONLINE BUSINESS 477
Djurdjević Nataša

POST PLATFORM AND CAPABILITIES OF SERBIAN POST 485
Dupljanin Đorđije, Dumnić Slaviša, Kujačić Momčilo

MOBILE TECHNOLOGIES AS A WAY OF GENERATING THE DEVELOPMENT OF POSTAL SERVICES 492
Strbac Slavica, Grgurović Biljana, Milutinovic Jelena

WARRANTY MANAGEMENT MODEL IN E-COMMERCE 498
Vasković Jelena, Čović Nemanja, Vasković Vojkan

ANALYSIS OF THE USE OF CREDIT CARDS AT ATMS AND POINTS OF SALE IN AND OUTSIDE THE REPUBLIC OF SERBIA 503
Draskovic Milan, Kukrić Milena, Smiljić Sava

PROVIDING CRM SERVICES IN B2B PORTAL OF ELECTRONIC MEDIA 511
Živanović - Ratković Vanjica, Barać Dušan, Kovacevic Ivanka

ENTREPRENEURSHIP AND MANAGEMENT OF SMALL AND MEDIUM ENTERPRISES 518

THE BANKING FOR SMALL AND MEDIUM ENTERPRISES 519
Milosevic Nela, Barjaktarovic Rakocevic Sladjana, Milanović Nemanja

ORGANIZATION OF NON-WOOD FOREST PRODUCTS SELLING IN SMALL AND MEDIUM ENTERPRISES IN CENTRAL SERBIA 526
Nonic Dragan, Avdibegovic Mersudin, Nedeljković Jelena

SMALL AND MEDIUM ENTERPRISES BASED ON NON-WOOD FOREST PRODUCTS: CHARACTERISTICS AND TYPES IN SERBIA 535
Nonic Dragan, Nedeljković Jelena, Rankovic Nenad

THE IMPORTANCE OF HUMAN RESOURCES DEVELOPMENT AS NON-FINANCIAL SUPPORT TO SMES IN SEE AND SERBIA 545
Popovic-Pantic Sanja

SURVEY ON ENTREPRENEURIAL READINESS: MANAGEMENT VS ENGINEERING STUDENTS IN SERBIA 551
Rakićević Zoran, Ljamic Ivanovic Brankica, Omerbegović-Bijelović Jasmina

ENTREPRENEURIAL MODEL OF FRANCHISING 560
Stefanovic Suzana, Stanković Milica

FINANCIAL MANAGEMENT 568

ALTERNATIVE SOURCES OF FINANCING OF THE SMALL AND MEDIUM SIZE ENTERPRISES IN THE REPUBLIC OF MACEDONIA 568
Boskoska Meri, Panovska - Boskoska Violeta

BEHAVIORAL FINANCE AND INVESTMENT DECISIONS 576
Barjaktarovic Rakocevic Sladjana, Milosevic Nela, Rakocevic Rade

BUDGET CONTROL AND FUND ACCOUNTING 584
Popovčić-Avrić Snežana, Mizdrakovic Vule, Djenic Marina

THE CRITIQUE OF INTEGRAL BUSINESS PERFORMANCE MEASUREMENT SYSTEMS 589
Milanović Nemanja, Milosavljevic Milos, Milosevic Nela

SOVEREIGN CREDIT RATING PREDICTION USING FUZZY LOGIC 597
Jovović Aleksandra, Jelinek Srdjan, Rakićević Aleksandar

ACCOUNTING INFORMATION SYSTEM AS THE SOURCE OF CORPORATE COMPETITIVE ADVANTAGE 605
Dmitrović Šaponja Ljiljana, Gravorac Saša, Milutinović Sunčica

FINANCIAL REPORTING IN CONTEMPORARY BUSINESS CONDITIONS 612
Dmitrović Veljko, Latinović Milica, Obradović Tijana

RECOGNITION VERSUS DISCLOSURE IN FINANCIAL REPORTING 619
Novak Aleš

THE ROLE OF FINANCIAL INFORMATION IN THE EVALUATION OF STRATEGIC MATTERS IN BANKS 626
Knezevic Snezana, Stanković Aleksandra, Vukčević Zec Aleksandra

MUNICIPAL BONDS AS A MODEL OF PROJECT FINANCING OF INFRASTRUCTURE PROJECTS 633
Benkovic Sladjana, Ljiljana Zipovski

HEDGE FUND MANAGEMENT COMPANIES AND DATABANK TRANSPARENCY 642
Totić Selena, Đoković Aleksandar, Milenković Nemanja

CURRENCY DERIVATIVES USE IN EMERGING MARKETS 650
Bogojevic Arsic Vesna

THE VISIBLE HAND OF STATE IN THE BUSINESS OF INSURANCE COMPANIES AND INVESTMENT FUNDS 658
Demko Rihter Jelena, Njegomir Vladimir, Vrkatić Ivana

EMPIRICAL EVIDENCE ON EFFICIENCY OF TRADITIONAL VERSUS BEHAVIOURAL ASSET-PRICING MODELS: AN OVERVIEW 666
Latinović Milica, Obradović Tijana, Dmitrović Veljko

LOAN PORTFOLIO MONITORING 673
Jovin Slobodanka, Momčilović Mirela, Ercegovac Dajana

SELECTION OF UNIVERSAL SERVICE FINANCING MODEL USING FUZZY MCDM 680
Jovanović Bojan, Trickovic Ivan, Šarac Dragana

COMPARISON OF MOVING AVERAGES FOR TRADING TRENDS: THE CASE OF THE BELGRADE STOCK EXCHANGE 688
Rakićević Aleksandar, Končarević Radovan, Petrovic Bratislav

RESULTS OF APPLIENCE OF BENFORD'S LAW ON SERBIAN COMPANIES 696
Barjaktarović Lidija, Milojevic Marko, Terzic Ivica

TESTING MOVING AVERAGE TRADING RULE IN CASE OF SERBIA AND CROATIAN STOCK MARKET INDICES 703
Radovanov Boris, Marcikic Aleksandra

FINANCIAL INTERMEDIATION SERVICES IN THE SYSTEM OF NATIONAL ACCOUNTS 708
Vulović Marija, Gavrilović Dušan, Vukmirović Aleksandra

POSTAL AND FINANCIAL INCLUSION 715
Šarac Dragana, Marković Milan, Rogić Bojana

CREDITING AND INSURING EXPORT BUSINESS 722
Dragosavac Milos, Kisin Nina, Drinić Dragana

ACHIEVING SET DEVELOPMENT GOALS WITH ECONOMICAL EXECUTION OF PUBLIC EXPENDITURES 733
Knežević Milena, Tesanovic Branko, Trandafilović Sasa

INNOVATIVE BUDGETING EXPENSES OF DEFENSE 741
Trandafilović Sasa, Lučanović Paun, Knežević Milena

BASIC COMPONENTS OF INTERNAL CONTROL IN PUBLIC SECTOR WITH A VIEW TO THEIR ROLE IN THE MINISTRY OF DEFENCE AND THE SERBIAN ARMY 747
Zugic Rade, Kostic Radan, Radojkovic Milica

THE IMPORTANCE OF A PUBLIC - PRIVATE PARTNERSHIP FOR TRANSITION COUNTRIES 755
Miletic Dalibor, Ilić Silvana, Stevanović Marija

INCREASING CAPACITY LEVEL OF FINANCIAL MANAGEMENT IN PUBLIC SECTOR 759
Leko Danica

HEALTH CARE MANAGEMENT 767

MULTIVARIATE MODELS FOR FORECASTING DEMAND IN AMBULANCE SERVICES 768
Marcikic Aleksandra, Radovanov Boris

COMPARATIVE REVIEW OF ICT DEVELOPMENT IN THE FIELD OF HEALTH CARE SYSTEM IN SLOVENIA AND SERBIA 774
Jovanovic Milenkovic Marina, Milenkovic Dejan, Rajkovič Uroš

UPGRADING THE EHCI INDEX: A STATISTICAL APPROACH 782
Dobrota Marina, Stefanovic Milos, Bulajić Milica

CONFLICT MANAGEMENT - CONFLICTS IN PRIMARY HEALTH CARE 790
Mandic Mila, Jakic Gordana, Rabrenovic Marija

HUMAN RESOURCE MANAGEMENT 797

HR SHARED SERVICES CENTERS AS PART OF A NEW BUSINESS MODEL OF THE ORGANIZATIONS 798
Petković Mirjana, Djordjević Biljana

E-SKILLS FOR PUBLIC SECTOR EMPLOYEES IN THE PROCESS OF E-GOVERNMENT DEVELOPMENT 807
Bogdanoska Jovanovska Mimoza, Ratkovic Tatjana

INTERNATIONAL PERFORMANCE MANAGEMENT – ISSUES AND CHALLENGES 814
Ratkovic Tatjana, Bogdanoska Jovanovska Mimoza, Anđelković Labrović Jelena

THE PRACTICE OF PERFORMANCE BASED PAY IN CENTRAL AND EASTERN EUROPE 820
Berber Nemanja, Slavić Agneš

COMPETENCIES ASSESSMENT OF THE EXPERTS - PARTICIPANTS IN GROUP DECISION-MAKING ON SELECTION OF THE METHODS FOR ASSESSING THE QUALITY OF MILITARY DRIVERS 828
Lukovac Vesko, Pejčić-Tarle Snežana, Pamucar Dragan

APPLICATION OF THE PROCESS FUNCTIONS METHOD FOR EVALUATION OF THE ADMINISTRATIVE BODIES IN ORGANISATIONAL STRUCTURE 834
Lukovac Vesko, Djorovic Boban, Pamucar Dragan

EDUCATIONAL ACHIEVEMENTS AS A DETERMINANT OF AN INDIVIDUAL'S FORMAL POWER 842
Marič Miha, Jeraj Mitja

ICT AND MANAGEMENT 849

USE OF TEMPORAL CONCEPTS IN TRANSACTIONAL DATABASES 850
Vesic Slavimir, Babarogic Sladjan, Anicic Nenad

PERFORMANCE EVALUATION OF TEMPORAL FEATURES DEFINED IN ORACLE 12C DATABASE 858
Radovanović Sandro, Milovanovic Elena, Anicic Nenad

AUTOMATIC GENERATION OF EXECUTABLE UI PROTOTYPES USING SILABREQ LANGUAGE 867
Savić Dušan, Antović Ilija, Stanojević Vojislav

SOFTWARE DELEGATES AS A METHOD OF CODE ORGANIZATION WITHIN CONTEXT ORIENTED PROGRAMMING ENVIRONMENT 875
Lazarević Saša, Stevanović Branko

SERAPHIM: LINUX KERNEL MODULE FOR RESOURCE MANAGEMENT AND COMMAND EXECUTION 883
Živadinović Miloš, Milenkovic Ivan, Simić Dejan

THE ARCHITECTURE OF INTEGRATED IDENTITY MANAGEMENT AND MULTIMODAL BIOMETRIC SYSTEM 981
Jovanović Bojan, Bogićević Marija, Milenkovic Ivan

METHODS FOR BIOMETRIC DATA CONNECTION IN MULTIMODAL SYSTEMS 900
Paunović Saša, Jerinić Ivan, Starčević Dušan

INTEROPERABILITY PROBLEM IN MULTIMODAL BIOMETRIC SYSTEMS 905
Šošević Uroš, Milovanović Miloš

THE IMPACT OF APPLYING INTERNATIONAL SPECIFICATIONS AND STANDARDS TO BIOMETRIC SYSTEMS 912
Milinković Milorad

NOVEL APPROACH FOR TEXT PLAGIARISM DETECTION 918
Krstojevic Predrag, Milikic Nikola

NEW PROCUREMENT MODEL 926
Manojlov Dragan, Nagy Viktor

WEARABLE COMPUTING IN EDUCATION 934
Petrovic Barbara

IMPROVING THE QUALITY AND RELIABILITY IN THE DEVELOPMENT OF SOFTWARE SOLUTIONS 942
Davidov Tatjana, Bošnjak Saša

SOFTWARE SOLUTION FOR THE PRODUCTION QUALITY MONITORING 950
Nešić Zoran, Vesić Vasović Jasmina, Radojičić Miroslav

DEVELOPING JOOMLA COMPONENT FOR THE VOTING SYSTEM BASED ON COMPARATIVE ANALYSIS 958
Kuzman Maja, Pantelic Ognjen, Pajić Ana

PROJECT MANAGEMENT IMPACT DURING ERP SYSTEM IMPLEMENTATION 965
Denić Nebojša, Ilić Momir, Spasić Boban

MANAGING THE RISKS IN INFORMATION TECHNOLOGY (IT) AND ROLE OF INTERNAL AUDITING 974
Gavrilović Marina

THE INTRODUCTION OF THE EFFECTIVE METHOD OF GIS TECHNOLOGY IN WATER SUPPLY SYSTEMS 978
Stajčić Dejan, Ćebić Branko, Stojčetović Bojan

IMPROVING SERBIAN HEALTHCARE SYSTEM WITH "FIND A MEDICINE" 985
Milić Miloš, Vlajić Siniša, Lazarević Saša

AHP DECISION SUPPORT IN SLA NEGOTIATION 993
Mikavica Branka, Kostic-Ljubisavljevic Aleksandra, Radonjic Djogatovic Vesna

INNOVATIVE ORGANIZATION AND MANAGEMENT 1001

MILITARY TRANSFORMATION PROCESS AND DISBANDING OF MILITARY UNITS 1002
Nebojša Nikolić

POSSIBILITY OF ORGANIZATIONAL CONSULTING AS A PROCESS IN IMPROVING THE PERFORMANCE OF ORGANIZATIONS AND INSTITUTIONS 1007
Jevtić Marija, Mojović Marina

MANAGEMENT OF COMPANIES INNOVATIVE ACTIVITIES IN THE FUNCTION OF ACQUIRING AND MAINTAINING A COMPETITIVE ADVANTAGE 1012
Lalić Nenad, Jovičić Miladin, Zupur Ognjen

INTERNATIONAL MANAGEMENT 1020

THE IMPORTANCE OF ASIAN CONGLOMERATE BUSINESS MODELS IN INTERNATIONAL MANAGEMENT 1021
Backović Nemanja, Milićević Vesna, Ilić Bojan

FOREIGN DIRECT INVESTIMENTS AND ECONOMIC GROWTH: THE CASE OF SERBIA 1029
Parežanin Miloš, Jednak Sandra, Kragulj Dragana

INTERNATIONAL COMPETITIVENESS AS A RESULT OF ENTREPRENEURIAL INITIATIVES IN CONTEMPORARY BUSINESS 1036
Sofronijevic Adam, Milićević Vesna, Ilić Bojan

THE EVOLUTION OF THE PUBLIC DEBT IN ROMANIA AND SERBIA DURING AND AFTER THE GLOBAL RECESSION 1043
Săvoiu Gheorghe, Jaško Ondrej, Marian Taicu

THE ECONOMIC CONVERGENCE PROCESS TO EUROPEAN UNION: SOME TRENDS AND CHARACTERISTICS OF ROMANIAN AND SERBIAN ECONOMIES 1051
Săvoiu Gheorghe, Apostol Luiza, Čudanov Mladen

THE IMPORTANCE OF LEGAL AND FINANCIAL SYSTEMS FOR DOING BUSINESS IN INDIA 1058
Jaškova Anna

KNOWLEDGE MANAGEMENT 1065

KNOWLEDGE MANAGEMENT SOFTWARE APPLICATION IN ICE-CREAM COMPANIES 1066
Ristevska Ana

MEASURING IMPLICIT AND EXPLICIT KNOWLEDGE IN ORGANISATIONS 1071
Vukić Ivan, Čudanov Mladen, Gheorghe Săvoiu

MARKETING MANAGEMENT 1079

CONSUMERS´ ATTITUDES TOWARDS PURCHASING FASHION COUNTERFEITS 1080
Kostić - Stanković Milica, Cvijovic Jelena

APPLICATION OF CROWDSOURCING IN MARKETING 1087
Vlastelica Bakic Tamara, Cicvaric Kostic Slavica, Nešković Ema

METHODOLOGY FOR EXPLORING FACTORS THAT AFFECT PEOPLES INTENTION TOWARDS COSMETIC SURGERY 1092
Jovic Marija, Filipovic Vinka, Jovic Marko

KEY ACCOUNT MANAGEMENT - STRATEGIC IMPERATIV IN POSTAL SERVICES 1098
Ožegović Spasenija, Šarac Dragana, Unterberger Marija

ROLE OF MARKETING COMMUNICATION IN CANCER PREVENTION 1105
Cvijovic Jelena, Kostić - Stanković Milica, Krstic Goran

VOJVODINA AS A TOURISM DESTINATION: CITIZENS' PERSPECTIVE 1113
Vranić Ivana, Cicvaric Kostic Slavica, Vlastelica Bakić Tamara

THE EFFECTIVENESS OF MEDIA CAMPAIGNS IN COMMUNICATION WITH CHILDREN 1119
Malinović Anja, Vlastelica Bakic Tamara, Cicvaric Kostic Slavica

CHALENGES AND OPPORTUNITIES OF INTERNET MARKETING IN SERBIA AND THE WORLD 1126
Markov Jasmina, Stankov Biljana, Roganović Milijana

THE EFFECTIVENESS OF ATL AND BTL ADVERTISING TECHNIQUES 1134
Šehović Marijana, Duduković Mirjana, Mladenović Jelena

OPERATIONAL RESEARCH AND QUANTITATIVE METHODS IN MANAGEMENT 1140

APPLICATION OF SOME LOCATIONAL MODELS IN NATURAL RESOURCES INDUSTRY - AGRICULTURE CASE 1141
Andrić Gušavac Bisera, Stojanović Dragana, Sokolović Željko

MULTIPLE CRITERIA APPROACH TO SELECTING SITES FOR PORTS OF NAUTICAL TOURISM 1149
Kovačić Mirjana, Jugović Alen, Perić Hadžić Ana

TRAVEL BEHAVIOUR OF TEENAGERS: KEY ATTRIBUTES IN CHOOSING TOURIST OFFER 1157
Vukic Milena, Kuzmanovic Marija, Kostić - Stanković Milica

PREFERENCES TOWARDS ORGANIC VS. NON-ORGANIC FOOD: AN EMPIRICAL STUDY OF CONSUMERS IN SERBIA 1165
Marinovic Minja, Popovic Milena, Kuzmanovic Marija

MATHEMATICAL MODEL OF OPTIMAL ECONOMIC PLAN FOOD FOR LUNCH MEMBERS OF SERBIAN ARMY 1172
Jovic Sasa, Tesanovic Branko, Tešanović Jelena

INVENTORY MODEL FOR DIFFERENT KIND OF PRODUCTS - THE CAPACITY OF STORAGE SPACE AS A CONSTRAINING FACTOR 1180
Vasileva Liljana, Atanasova-Pachemska Tatjana, Pachemska Sanja

OPTIMAL VEHICLE ROUTING IN THE OIL INDUSTRY 1186
Golubovic Jelena, Makajić-Nikolić Dragana, Nikolić Nebojša

EFFECTIVENESS DETERMINATION OF HIGHER EDUCATION USING LINEAR PROGRAMMING 1192
Timovski Riste, Atanasova-Pačemska Tatjana

MULTI-CRITERIA OPTIMIZATION OF THE MOST COMPETITIVE BANK IN MONTENEGRO SELECTION PROCESS 1199
Rakocevic Svetlana, Dragašević Zdenka, Gliševič Nevenka

RISK MANAGEMENT IN OPERATIONAL PLANNING PROCESS AT THE OPERATIONAL AND TACTICAL LEVELS 1207
Karovic Samed, Radovanovic Goran, Ristić Vladimir

A NEW CONSTRUCTIVE HEURISTICS FOR SOLVING THE MINIMUM FEEDBACK VERTEX SET PROBLEM 1216
Stanojević Milan, Stanojevic Bogdana

OPERATIONS MANAGEMENT 1222

MRP FOR COMPLEX ASSEMBLY SYSTEMS UNDER ENVIRONMENTAL UNCERTAINTY 1223
Danilovic Milos, Ilic Oliver, Cvetic Biljana

SPREADSHEET APPLICATION IN OPERATIONS MANAGEMENT EDUCATION 1231
Đorđević Lena, Antic Slobodan, Lecic-Cvetkovic Danica

IMPROVEMENT OF PLANNING SYSTEM IN SUPPLY CHAINS AND SOFTWARE SUPPORT 1239
Omerbegović-Bijelović Jasmina, Atanasov Nikola, Rakićević Zoran

AN OVERVIEW OF CAUSES FOR BULLWHIP EFFECT AND MODES OF DECREASING THEIR EFFECT 1249
Panić Biljana, Vujošević Mirko, Makajić-Nikolić Dragana

MAINTENANCE MANAGEMENT MODELS - A COMPARATIVE ANALYSIS 1257
Popovic Jovana, Popovic Jelena, Paunović Viktorija

NOVEL APPROACH TO BUSINESS PROCESS PERFORMANCE MEASUREMENT 1264
Simeunović Barbara, Radović Milić, Slovic Dragoslav

BPM PRACTICE: EXPERIENCES FROM COMPARISON STUDY IN SERBIA 2012-2014 1272
Stojanović Dragana, Tomašević Ivan, Simeunović Barbara

OPERATIONS MANAGEMENT RESEARCH: AN UPDATE FOR 21ST CENTURY 1280
Tomašević Ivan, Stojanović Dragana, Simeunović Barbara

ORGANIZATION OF BUSINESS SYSTEMS 1288

COMPARISON OF DIFFERENT QUANTITATIVE APPROACHES TO ASSESMENT OF ORGANIZATIONAL CULTURE 1289
Jevtić Miloš, Todorović Ivan, Komazec Stefan

PUBLIC SECTOR DOWNSIZING THROUGH CENTRALIZATION OF NON-CORE FUNCTIONS: BELGRADE CASE STUDY 1298
Todorović Ivan, Komazec Stefan, Jevtić Miloš

ORGANIZATIONAL ANALYSIS AND DIAGNOIS: TRACKING DOWN PROCESSES AND STRUCTURE 1306
Stefanović Ivan, Momčilović Marina

ROUTINES CAPABILITIES AND ABSORPTIVE CAPACITY INTERPLAY: A REVIEW AND RECONCEPTUALIZATION 1315
Stefanović Ivan, Prokic Sloboda

DEVELOPMENT OF PROCESS MODEL OF ENTERPRISE ORGANIZATION 1324
Matić Branko

RELATIONSHIP BETWEEN BUSINESS ENVIRONMENT AND ENTREPRENEURIAL ACTIVITIES 1332
Krivokapić Jovan, Jaško Ondrej

PROTECTION OF PERSONAL DATA AND THE PRACTICES OF THE IT COMPANIES IN SERBIA 1339
Krivokapic Djordje, Kostić Bojana, Đukanović Goran

PERFORMANCE MANAGEMENT 1347

PERFORMANCE MANAGEMENT METHODOLOGY: INTEGRATIVE APPROACH 1348
Obradović Tijana, Dmitrović Veljko, Latinović Milica

APPLICATION OF THE BALANCED SCORECARD IN DEFENCE PERFORMANCE MANAGEMENT 1357
Kankaraš Milan, Stojković Dejan, Kovač Mitar

ROLE OF TRANSFER PRICING IN BUSINESS OF MULTINATIONAL COMPANIES 1363
Stevanovic Tatjana, Petrović-Ranđelović Marija

TOWARDS A FRAMEWORK FOR ENHANCING R&D INDICATORS OF OECD COUNTRIES 1368
Zdravković Stefan, Markovic Maja, Mitrović Maja

THE ROLE OF SPORT IN ECONOMY 1376
Jeraj Mitja, Todorović Ivan

AIRPORT CHARGES AND DISCOUNTS: IMPLICATIONS FOR AIRLINES OPERATED AT AIRPORTS IN SOUTHEAST EUROPE 1383
Kalić Milica, Kuljanin Jovana

PROJECT MANAGEMENT 1391

CHALLENGES OF IT PROJECT PORTFOLIO SELECTION 1392
Petrović Dejan, Mihic Marko, Obradović Vladimir

ORGANIZATIONAL PROJECT MANAGEMENT MATURITY ANALYSIS OF ENERGY SECTOR COMPANIES 1400
Mihic Marko, Petrović Dejan, Obradović Vladimir

EMOTIONAL INTELLIGENCE: NEW COMPETENCE OF PROJECT MANAGERS 1407
Obradović Vladimir, Petrović Dejan, Ristic Milica

HOW TO SELECT THE BEST PROJECT MANAGER? 1415
Baruch Keren, Yossi Hadad, Zohar Laslo

APPLICATIONS OF RANKING INDEXES OF PROJECT ACTIVITIES FOR PROJECT MANAGEMENT TASKS 1422
Yossi Hadad, Baruch Keren, Zohar Laslo

PROJECT SUCCESS ANALYSIS: EVIDENCE FROM SERBIA 1429
Todorović Marija, Toljaga-Nikolić Danijela, Mitrović Zorica

RISK MANAGEMENT METHODS: HOW TO DEAL WITH RISKS IN A PROJECT 1436
Toljaga-Nikolić Danijela, Todorović Marija, Bjelica Dragan

DEFINING "SUCCESS" FOR PROJECT MANAGEMENT INFORMATION SYSTEM: A CROSS SECTIONAL STUDY 1444
Bjelica Dragan, Mitrović Zorica, Todorović Marija

RISK INDEX AS PROJECT RISK MEASURE 1451
Komazec Nenad, Stankovic Miomir, Savić Suzana

THEORY OF COMPLEXITY AND INNOVATION PROJECTS 1460
Dodevska Zorica, Mihic Marko

SELECTION AND PRIORITIZATION OF CAPITAL PROJECTS IN THE PUBLIC SECTOR 1469
Radovic Sonja, Pejic Sanja, Stojkovic Svetlana

PROJECT MANAGEMENT ON INTERNET – BLOGGERS AS FOCUS COMMUNITY 1475
Velimir Tasic

ASPECTS OF PUBLIC RELATIONS AND FINANCIAL MODELS WITHIN NGO'S 1483
Radonic Milenko, Dogović Marko, Drecun Ivana

QUALITY MANAGEMENT 1492

SERVICE QUALITY IMPROVEMENT: THE BUSINESS PROCESS MANAGEMENT APPROACH 1493
Krstić Uroš, Djuric Mladen, Janicijevic Ivan

CORRELATIONS OF RESTRUCTURING ENTERPRISES PERFORMANCE AND ISO 9001 CERTIFICATION 1500
Lukić Marija, Čudanov Mladen, Mijatovic Ivana

ANALYSIS OF THE EXPERIENCES IN THE IMPLEMENTATION OF AN INTEGRATED MANAGEMENT SYSTEM 1505
Krsmanovic Maja, Horvat Ana, Zivkovic Nedeljko

CONCEPTS OF STANDARDS AND STANDARDISATION IN PUBLIC ADMINISTRATION JOURNALS 1512
Ruso Jelena, Djuric Mladen

CRITICAL ANALYSIS OF THE ISO METHODOLOGY FOR ASSESSING THE ECONOMIC EFFECTS OF STANDARDS 1519
Trajkovic Ana, Mijatovic Ivana

STANDARD ISO 26000 AND SOCIAL RESPONSIBILITY IN THE SERVICE OF SME-S SUSTAINABILITY 1525
Vukosavljevic Ljiljana, Jovanovic Bojana, Djuric Mladen

THE ECONOMIC SUSTAINABILITY OF STANDARDS – CAN ISO METHODOLOGY HELP ? 1533
Gojkovic Stevan

EXPERIENCES IN THE IMPLEMENTATION OF ISO 20000 1539
Tuševljak Milica, Tabaš Jelena, Tuševljak Jelica

STRATEGIC MANAGEMENT 1547

STRATEGIC SHIFTS IN STRATEGIC RESEARCH – SHORT REVIEW OF ORGANIZATIONAL AND PROGRAM CHANGES 1548
Nikolic Nebojsa

ORGANIZATION AND FUNCTIONING OF THE SECURITY MANAGEMENT IN CRISIS SITUATIONS 1553
Radončić Hajradin, Talijan Miroslav, Petrović Aleksandar

DEFENCE STRATEGIC MANAGEMENT- APPLICATION OF SIMULATION IN THE PERSONNEL COSTS OPTIMIZATION 1559
Mitic Vlada, Stojković Dejan, Kankaraš Milan

EVALUATION OF CAPACITY DEVELOPMENT IN STRATEGIC PLANNING – A CASE OF CENTRAL GOVERNMENT INSTITUTIONS IN SERBIA 1565
Mitrović Zorica, Bjelica Dragan, Toljaga-Nikolić Danijela

SUSTAINABLE DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT 1572

DELTA UNIVERSE AND NATURE PROTECTION IN THE DANUBE DELTA 1573
Camelia Slave, Rotman Anca Laura

"MULTIPLE CRITERIA APPROACH TO SELECTING SITES FOR PORTS OF NAUTICAL TOURISM 1578
Kovačić Mirjana, Jugović Alen, Perić Hadžić Ana

ALTERNATIVE – RSE ENERGETIC RESOURCES IN SLOVENIA AND SERBIA AND ITS POSSIBILITIES OF EXPLOATATION IN PRACTICE 1586
Žnidarič Davorin

THE MODEL OF AN ORGANISATION OF THE EFFECTIVE PUBLIC COMMUNICATION IN HAZARDOUS WASTE MANAGEMENT 1592
Žilič Fišer Suzana, Fišer Jure

ENVIRONMENTAL SUSTAINABILITY SCREENING OF SMALL-SCALE URBAN WATER SUPPLY SYSTEMS 1598
Kovacevic Bojan, Markovic-Kovacevic Ivana

SUSTAINABLE WASTE MANAGEMENT - SURVEY ON WASTE COLLECTORS' WORK SATISFACTION IN THE PUBLIC UTILITY COMPANY 1608
Ćirović Marko, Petrović Nataša, Radojičić Zoran

T**OWARDS A FRAMEWORK FOR EVALUATION SUSTAINABLE SOCIETY INDEX** 1614
Maričić Milica, Jankovic Marija, Jeremic Veljko

THE RESEARCH ON THE DEVELOPMENT OF ENVIRONMENTALLY RESPONSIBLE LOGISTICS IN SERBIA 1622
Jovanović Igor, Jakovljević Luka, Pavićević Milica

ECO-INNOVATIONS AS A SOURCE OF COMPETITIVE ADVANTAGE IN ENTERPRISES 1629
Urbaniec Maria

CONSTRUCTED WETLANDS AS APPROPRIATE WAY OF WASTE WATER TREATMENT IN RURAL REGIONS 1636
Vuk Drago, Žnidarič Davorin, Senegačnik Marjan

GREEN INNOVATION AS THE TRIGGER OF ENVIRONMENTAL RESPONSIBILITY 1642
Jakovljević Luka, Jovanović Igor, Lazin Stefan

DEVELOPMENT IN RENEWABLE ENERGY PRODUCTION IN SERBIA WITH THE EMPHASIS ON BIOETHANOL 1650
Semenčenko Dušica, Semenčenko Valentina, Mosurović Ružičić Marija

SMART METER AND CONSUMERS 1657
Popovic Dejana, Šahović Nikola

SUSTAINABLE DEVELOPMENT INDICATORS OF THE REPUBLIC OF SERBIA 1663
Milanovic Tijana, Petrović Nataša, Milanović Maja

RESEARCH ON THE SUBJECT OF STUDENTS' AWARENESS AND KNOWLEDGE ABOUT GREEN IT 1670
Novaković Jelena

CLIMATE CHANGE TREATMENT IN NATIONAL SECURITY DOCUMENTS 1677
Nikolic Nebojsa

TECHNOLOGY AND INNOVATION MANAGEMENT 1682

SUSTAINABLE TECHNOLOGY MANAGEMENT AND DEVELOPMENT - STATE UNIVERSITY AND INDUSTRY PERFORMANCE MODEL 1683
Levi Jakšić Maja, Jovanović Milica, Petković Jasna

GOVERNMENT PERFORMANCE IN TECHNOLOGY AND INNOVATION MANAGEMENT – THE CASE OF SERBIA 1692
Marinković Sanja, Rakićević Jovana, Levi Jakšić Maja

MECHANISMS FOR STIMULATING INNOVATION CAPABILITIES IN WESTERN BALKAN COUNTRIES 1701
Štrbac Dijana, Kutlača Đuro, Živković Lazar

POSSIBILITIES OF OPENING UP THE STAGE-GATE MODEL 1708
Stošić Biljana, Milutinović Radul, Leković Sonja

THE EVOLUTION OF MOBILE TECHNOLOGY IN RETAIL MARKETING CHANNELS IN THE REPUBLIC OF SERBIA 1716
Končar Jelena, Vukmirović Goran, Leković Sonja

ADVANCE REAL ESTATE MANAGEMENT SYSTEM 1721
Jovanović Verka, Vukelić Đorđe

CLOUD COMPUTING INFRASTRUCTURE APPLICATIONS IN COMPUTER SIMULATION 1729
Marinković Mihailo, Čavoški Sava, Marković Aleksandar

CASE STUDIES 1736

INCITING PHYSICAL ACTIVITY AMONGST YOUTH USING MODERN TECHNOLOGIES 1737
Vukasinovic Nevena, Filipić Filip, Spasojević Predrag

ALFA BANK: DEVELOPMENT STRATEGY FOR NEW DIGITAL CHANNELS 1747
Nešković Ema, Petric Kristina, Damnjanović Vesna

ENVIRONMENT QUALITY UNIQUENESS ALTERNATIVE – MIXING 4P'S AND 4E'S 1753
Novcic Branka, Šegota Tina

DESTINATION BRANDING THE CASE OF BELGRADE - A FRIENDLY EUROPEAN CITY 1762
Bivolarević Stanislava, Damnjanović Vesna

THE ROAD TO SUCCESS - WHAT SHOULD AUTOGARANT DO? 1768
Jeveričić Milan, Jovanovic Uros, Petrovic Milan

CREATIVE MARKETING STRATEGIES H&M VS ZARA 1774
Zozi Jelena, Janicic Radmila

NEW BUSINESS MODELS

MANAGING BUSINESS MODEL IN FUNCTION OF ORGANIZATIONAL DYNAMISM

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Abstract: *One of the most challenging managerial attempts nowadays is undoubtedly strive for creation of a business model which would best integrate the organizational position towards the external adaptation and integral integration. This managerial process is a logical continuation of modeling the competitive advantage of a certain enterprise, in such a way that the organizational learning would best integrate the used, not the overall organizational knowledge, the flexibility of the organizational systems would determine the potential of the behavioral processes and that the changes oriented towards innovation would enable strategic positioning regarding the existing and potential competition.*

The prior objective of creating and further managing a business model is achieving an integrated and pro-active combination of elements that implement the needs of an organizational dynamism, in the process of problem analyzing of sustainable dimensions of the competitive advantage. Therefore, its ultimate target is managing a Customer – integrated Business model, as one that places an 'integrated importance' to the role of the customer within managing the organizational competitive advantage.

Key words: *Business model, strategic positioning, organizational inertia and dynamism, pro-activity and strategic flexibility, customer-integrated model*

INTRODUCTION

Business modeling and the process of managing it has emerged it's importance for an applicative usage from the mid 1960's when dynamic companies, such as IBM – in main framing the computer from industrial to predominantly personal, Sears Roebuck – in shifting from overall catalogue offer to a retailing specialized catalogues, Motorola – from consumer electronics - operating method to high-technology added value in telecommunications, mobile and internet based competitive model, IKEA - from immense non compositional to separate segmented business offer, and many others, have identified the necessity of *changing the dominant business logic*, with regards to the contingency analyses of the internal and external stimulus, determinants and obstacles for a prominent and recognizable sustained competitiveness.

Each organized effort for planning and implementing a certain *business model* integrates not only the organizational, but also the departmental level, especially to those organizational units which are most critical for a proper determination and combination of business elements whose relationship and inter-dependence forms the scope and depth of the competitive potential of any enterprise. In this context, business modeling is far more a process than a state, predominantly due to the needed changes, transformational or transactional, that shape the process of managing it.

1. METHODOLOGICAL DETERMINATION AND ELEMENTS OF BUSINESS MODEL

Despite the fact that applicative importance of business modeling has emerged from the mid 1960"s, up to the end of 1990"s their hasn"t been a unified and accepted methodological framework for *managing an organizational business model*, which inter-relates with the increase of the need for a planned, not an incidental organizational change, mainly focused on changes for adopting the strategies to the complex

environment. However, it is quite important to emphasize that *the concept of business modeling is far from applying the organizational strategy, or operative accommodation of strategic elements*. In detailing the desired nature and capacity of their business model, every organization focuses on their *particular combination of resources - especially the used knowledge, skills, capabilities and experience, on one hand, with the capacity for pro-active behavior, strategic flexibility and organizational inertia, on the other hand, both of them aimed at reaching the state of organizational dynamism*.

The fundamental logic of the business model is *finding out the key value – adding resources and capabilities and integrating them in accordance with the organizational strategy, structure, systems and human resources*. *Theoretical defining of a business model* presents a variety of methodological approaches, which determine it as the following:

- *The method of doing business by which a company can sustain itself through generating revenue* (Chesbrough & Rosenbloom, 2002)*;*
- *Firm's intended or actual response to how value is created or appropriated (*Magretta, 2002*)*
- *Design of organizational structures (Baden-Fuller & Morgan, 2010), such as boundary – spanning transactive structures (*Amit & Zott, 2001*);*
- *An operational tool expressing the business logic of an organization (*Osterwalder, 2004*);*
- *A convention between partners concerning the generation and sharing of value among stakeholders (*Verstraete & Jouison, 2007*);*
- *A firm's underlying logic and strategic choices to create and capture value within a value network (*Shafer, Smith & Linder, 2005*) and the most prominent and influencing definition in the business modeling literature is:*
- *An architecture for the product or service, an information flow, a description of the benefits for the business actors involved, and a description of the sources of revenue (*Timmers, 1998*).*

It is evident from majority of the above detailed definitions that business model initially *refers to using a „dual business developmental perspective*", in terms that it simultaneously stipulates, in our profound analyses, the following organizational counter-parts:

- *Pragmatism and innovative changes;*
- *Integrity and particularization;*
- *Management and leadership;*
- *Adaptively and pro-actively performing*
- *Short – term profit orientation and long – term business value maximization;*
- *Strategic choices and user generated operational context etc.*

Each business model integrates various *constitutional elements*, predominantly determined and described through the following Table:

1. The initial element of each business model is *value proposition*, which refers to the perceived value benefit, which a customer would get from the specific combination of the organizational products or services. It precisely determines *the quality features* which are prevalent for the customer from the organizational offer. This first element details *the cognitive offer view* which, in fact, is dominant for the perceived value from the transactions with the specified organization.
2. In order to accommodate the numerous products or services to the most particular customer demands, an organization has to undertake changes in order to position itself in front of the *target customer* – the model of interdependence starts from *identifying the customer portfolio which can be best served with organizational products and services* that have undergone transactional or transformational changes. The importance of this second business model element lies in *clear determination of the customer wishes, tendencies, motives, expectations, benefits etc.*, received with the act of purchasing the product or service.

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Table 1 Business model elements

No.	Element of business model	Description
1.	**Value proposition**	*An overall view of the company's bundle of products and services*
2.	**Target customer**	*Segments of customers a company wants to offer value to*
3.	**Customer handling/distribution channel**	*Various means of the company to get in touch with it's customers*
4.	**Customer interfaces/relationship**	*Kinds of links a company establishes between itself and its different customer segments*
5.	**Value configuration**	*Arrangement of activities and resources*
6.	**Capability/core competency**	*Competencies necessary to execute the company's business model*
7.	**Partner network**	*Network of cooperative agreements with other companies necessary to efficiently offer and commercialize value*
8.	**Cost structure**	*Monetary consequences of the means employed in the business model*
9.	**Revenue model**	*A way a company makes money through a variety of revenue flaws*

Source: Adopted according to Osterwalder, A., Pigneur, Y. & Tuchi, C.L. (2005), Clarifying Business Models: Origins, Present and Future of the Concept, *Communication of the AIS,* Vol.16 (1), p.13

3. The process of achieving a *full alignment with the identified need*s, in a broader meaning of the word, includes a proper way of handling them, through the distributive channels. As a third element, *customer handling/distribution channel integrates all communicational approaches* in order to create a sense of satisfaction at a specific customer, in terms of mutual articulating, gestures, emphasizing common interest of both sides etc. The only exception of this element is at public tenders, in which case this element is included in the following one – customer interface/relationship
4. Each customer, as a member of various determined target customer segments, possesses different means of establishing and developing a closer relationship, which is done in the element *customer interfaces/relationship*. It implies that, with regards to the handling method, the complete relationship is build with an accent to the *stimulus for a customer segmented satisfaction*, which is highly important especially for the higher customer segments which want a clear distinction in satisfying their determined needs.
5. Very after the relations with the customers have been set up, the company should create a *specific combination for optimal usage of its resources and capabilities*, particularly processes and activities which add value for the customers, which is done in the fifth business model element – *value configuration*. It is important that each organizational configuration of resources and capabilities *must be unique* compared to other companies, as well as compared to various customer segments. It details *the capacity of the organization to be original* in satisfying its customers.
6. In certain circumstances, an organization could be able to integrate its resources and capabilities pro-actively, but would not bear the needed competencies for implementing the desired business model – it is the focal point of the sixth element, i.e. *capability/core competency*. As an applicative element, it stipulates that *core organizational competencies are expected to be sustained*, and therefore to influence to a *more complete delivering the promised organizational outcome* – benefit from the products or services for the customers.

7. *Partner network*, as an element of the business model refers to the undeniable truth that *each organization can not be specialized in every business function*. The tendency for finding out a solid and serious network of business partners would result in bringing about *higher quality of the performance for lower costs*. Its focus is towards an increased efficiency and at the same time commercializing the benefits that arises from the achieved value for the targeted customers.
8. It is useful to measure invested money in increasing the level of satisfaction of the customer segments. Therefore, in the element named *cost structure*, an organization makes efforts to *leverage the benefits*, in order to determine *which means of effecting value configuration are priority, and which are of a second level of importance*. The cost structure should not lower the promised quality level to the customers, and at the same time it is not expected to be based on a non-sustainable combination of resources and capabilities.
9. Finally, business model finalizes with creation of *revenue model* – which implies that an organization should determine *the level of risk exposure for different revenue flaws*, in order to enable itself to put priority to those that are best suited to the contingency combination of internal and external elements. The importance of revenue model is *categorizing the revenue flaws in accordance with the degree of prosperity and potential for influencing its competitive advantage*.

Every element of the business model influences to the fulfillment of the consecutive one, as well as to the overall effectiveness and efficiency of the created business model, in which, as *most creative and sensitive elements usually are perceived target customer, value configuration, building capability/core competency and partner network elements*.

A categorization of the elements of the business model which pays prevalent attention to *using transformational strategy for changes* is detailed as constituted of the following *integral business model elements (*Yip 2004):

- *Value proposition,*
- *Nature of inputs,*
- *How to transform inputs (including technology),*
- *Nature of outputs,*
- *Vertical scope,*
- *Horizontal scope,*
- *Geographic scope,*
- *Nature of customers,*
- *Organization of the model.*

The most important difference of the last model, compared to the first, previously detailed business model is in *the position of the customers*, which is on the 8-th level. The prior reason for it lies in the fact that *in strategic modeling of the business, customers are initially positioned, as an element which influences to all other elements*. In this context, customers on the 8-th level may manifest certain variability with regards to a closer integration of the resource/capability combination compared to the desired level of customer satisfaction.

Besides these 2 business model concepts, the most intriguing issue in creating and managing most efficient business model is in the *proper combination of resources and competencies, aimed at adding value to the organizational performance*. A model which pays most attention to it is named *RCOV model (Resources and Competencies, Value Proposition, Organization)*, in which *each combination of the resources and competencies is measured through its marginal influence to the customer quantitative and qualitative benefit*. The presentation of the approach, in combining the elements of this *configurative business model* would best be detailed on the following Figure:

It is evident that the *integration of elements of the RCOV business model is done through organizational and customer learning, socialization and acquisition of new customers, offer specification, production and/or distribution by the customers*, resulting in the *customer integrated character of this model*, although the very customer is not an element of the model, but may appear within the dimension external organization

Figure 1 The RCOV Business model (Demil & Lecocq, 2010)

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2. MANAGING PRO-ACTIVITY, ORGANIZATIONAL INERTIA, STRATEGIC POSITIONING AND FLEXIBILITY FOR ORGANIZATIONAL DYNAMISM

In order to increase the level of successfulness, each business model is expected to execute certain *management criteria for success of a business mode (*Rasler 2010), among which, as most applicable, arise the following:

- *A pro-active business approach that turns out thoughts into looking for business and our marketing strategies to creating a need and away from a current business model where marketing focuses on fulfilling a need and waiting for the customer to ring,* undertaken through these *managerial steps:*
    - *Figuring out the company culture,*
    - *Putting a business plan in place,*
    - *Showing leadership, and*
    - *Recruiting and retaining top performers.*
- *Business model constitutes a change in company culture, one that allows us to plan and one that still maintains a sense of urgency. The new culture is about creating more opportunities and building relationships.*

Organizational pro-activity is higher at experienced organization, compared to young and start-up companies, in which the manifestations of *organizational inertia*, especially the structural one, emerge owing to the *managerial determination* (Marx 2008) that *less subject to structural inertia, young organizations may seem more adaptive than established firms, but their agility depends critically on the availability of resources to pursue multiple paths, aimed at reaching strategic continuity.*

The integration of pro-activity and organizational inertia leads to a proper determination and consecutive application of the concept of *strategic positioning for managing business models*, which is fundamentally consisted of the following constitutive elements (Porter, 1997):

- *The right goal,*
- *A value proposition,*
- *A distinctive value chain,*
- *Trade – offs,*
- *Fit among strategy elements,*
- *Continuity of direction.*

The managerial challenge is to inter-relate these elements in order *to achieve an organizational dynamism, from their predominant static character*, like it has been achieved in Ikea, Neutrogena etc. In doing so, an organization should initially attempt to achieve its *strategic flexibility*, a propulsive business concept that is theoretically determined as:

- *The ability to identify innovation opportunities, commit resources to new courses of action, or reverse unproductive resource deployment (*Shimizu and Hitt, 2004; Uhlenbruck, 2003).

Strategic flexibility is influenced by organizational structures and dynamic capabilities, on one hand, and on the other hand it influences the *organizational dynamism*, which in return is critical for creating and managing of *dynamic business model* through *reducing the structural complexity and making full use of a pro-active organizational culture*. Key determinant in the organizational dynamism are *dynamic capabilities*, which refer to:

- *A learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness* (Zollo and Winter, 2002).

In creating a *dynamic business model*, *dynamic capabilities are inter-related with the forms of knowledge* needed for anticipating and proper effecting of customer needs through structures and routines, on the following *managerial approach for their dynamic integration(*Mason and Leek *2008)*:

- *A relationship between the structures and routines is captured by a firm's business model,*
- *Exists a constant and iterative need for creating and sharing know-how to drive improvements to both structures and routines.*

Actual *dynamic change model* which fulfills the above detailed managerial approaches would best be presented on the following Figure:

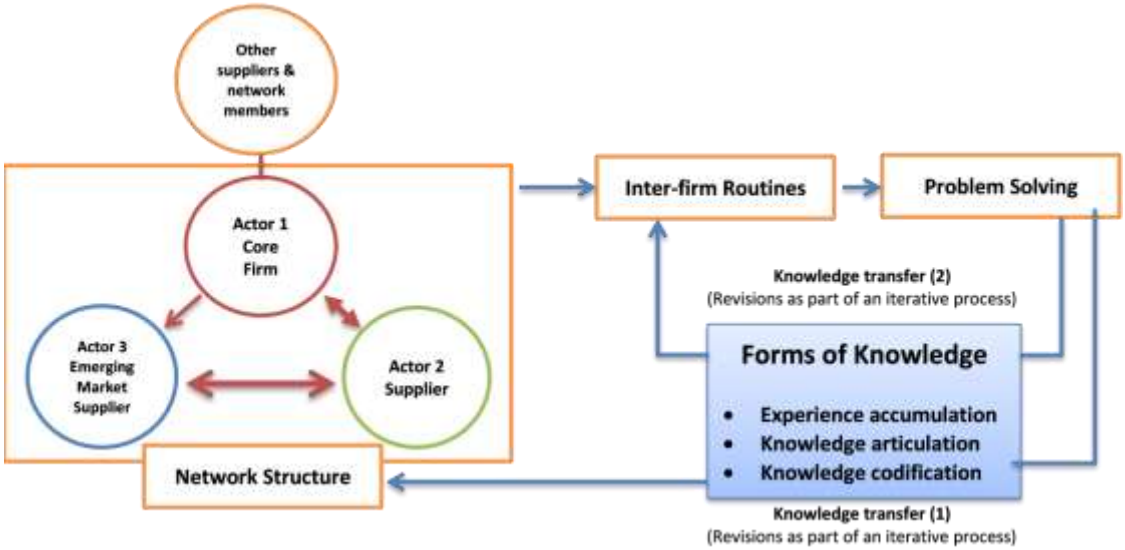

Figure 2 A dynamic Business model (Mason and Leek, 2008)

Fundamentally, in order to *manage pro-actively the dynamic character of the business model*, it is essential to *adopt the need and form of the knowledge to the internal combination of structures and routines, on one hand, and to the nature and depth of the needs of the specific external customer segment, on the other hand*

3. CONCLUSION

Each organized effort for planning and implementing a certain business model integrates not only the organizational, but also the departmental level, especially to those organizational units which are most critical

for a proper determination and combination of business elements whose relationship and inter-dependence forms the scope and depth of the competitive potential of any enterprise. In this context, business modeling is far more a process than a state, predominantly due to the needed changes, transformational or transactional, that shape the process of managing it.

However, it is quite important to emphasize that the concept of business modeling is far from applying the organizational strategy, or operative accommodation of strategic elements. In detailing the desired nature and capacity of their business model, every organization focuses on their particular combination of resources - especially the used knowledge, skills, capabilities and experience, on one hand, with the capacity for pro-active behavior, strategic flexibility and organizational inertia, on the other hand, both of them aimed at reaching the state of organizational dynamism.

Each business model integrates various constitutional elements, predominantly determined as: value proposition, target customer, customer handling/distribution channel, customer interfaces/relationship, value configuration, capability/core competency, partner network, cost structure and revenue model.

The most intriguing issue in creating and managing most efficient business model is in the proper combination of resources and competencies, aimed at adding value to the organizational performance. A model which pays most attention to it is named RCOV (Resources and Competencies, Value Proposition, Organization) model, in which each combination of the resources and competencies is measured through its marginal influence to the customer quantitative and qualitative benefit.

The integration of pro-activity and organizational inertia leads to a proper determination and consecutive application of the concept of strategic positioning for managing business models. Strategic flexibility is influenced by organizational structures and dynamic capabilities, on one hand, and on the other hand it influences the organizational dynamism, which in return is critical for creating and managing of dynamic business model, through reducing the structural complexity and making full use of a pro-active organizational culture.

Fundamentally, in order to manage pro-actively the dynamic character of the business model, it is essential to adopt the need and form of the knowledge to the internal combination of structures and routines, on one hand, and to the nature and depth of the needs of the specific external customer segment, on the other hand.

REFERENCES

Bock, J. Adam, Tore Opsahl, Gerald George and David M. Gann (2012, March), The Effects of Culture and Structure on Strategic Flexibility during Business Innovation, *Journal of Management Studies,* Vol.49, Issue 2, 279-305

Coulson-Thomas, Colin (2013, Autumn), To Business excellence and beyond, *Management Services,*Vol.57, Issue 3, 18-23

Demil Benoit & Lecocq Xavier (2010), Business Model Evolution: In Search of Dynamic Consistency, *Long Range Planning,* Vol. 43, No.2, 227-246

Marx Matt (2008), On a short leash? Young organizations, strategic change and venture capital, Paper presented at the Academy of Management Annual Meeting Proceedings, 1-6

Mason, J. Katy and Leek Sheena (2008, June), Learning to Build a Supply Network: An Exploration of Dynamic Business Models, *Journal of Management Studies,* Vol.34, Issue 4, 774-799

Mokhlesian Shahin and Holmen Magnus (2012, September), Business model changes and green construction process, *Construction Management and Economics,* Vol.30, 761-775

Osterwalder, A., Pigneur, Y. & Tuchi, C.L. (2005), Clarifying Business Models: Origins, Present and Future of the Concept, *Communication of the AIS,* Vol.16(1), 1-25

Pauwels Koen & Weiss Allen (2008, May), Moving from free to fee: How nline firms market to change their business model successfully, *Journal of Marketing,* Vol.72, 14-31

Ple Loic, Lecocq Xavier and Angot Jaques (2010), Customer-Integrated Business Models: A Theoretical Framework, *Management,* Vol.13, No.4, 226-265

Porter, E. Michael (1997, January-February), What is Strategy, *Harvard Business Review,* Vol. 75, Issue 1, 156-157

Rasler, K. (2010, December), Run a Proactive, not Reactive Business, *Air Conditioning Heating and Refrigerating News,* Vol.241, Issue 17, 8-9

Yip S. George (2004, Summer), Using Strategy to change your Business model, *Business Strategy Review,* Vol.15, Issue 2, 17-24

INNOVATIVE APPROACH TO THE ANALYSIS OF THE SPA TOURISM IN VOJVODINA (SERBIA)

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Abstract: *Along with other neighboring countries in the region of the Pannonia plane, Vojvodina (Serbia) lies on rich thermal springs which can be listed among the world largest. Contrary to the fact that the rich in water is equal, Important and urgent task is to include Spa centers in Vojvodina in an integral cooperation. Practice shows that economic growth can only be achieved by laying good foundations and having a network of common goals. Numerous weaknesses and errors were noticed, primarily in stakeholder analysis, benchmarking, organization and marketing which all hinder the possible development of the Spa tourism in Vojvodina. In this article, on the basis of the research problem, authors wish to highlight the importance of expansion of the methods and techniques which are needed and urgent for improvement and promotion of Vojvodina Spa tourism in the region.*

Keywords*: spa tourism, stakeholder analyses, foreign experiences, regional development*

1. INTRODUCTION

According to world assessment there are more than 71600 spas, employing 1.2 million people (European Spa Magazine, 2008) “Europe is the largest region of Spa tourism in the world with over 22607 spas and revenue of about 18 billion US dollars.” (Global Spa Economy, Report, 2007). According to most studies (Ellis, 2008) spa and wellness tourism based on thermal and healing springs will become a leading part of health tourism by 2015. Neighboring Hungary is very rich in thermal springs, about 80% of the total country lies on thermal waters; it is fifth in the world after Island, USA, Italy and Japan. Serbia is also in a favorable position, and it is rich in thermal springs. Spa tourism in Hungary has grown from 12.7 million to 16.1 million guests in the period from 2000-2004. According to the strategic development program of Hungary (Szechenyiterv), 74 spas have received state subsidies, out of which 60 spas used that subsidy by the end of 2006.

For comparison purposes the tourism region of Southern Pannonia Plane of Hungary and Vojvodina as a tourism region in Serbia will be observed. By comparing the two closest tourism regions (Southern Pannonia Plane – Dél Magyarországi régió and Vojvodina from Serbia) it already becomes noticeable that Vojvodina region makes only half of the revenue compared to the observed region in Hungary. (See tables 1 and 2). It should be mentioned that, as far as the tourism and spa capacities go, that is even the leading region in Hungary (cumulative data of the Danube region – Dunántúl. Table 1). Especially, we need to say that this is not related to the leading tourist region in Hungary.

Table 1: Number of tourist nights in Hungary, in period Jan-Sept 2012 (iKSH 2013)

Tourist region	I–III. quarter cumulative
Middle Hungary (Közép-Magyarország)	6110759
Middle Közép-Dunántúl	1995155
West Nyugat-Dunántúl	3539167
South Dél-Dunántúl	1823853
Dunántúl	7358175
Northern HungaryÉszak-Magyarország	1338761
Norther Pannonia valeÉszak-Alföld	1453362
Southern valeDél-Alföld	1009215
Vale and the NorthAlföldésÉszak	3801338
Hungary Total	17270272

Table 2: Number of tourist nights in Serbia, in period Jan-Sept 2012 (RZS, 2012)

Tourist region in Serbia	Number of tourist nights
Belgrade region	1084240
Vojvodina region	572491
Sumadija region and Western Serbia	2442740
Southern and Eastern Serbia	1076651
Republic of Serbia Total	5176122

The state of Hungary takes care of its, so-called, prominent tourist regions and destinations, and it offers additional financial aid and support when applying to EU funds for development projects. In the so-called "prominent" regions in the area of health tourism in Hungary belong Dél-Alföld (Southern Pannonia vale), Észak-Alföld (Northern Pannonia vale), Nyugat-Dunántúl (West Danube region) (ROP 2013).

In Hungary, the strategically defined tourism development goal (which had in itself the development of spa and wellness tourism) was followed by, among other things, by specific activities which included research of stakeholders in that niche and the development of cluster cooperation. Various studies point out the significance of real and thought-out planning, flexibility in forming development plans of spa center, logical thinking and an entrepreneurial spirit. On a bilateral plan between Hungary and Serbia the strategy of common approach to spa tourism is being formed under the name "Cooling Cubes" in the gravitational area of the Budapest-Belgrade highway. The project is so far entrusted to the Agency for regional development. Certain parameters in the area of finance and joint ventures are developed in such a way that they support the projects, and if necessary, secure the investment part (with the application on EU projects).

The goal of spa clusters is to set up cooperation between spas, businesses, social organizations, NGOs, all the way up to State level. Cooperation is spreading from bilateral to multilateral level when it is expanded to regions of Romania (connecting as the Spa cluster of Hungary's Southern region). With various arrangements of cooperation, we are closer to the goal of creating a common tourist brand, irrelevant of borders, because "our chance is in networking". (http://www.datekla.eu/index. php?ln=hu&cid=2021&id=44)
The starting hypothesis of work is that the ones who offer spa services in Vojvodina are not doing enough preliminary analysis of the potential stakeholders on different basis, and thus their communication with existing or potential investors is not attractive and the interest of starting investors is soon lost.

According to literature (Scott, Baggio, 2008), in most cases the examples of such data collecting is hard to find. Unfortunately, it is also noticeable that the generic methods of the stakeholder analysis are left out, let alone supported or expanded by additional methods and techniques. By researching these aspects we had to accept the fact that "some of our examinees do not accept our plea for cooperation" (Kovacs, Bacsi, Loke, 2012) which were the same problems that the researchers in Hungary came across.

One of the problems with the tender holders is that often they search for only one large investor (who then becomes the sole responsible person for the project). Those kinds of investors are always low in number. That approach can limit the circle of potential partners from the very start. That problem already occurred in spa Kanjiža (unsuccessful project of investment in the hotel and wellness park http://www.banja-kanjiza.com/node/3/Planovi) and with Master Plan Palić. Most investors are hard to accept the sole responsibility of the complete investment. Positive exceptions are for example the construction of the aqua park in Bački Petrovac where a Slovak company "Aqua term invest" invested 8.5 million Euros in the first stage of 2012. The Becej complex is also in the process of joint investment with the help of Aquaprofit from Hungary (Vital Spa). With more sophisticated research of potential stakeholders several smaller, secondary ones, could be found which could achieve the wanted potential for the start and maintenance of a project.

Even though destinations can be familiar to domestic tourists, they are still a mystery to foreign ones." (Smith, Pucko, 2010 page 278). An additional problem can be a rough approach due to the under-developed road infrastructure or a complicated route. There is also a possibility of a so-called "tunnel-effect" where the highway leads the travelers to major cities towards which the highway traffic is funneled. (Szügyi, Sefcsich, 2011) On the basis of this phenomenon spa Kanjiža, even Bečej near Tisa or spa Bezdan, spa Junaković and the municipality of Apatin near the Danube remain pretty isolated. Highways have positive gravity effects on tourist for big cities (centers).

2. MATERIALS AND METHODS

Successful projects based on the studies (Kovacs, 2012) are always founded on a well segmented market of supply and demand. Precise categorization of spas, (waters as a potential are sometimes referred to as hardware, sometimes as software) is the first step to attract someone with development ambition (of capacities and services). Good example for that is the spa Heviz from Hungary. By the way, the most recognition among guests get the spas with more healing properties or a health tradition like the most famous spas (e.g. Balatonfüred, Bükk, Debrecen, Eger,Gyöngyös, Gyula, Hajdúszoboszló, Harkány, Hévíz, Miskolc, Parád, Sopron, Zalakaros) and in the promotion of spa (historical ambience) buildings, and the quality of service, which makes Heviz one of the most recognized spa centers in the region.

According to literature (Smith, Puczko 2009) a general guideline of the development activities is given by the very classification of waters, as a leading content in spa tourism. Basic categories are: (Smith, Pucko, 2010 ,86):

- Mineral waters – which contain an amount of dissolved mineral content, minimum is 500 mg/l or 1000 mg/l
- Thermal waters – natural water which has at least 30° C or 32° C at the spring (this can vary from country to country)
- Healing waters – healing effect needs to be proven or based in the medical and therapeutic effects-evidence. (There are various attempts, but they mostly do not measure up to world unified standards, e.g. see Spa Evidence 2013). There is an action in Hungary to collect data on yet insufficiently analyzed waters, so they could expand their offer of medical treatments, or to create more attractive and smaller (less known) springs and to attract potential investors.

Stated categories of waters already create clear segments of potential tourists and potential investors. By the next segmentation, it is possible to better differentiate the circle of guests and gravity of other interested groups. The basic forms of spas are (Smith, Puczko 2009, 87)

- Spa as a place of healing with certain means and methods.
- Spa as a center of health for free time, rest and recuperation.
- Spa as the most important center of a region, intended for vacation.
- Spa as a sports center with special offers for various sports (winter, water, golf, riding, etc.)
- Spa as a cultural center.
- Spa as a congress center.

Nowadays management of spa and wellness capacities is becoming a more complex task, especially with the development of new products – services (with the ambition to attract new market segments). This task demands good definition and differentiation of spas, their infrastructural potentials as well as management and communication models. Management, marketing, organizational challenges – as problems, are only going to manifest and grow if behind it all is not an inherited natural wealth, or newly created conditions (infrastructural) which are often demanded by foreign tourists.

Spa or wellness center cannot contain everything in its offer. Setting a clear categorization is very important also for preforming a stakeholder analysis. Maybe the most encompassing categorization of SPA centers comes from ISPA 2006: (Smith, Pucko, 2010, 87):

- Club Spa – object that primarily offers fitness services, as well as some other services for ordinary spa users in the broader sense;
- Day Spa – object that offers beauty programs, fitness and wellness programs, without accommodation and the length of the service can be from one hour to the whole day;
- Spa hotels – offer accommodation for a few days with all (inclusive) programs designed to provide physical and spiritual balance;
- Holistic Spa – spas which offer alternative therapy and diets in an effort to make a positive change in their guests;
- Medicinal Spa – object that offers traditional and complementary therapy treatments and health protection, as well as other spa services and can be included as health institutions;
- Bath – spa constructed to use the natural mineral, medicinal or sea water which is on that location, offering hydrotherapy to their guests;
- Resort Spa – vacation place separated from cities and villages, spa location is set in the beautiful natural ambience, offering a wide selection of wellness services and top programs for guests;
- Sport Spa –offering spa services and special sport programs;
- Structural Spa – establishing an operational goal towards strict rules, which offers the guests the opportunity for reaching a certain goal.

The last segmentation of spa types is very important as a possible start basis and stakeholder analysis aspect. By going into these categories, from the aspect of certain spas or springs, we come to very clear possible interest circles from the supply as well as from the demand side.

Based on the preliminary statements authors suggest an approach by which multiple methods would be included into the research thus ensuring a clearer picture on the questions of spa tourism, and at the end sure recommendations on future activities needed to ensure positive results. In order to solve this core problem we suggest use of, parallel to the expert grading, other modern methods.

General overview of recommended/used methods for more complete – wider analysis of the stakeholders can be:

- Benchmarking,
- Stakeholder mapping,
- Social Network Analysis.

2.1. Benchmarking aspects

As the beginning step of the stakeholder analysis, we suggest contemplation of several benchmarking aspects which have been used with successfully managed projects in Hungary. This step helps in clearing crucial management and marketing questions, as: defining basic and side businesses, potential users, other financial as well as engineering aspects. It is important to mention that successful destinations have additional content in their service offer. General practice in benchmarking is to compare or take the best practice as the base value. Aspects can be various, and taking for example “Hungarian Spas”, which very much behind compared to spas from developed EU countries. Compared to German, Austrian, Italian and Slovenian centers of this type Hungarian spa are 15-20 years behind. (Kovacs, 2011) Benchmarking of spas is done on the basis of collected and calculated data (often) obtained from the very spa operators. Benchmarking of spas can be divided into three categories:

a. Spa profile benchmarking (Cohen, Bodeker, 2008, 55) - allows for the comparison of spa characteristics and quality. E.g. Number of spas, different spa types, location, size, facilities, business infrastructure, infrastructure and available capacities, offered services, price formation, etc. ... (Cohen, Bodeker, 2008,56)

b. Spa performance benchmarking (results) is related to comparison of various indicators: profit, expenses, guests, human/business potential,etc.

c. Ratios benchmarking – mainly the same indicators are observed as in spa performance benchmarking.

Additional valuable data can be obtained with analysis of local inhabitants. Primarily we can observe their attitude towards the spa and tourists (Kovacs, Bacsi, Loke, 2011, 59 tab. 3.3) and socio-demographic aspects of tourism sustainability in that location. Considering the effect which the spa would have on that region or city/community, socio-economic aspects, as well as other attractions in the vicinity or region as a potential for tourism development.

2.2. Stakeholder analysis

Stakeholders are, as interested initiators and carriers of the realization of the idea of the spa tourism, present in various groups from the world of economy, society and politics, for example:

- Tourists (different types, with different motivations), patients (at treatments, rehabilitation, etc.),
- The health care (institutions, professional employment, educational background)
- The academic sector- State and private universities, institutions, education centers and other science and research institutions from the corresponding areas,
- Regional administration and government officials (often in the role of regulators, creating strategies for the development of tourism, working out the layout of the facilities, decisions about marketing and advertising in tourism, building the infrastructure, promotion of tourism, the administration of the public income for tourism, the state- ministries (for example the ministries of economy, environment, agriculture. The education of the government organization and institutions)
- TOS,- National Corporation, - PUC Srbija Šume, PUC Vode Srbije, National resorts LTO
- One stop shop full service centers, centers for tourism, media of the local community, NVO
- Strategic and other investors, local and foreign and direct partners in PPP
- International agencies for development (International agencies for development, USAID, GTZ, EU, WB, UNDP, FAO, SIDA, WTO and others)
- Promoters of the development of tourism (Economic chambers, Marketing companies, non-government organizations)
- Industrial operators- (Tour operators, touristic agencies, hotels, B&B, other accommodation facilities, hostels, restaurants and cafés and other service providers, shops, traffic companies and other transport services.
- Gaming industry, etc.

- Agency and other tourism middle men – indirectly involves companies in the tourism value chain connected to operators and investors (e.g. outsourcing, organic and other foods, marketing services, financial services, software services, civil engineering companies)

All public companies in their nature do not have much motive for change. Gain that needs to represent the main moving force does not have such significance in the public sector. The concept of public sector is gradually changing towards creation of an efficient and profitable public sector and that demand is arising as a necessity. The public sector must remain oriented towards satisfying customers' needs in an efficient and responsible way." (Domazet, 2008)

Different subjects at a tourist destination (commonly marked as stakeholders, players, participants in the tourist business, etc.) are informed about each other, or about the cooperation and creation of various partnerships (not on the competition). Their potentials are measured also in the performance and capability of successful dealings in planned tourism development at that destination having one common goal – to secure highly qualified and integrated tourist product to a particular market. Considering these aspects, stakeholders in Hungary have presented themselves much more clearly and with more coordination, while stakeholders in the Vojvodina marketing strategy are not differentiated. In a researchers development project they are referred to as a unique opinion "group" – interviewee. Often municipalities and local authorities are faced with a difficult problem of transferring the public resources for the use in private sector. The problem is that then they are sold (privatized) or rented in various usage forms (e.g. concessions) by creating contract terms in PPP cooperation (e.g. very hard debates have been in Spa Vrdnik).

2.3. Social Network Analysis in Spa Tourism

In order to overcome stated problems, we suggest use of the Social Network Analysis methodology.
Stakeholder analysis can be improved with terms (measures) using Social Network Analysis methodology. These terms or sizes can easily be applied with stakeholder analysis in tourism (Scott, Baggio, Cooper C, 2008). (Measures such as size, inclusion, components, availability, density, centralization, symmetry, transitivity, etc.) Several possible indicators - measures for potential defining of networked stakeholders. Those measures and definitions can show the nature of a wanted or existing network of stakeholders in a very good way. (With this expansion we get the possibility of better comprehension of roles and characteristics of certain stakeholders. It is possible to achieve compatibility of various software tools (e.g. UCINET, GRADAP) when quantifying the stakeholder relationship or even simulating their mutual potential.

Some other measures, involved in Social network analyzes methodology, According to Typical Social Network Measures of Ties (Brass, 1995) E.g. Indirect links, the frequency, the stability, the symmetry, Typical Social Network Measures Assigned to Individual Actors (Brass, 1995) can be also useful when defined for determining the power of Degree, In-degree, Out-degree, Range (Diversity), Closeness, Betweeness, Centrality, Prestige, Roles, Star, Liaison, Bridge, Gatekeeper, Isolate. Including the measures of Social Network Analyses helps the accuracy of identifying the most powerful actors from the list of stakeholders. It can help to answer the questions, what emotional interest do they have in the outcome of work? Is it definitely positive or negative? What motivates them most of all? What information do they need? Especially in Serbia where the tourism management and the commercial tourism industry often represent two very different systems that operates on very different assumptions and requirements. but that usually claim to the same resources

3. RESULTS

Experience of Hungary and other countries as a comparison for the analysis of noticed errors in the development functioning of spas in Vojvodina (Serbia)

- Undefined regionalization in (spa) tourism – Spas in Europe show a tendency to develop into regional centers of health, with a more prominent advance on international markets where they are represented by the health system. Others are relatively isolated from crisis influences thanks to the characteristics of the health tourism, with a condition that they are continuingly perfecting their quality and service. Unclear segmentation in offer and demand is a poor attractor of consumers and potential investors are not targeted. Incomplete offer without support of a wider set of necessary functions results in a loss of competitive status.
- Development should be based on complex services (health tourism) – healing with healing waters.
- There is no list of stakeholders (missing) with local tourist organizations so the necessary actors in the spa tourism are not known. Tourist cluster Subotica-Palic has done certain research of stakeholder's circle including the degree of their interest and satisfaction but the results of that research are not recognized or included in any business politic (Izabel Lanji Hnis, 2013)
- Receiving funds for financing the function – Here it is a characteristic that spa visitors are mostly those people who go through a health security fund (those who are ill) and those who have enough money

for rest and relaxation – an important segment of Serbian tourism which has over 50% of accommodation capacities and makes more than 50% of sleep-overs from domestic tourists. The number of foreign visitors is very low and the number of sleep-overs is relative considering the number of sleep-overs achieved in spas abroad.

- Clouded and unclear privatization and negotiations on development projects. A mistake would be to limit the possibility of attendance of other investors, who see opportunity in tourism, from international investment funds to individuals – physical persons who wish to invest in their own small capacities (accommodations). For years there has been "covert communication" which destroys the group (of other) interested stakeholders, and instead to attract them it only makes the primary candidates quit up front. True example of this is Spa Palic and its unclear destiny. From a development point of view projects who work parallel on both wellness hotels and spa capacities should be preferred. If possible thermal springs should be included, and not fill the pools with ordinary city water. Negative example in Kanjiza is the projected Hotel Ana. Last changes in the project Spa Kanjiza are connected with so-called Vekerle project from Hungary. (http://www.magyarszo.com/hu/1920/vajdasag_magyarkanizsa/ accessed 22.04.2013)
- Undeveloped system of social security care and health expense covering. Institutions are neglected and financially they close business very difficult.
- There are further developments in domestic tourism in Hungary, with special interest in state subvention vouchers for excursions and tourist stays, which business owners can buy, as well as so-called mess-hall vouchers for the employed in public services, which affected the increase in the stagnant demand. Motivational aspects were recognized for employees in private, foreign and multinational companies which also contribute to the development of tourist demand. Influence of domestic tourist should not be neglected because Serbia has "low interest of foreign guests (from 2.8% to 4.5% in 2008!) While in Slovenia that goes over 54.6% in the same period." (Stojkovic et al, 2006 p. 297) Generally we can recognize the lack of possible communication lines between stakeholders and PPP forms which remain unknown.

4. DISCUSSION

It is necessary to define priorities. Results of comparison with Hungary show that more work is needed on a more complete development of health center offers, not only based on natural wealth. It is necessary to scientifically prove the healing properties of waters and other treatments and there has to be a correspondence of health and medical research with the development of health tourism with the support of further research. Parallel to that wellness services need to be developed, as well as hotel capacities. Good stakeholder analysis contributes to the development of effective marketing activities.

It is necessary to develop cooperation with international development agencies, which ensure funds for initial projects in tourism and similar businesses. Competition in the wider border region for investment in tourism is high, which demands additional efforts of creating attractive conditions for investors. That includes the preparation of master plans and efficient support for investors as well as clear investment offers. Every development project in Hungary was done parallel to the development of infrastructure. It is good to work on regional airports, highway construction, railway traffic, etc. The location preparation is important from a cultural and historical aspect (monuments, parks, music pavilions, etc.). For example, in Hungary at Spa-Lake Heviz, the park is among the leading content. Same thoughts apply to Serbia. "Presence of cultural, historical and sport potentials of a spa and its surroundings gives a whole integrated tourist product, where the quality of specific parts largely determines the quality of the total offer of that tourist destination" (Stojković, Pnajković Žikić 2006 , 297).

Complete management of a spa must unite all demands of a successful healing, or a medical aspect as well as a financial – marketing (business) aspect. Those are usually two very different areas. Because of that the success depends on team work and a talented leader. Management roles can be general or specific in certain areas. Careers are usually started with assistant managers and promoted to resource managers of certain areas (Cohen, Bodeker, 2009)

5. CONCLUSION

Foreign experience in achieving a national strategy of the development of health tourism should serve as a role model for the development of spa tourism in Vojvodina. For comparison we started with statistical data for the same period in Hungary and Serbia. It is useful to see the data for two tourist regions (Del Dunantul, and Del Alfold which borders with Vojvodina and lies on the same thermal waters as Vojvodina). It is obvious that using the same natural potentials Vojvodina lacks in the number of sleep-overs. 572491 in relation to something over one million in the tourist region DelAlfold (see picture 1).

Benchmarking several of stipulated problems of development projects (experience of spa capacities in Hungary) we can create a picture of possible stakeholders and possible method approaches for a more perfect analysis. Several of the preliminary findings are:

- Primarily, oversized ambition of increase in water surfaces (pools) need to be avoided, unequal to demand
- Too ambitious investment and development plans for complexes which are above capabilities (e.g. when a local interest capacity wants to become a national or an international interest without any proven potential for growth)
- Legal regulations need to exist as a basis for a healthy PPP
- International funds (management of projects) need to be monitored and used
- Communication with local community in a simple and comprehensive way, so that local hosts can be motivated for idea generation and acceptance. Projects of public relations (media campaigns, events, news, open days) for increasing local community awareness on the eco-tourism
- By targeting a wide circle of guests and offers potentials remain unused, and impossible to coordinate
- Instead of season offers, such as open pools, capacities should be developed which secure a more flexible interval of use, with additional services
- Multipurpose use of thermal waters (e.g. additional source of energy)

Social Network Analysis contributes to the development of human resources inside a branch, secures a systematic approach for valuing existing actors and their communication, as well as to simulation of possibilities of including new ones (from individuals to associations, networks, even on an international level). We recognized reasons for failed attempts in finding stakeholders and partnership building which can be interpreted more than this article allows. It is important to say that the success or failure of projects in much depends on the adequately defined and continuously renewed stakeholder circle. Many projects are not sustainable because they are not adequately promoted or insufficiently recognized in the circle of potential stakeholders. Those projects are not public enough and are promoted too narrow, or the very project does not include the interest elements of a wider circle of potential sides. Example for characteristic errors in stakeholder analysis is the investment plan in master plan Palic. Potential investors from Slovenia have come across the fact that the Lake Palic, in its present condition, is unattractive due to water pollution. There is a danger that similar aspects will make difficult or stop the finalization of projects in Spa Kanjiza. It is too ambitious to expect someone to invest and not to see the whole business environment. That can mean that the pools will contain clean water, but the nearby lake will be full of algae. Or in Spa Kanjiza the construction with unclear deadlines creates a picture of a constant construction yard not only for guests but also for those who want to do serious business in that tourist location.

REFERENCES

Babić Hodović V., Domazet A., Trivun V.,Softić S. (2008), “Strategija razvoja banjskog rekreativnog turizma u općini Olovo”, Ekonomski institut Sarajevo .

Bacsi, Z., Kovacs E., Loke Z.(2012), “Key Success Factor of Spas – Interviews With Leaders in Three Spa Towns in Hungary” Deturope 4 (1) :5-24.

Banja Kanjiža: http://www.srbija-banje.com/banje/banja-kanjiza .

Banja Vrdnik: http://banjasrbija.com/banja/banja-vrdnik-srbija/.

Brass, D.J. (1995),”A social network perspective on human resources management.” Research in Personnel and Human Resources Management, 13, 39-79.

Bjurstam A., Cohen M., (2008), “Spas and the future leadership climate” Understanding the global SPA industry Spa management, 1,363-377.

Ellis P., (2007), “Global Spa Economy Report” www.raisondetrespas.com/wp.../02/Global-Spa-business-2008.pdf, Chairman Global Spa Summit.

Horwath Consulting Zagreb, Ekonomski fakultet Beograd, (2006)” Strategija turizma Republike Srbije, Strateški marketing plan” 12. April 2006.

http://www.jiscinfonet.ac.uk/infokits/selecting-technologies/stakeholders (Stakeholder Management).

Kovacs E., Bacsi Z., Loke Z ,(2011),” The role of Health Tourism in Improving the Competitiveness of the Croatian – Hungarian Border Region”, 59. table 3.3.

KSH, Kozponti Statisztikai Hivatal (2013),http://www.ksh.hu/docs/hun/xstadat/xstadat_evkozi/e_oga011.html , pristupio 20.03.2013.

RZS 2012, Republički zavod za statistiku, “Statistika ugostiteljstva i turizma” Saopštenje UT 10, ISSN 0353-9555, СРБ292 УТ10 311012, Beograd, RS broj, 292 - god LXII, 31.10.2012.

Scot N. , Baggio R. , Cooper C., (2008) Network Analysis and Tourism , From Theory to Practice, Channel view publications, Clevendon .
Smith M., Puczko L., (2009), Health and wellness tourism, Butterworth-Heinemann Oxford.
Spa Evidence (2013),http://www.spaevidence.com/spaevidence/our-medical-advisors, pristupio 02.04.2013.
Stakeholder (érintett)elemzésEgyszerüsítettmódszertaniútmutató Budapest F¬város XI. KerületÚjbudaÖnkormányzataPolgármesteriHivatalarészére 2010-01-29 http://www.ujbuda.hu/fejlesztesi_terv_2010/Stakeholder_elemzes_v04.pdf , pristupio 03.01.2013.
Stojković Z., Paunković J.,Žikić S., Matić M.,(2011), “Integrisani razvojni parametri Banjskog turizma-rast valorizacije prirodnog potencijala” , Konferencijski zbornik ,Fakultet za menadžment,,Megatrend univerzitet, , 1:291-303.
Szugzi E., Sefcsich G., (2011), “Role of Traffic in the Development of Serbian Hungarian Frontier Region”, Deturope 3 ,(3): 46-65.

THE MODEL OF ORGANISATIONAL CAPABILITIES DEVELOPMENT

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Abstract: *The concept of organisational capabilities is relatively a new approach to face with uncertainties and environmental complexity and dynamism. The paper explains the generic model of organisational capabilities development with specific reference to a nature and types of organisational capabilities, the capability development process and capability inputs. The purpose of the paper is to extend understanding of organisational capabilities and their influences on performances of organisations.*

Keywords*: organisation, organisational capability, development, concept, model.*

1. INTRODUCTION

Organisations increasingly operate in a dynamic and complex environment. To stay competitive in such an environment organisations have to develop capabilities that enable them to deal with core challenges and problems.

Current organisations need to build and sustain capabilities to respond effectively, efficiently and timely to contemporary needs, to build capability in advance of need when emerging needs can be reasonably anticipated, and to establish flexibility to cope well with the unexpected. A failure in organisational capability can have a strong impact on organisational performance.

By developing different types of capabilities, organisations become more or less able to compete successfully in different environmental circumstances. Organisational capabilities can be classified according to different criteria.

Organisational capabilities are not static, but are dynamic realities and should be always in the state of development and improvement. They are influenced by many factors and capabilities development should be well structured and a systematically managed process.

2. THE CONCEPT OF ORGANISATIONAL CAPABILITY

The concept of organisational capability is relatively a new approach to deal with organisational problems. A basic assumption is that organisations have specific ways of acting which are based on organisational capabilities that have been gradually accumulated and shaped within organisations. Organisational capabilities enable organisations to deal effectively in an organisation-specific way with key organisational problems (Dosi, Nelson, Winter, 2002).

Authors have different but essentially similar views on a definition of the term “capability”. Helfat (2006) points out that an organisational capability refers to an organisational ability to perform a coordinated task, utilizing organisational resources, for achieving a particular result. Saint-Amant and Renard (as cited in Rauffet, Da Cunha, Bernard, 2010) define organisational capabilities as know how to act, potentials of action which results from the combination and the coordination of resources, knowledge and competencies of organisation through the value flow, to fulfil strategic objectives. Robert Grant (2010) defines an organisational capability as an organisational capacity to deploy resources for a desired result. Grant emphasizes that resources are not productive on their own and a team of resources must work together in order to perform organisational tasks.

Definitions indicate that an organisational capability means the organisation’s ability to carry out activities to meet its objectives. The quoted definitions do not take into account a way of carrying organisational activities out. It is important to emphasize that activities should be performed and objectives achieved under specified standards and conditions. Standards are quantitative or qualitative measures and criteria for specifying the levels of performance of an activity. Standards are the acceptable level at which activities must be performed to assure successful achievement of objectives. Conditions are those variables of an environment or situation that affect the performance of activities.

Capabilities are crucial for organisations. They establish key aptitudes that organisations have to build in order to perform activities and accomplish objectives. Organisational capabilities come up from the synergy of organisational resources and organisational knowledge. They require the efforts of various individuals to be integrated with one another and with crucial equipment, technology and other resources.

The need to sustain and develop the organisation's capabilities provides a basis for long-term plans and decisions about key organisational factors. In addition, organisational capabilities coordinate and constrain short-term planning and provide a logical basis for the physical structure of the organisation.

It is necessary to keep in mind that modern organisations work in an unstable and rapidly changing environment. Because of that, organisational capabilities have to evolve and change over time. The ability of organisational capabilities to adapt over time makes important influence on the success of organisations. If capabilities are inert, organisation will gradually lose ability to perform activities and accomplish objectives.

Schienstock (2009) points out that in the literature there are many other related concepts which are not clearly distinguished from the "capability concept" as, for example, "core competencies" or "organisational capacities". The great number of organisational capabilities or core competencies mentioned in the literature indicates that scholars have not been able to clearly enumerate many general problems organisations have to deal with and for which they have to develop appropriate capabilities.

3. TYPES OF ORGANISATIONAL CAPABILITIES

Organisational capabilities can be classified in accordance with different criteria. Authors identify various types of organisational capabilities depending on the selected criteria.

Schienstock (2009) distinguishes five dimensions of organisational capabilities: (1) selective or strategic capabilities which enable organisations to adapt to a rapidly changing environment; (2) organisational or integrative capabilities, which enable organisations to cope successfully with the problem of combining organisational efficiency with organisational flexibility; (3) technical or functional capabilities, which enable organisations to perform and extent their characteristic output; (4) capabilities and understanding of market and demand characteristics, which enable companies to profitably sell their products or services and to invade in new markets and (5) ability to learn, absorb, transform and reflect on acquired information and experiences, integrating and cutting through all these. Schienstock points out organisations are heterogeneous and focused on the development of different organisational capabilities.

Jon Kay (as cited in Armstrong, 2011) emphasizes that competitive advantage of the organisation is determined by its capabilities. He noted two kinds of capabilities - distinctive capabilities and reproducible capabilities. Distinctive capabilities are those characteristics of the organisation which cannot be replicated by others, or can only be imitated with huge difficulty. Distinctive capabilities describe what the organisation is specially or uniquely capable of doing and establish a basis for competitive advantage of the organisation. Distinctive capabilities can exist in such areas as technology, innovation, effective leadership, teamwork, specific knowledge etc. Reproducible capabilities are those that can be bought or created by other organisations with appropriate management skills and financial resources. That kind of capabilities cannot be a source of competitive advantage. In order to build and sustain organisational competitive advantage distinctive capabilities need to be supported by an appropriate set of complementary reproducible capabilities.

One of commonly used approaches to selecting of organisational capabilities is a functional analysis. A functional analysis identifies organisational capabilities in relation to each of the principal functional areas of the organisation. For instance, there are operations capabilities, logistics capabilities, research and development capabilities etc. The specific capability which can be recognized within the general research and development capability is innovative new product development. In addition, an example for the specific capability within logistics is equipment maintenance.

The process approach is another way of organisational capabilities classification. In accordance with that approach, all organisational capabilities can be grouped into primary capabilities, support capabilities and management capabilities. Primary capabilities are related to primary organisational processes. Primary processes are end-to-end cross-functional processes which span across the organisation and create direct value to organisation's end clients. Support capabilities enable performing of support processes within organisations. Support processes do not directly provide value to clients but they are directly responsible for providing all kind of support and resources which are necessary for execution of primary processes. Performance of management processes which guide primary and support organisational processes is directly linked with management capabilities.

Regardless of the approach that is applied, identified capabilities are likely to be broadly defined and should be disaggregated into more specific capabilities. For example, the human resource management capability can be disaggregated into the recruitment capability, the HR appraisal capability, the career development capability etc. Grant (2010) suggests establishing of a hierarchy of capabilities where more general, broadly defined capabilities are formed from the integration of more specialized capabilities.

The Australian Public Service (APS) is one of good practice examples in organisational capability management. APS points out needs to build and sustain organisational capability to respond effectively (and at pace) to contemporary needs, to build capability in advance of need when emerging needs can be reasonably anticipated, and to establish resilience to cope well with the unexpected. APS develops following capabilities: leadership, stakeholder engagement, citizen engagement, innovation, policy development, strategic planning, program delivery and implementation, project management, governance, risk management, change management, workforce planning and staff performance management.

4. THE MODEL OF ORGANISATIONAL CAPABILITIES DEVELOPMENT

Contemporary organisations are aware of capabilities development importance to overall organisational performances. Capabilities development is a high priority for many of them but they have not yet figured out how to do so effectively and efficiently. The generic model of organisational capabilities development is shown in Figure 1.

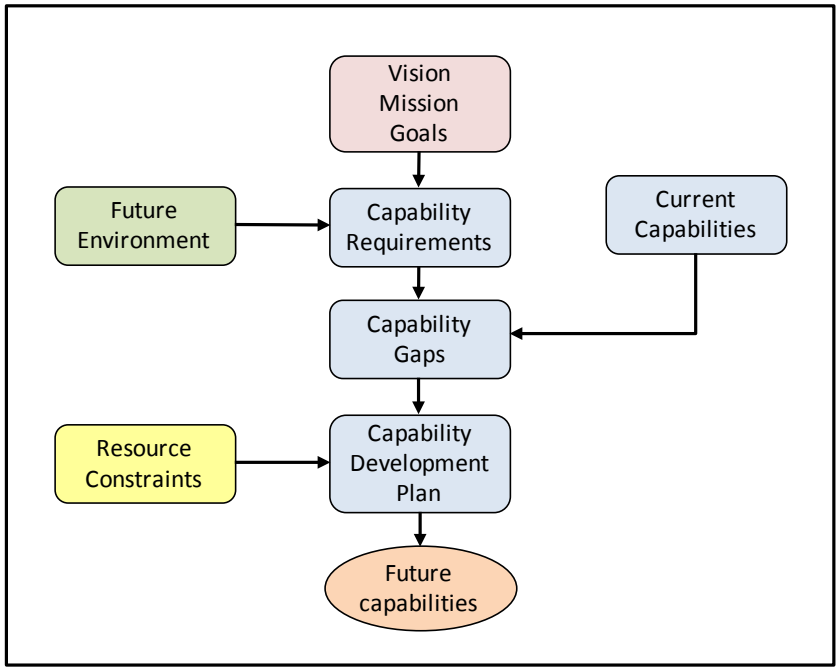

Figure 1: The generic model of organisational capabilities development

The basic step in the capability development process is an identification of capability requirements. That is probably the hardest part of the process and requires a combination of imagination and subject matter expertise. The purpose of this stage is to identify types and quantities of organisational capabilities required to accomplish given tasks and achieve defined goals and objectives.

Capability assessment is a stage that follows capability requirements determination. The purpose of the stage is to assess fulfilment of the previously identified capability requirements. Using the identified requirements and current organisational capabilities as primary inputs, capability assessment produce a list of capability gaps that require solutions and indicates the time frame in which those solutions are needed. It may also identify redundancies in capabilities that reflect inefficiencies. This stage of the process will also provide the relative priority of the gaps identified.

Development of possible approaches to solving (or mitigating) the capability gaps is the next step in the process. Planners develop options taking both materiel and non-material solutions into account. The development of realistic options is a crucial step in linking capability gaps to the scarce resources.

There is general agreement that organisational capabilities are result of the combined effect of multiple inputs. They cannot be built simply by purchasing new equipment or spending on R&D. Achieving necessary capabilities requires coordinated efforts in many areas and processes.

The main tool for organisational capabilities development is the capability development plan. This plan needs to be carefully developed to ensure that the organisation will have appropriate abilities and capacities to fulfil own mission and perform tasks. Some organisations formulate so called the capability strategy that defines what the organisation needs to do to develop and maintain its capabilities.

The implementation of the capability development plan follows its official approval by organisation's management. This is a very complex process which must be well prepared and led. Relevant bodies within organisation prepare the necessary partial plans and programs which would specify the capability development plan and support its implementation.

5. CAPABILITY INPUTS

Organisational capabilities are a result of the combined influence of multiple inputs. It is not the sum of those influences, but the synergy that arises from the way those inputs are combined and applied.

Defence institutions are the example of organisations which pay special attention to capability development. They identify different but similar the capability inputs. For instance, in the Australian Defence the fundamental inputs to capability are categorized and broadly defined as: personnel, organisation, collective training, major systems, supplies, facilities, support and command and management (Australian Department of Defence, 2012). Within the Canadian Defence a capability is a function of personnel, materiel facilities and procedures. In the United Kingdom, the military recognizes eight so called Lines of Development as a means of capability development: training, equipment, personnel, information, concepts and doctrine, organisation, infrastructure and logistics.

The Australian Public Service considers leadership, strategy and delivery as the most crucial areas of capability and key enablers of successful performance. The APS capability model (Figure 2) comprises 10 elements, grouped under the key enablers. The model provides a framework and common language for discussing and assessing organisational capability.

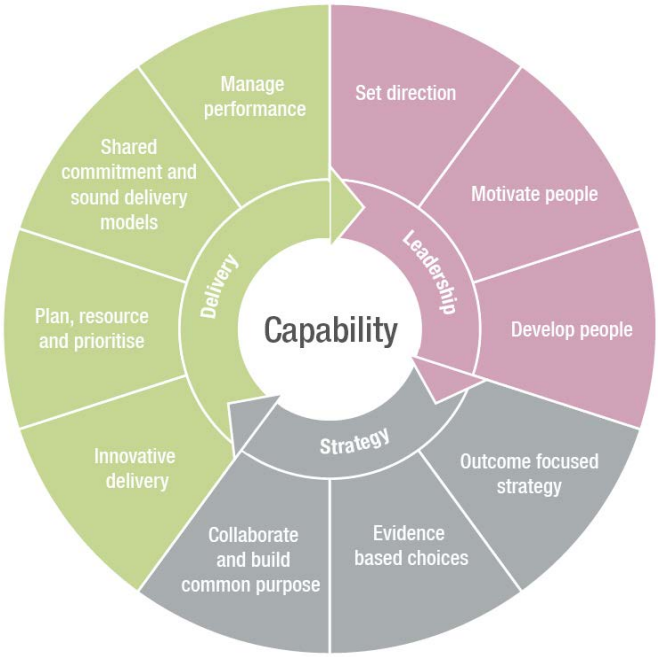

Figure 2: APS model of capability (Australian Public Service Commission, 2011).

Leonard-Barton (as cited in Gusberti, Viegas, Echeveste, 2013) describes the main components of the organisational capabilities by the four dimensions: knowledge and skills, technical systems, managerial systems, and values and norms. Capability Based Planning from the Systems Engineering identifies following capability inputs: people, process products, technology, and facilities.

As it can be seen from the discussed examples, scholars and practitioners have different views on capability inputs. However, most of them agree that organisational resources (human, material etc.) are fundamental

source of capabilities. Resources must be properly integrated and coordinated in order to produce capabilities. Organisational strategy, structure and management systems play a crucial role in resource integration and coordination.

Gusberti et al. state that resources are divided in technical systems and intangible resources or knowledge-that. Knowledge-that is expressed by knowledge contained in people and processes and can be acquired by training or education. The technical systems are essentially resources that were deployed by the capabilities in results and include products, technologies, facilities and materials. It can be divided in: (i) material resources; (ii) infrastructure, facilities, equipments, and information technology.

6. CONCLUSION

The traditional approach to organisational proceedings is based on establishing fixed structural arrangements which perform different tasks in order to achieve desired results. However, the complex and dynamic environment is characterised by rapid substantial and discontinuous change under which, to survive, organisations must be flexible and prepared for unexpected requirements and problems.

Such a situation requires a new organisational approach. Organisations need to focus on the creation and continuous development of specific capabilities that enable them to cope with uncertainties and new requirements in a much more flexible way.

Modern organizations should possess appropriate types of capabilities which enable efficient and flexible performance of tasks and activities in order to achieve desired results. The most important are capabilities which enable an organisation to perform key organisational processes and provide necessary outputs to clients. Also, organisations must develop an appropriate spectrum of management and support capabilities.

Development of organisational capabilities must be a result of a well arranged and managed process. The process of capability development consists of many activities which require an appropriate coordination and execution.

Organisational capabilities are a result of the synergy of multiple inputs but basic organisational resources are fundamental source of capabilities. Resources must be properly integrated and coordinated in order to produce capabilities. Organisational strategy, structure and management systems play a crucial role in integration and coordination of resources.

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REFERENCES

Armstrong, M. (2011). Armstrong's Handbook of Strategic Human Resource Management, Kogan Page Publishers.

Australian Department of Defence. (2012). Defence Capability Development Handbook, Canberra. Retrieved from http://www.defence.gov.au.

Australian Public Service Commission. (2011). State of the Service 2010–11. Canberra. Retrieved from http://www.apsc.gov.au.

Dosi, G., Nelson, R. R., Winter, G. S. (2002). The Nature and Dynamics of Organisational Capabilities. Oxford: Oxford University Press.

Grant, R. M. (2010). Contemporary strategy analysis. John Wiley & Sons.

Gusberti, T. D. H., Viegas, C., Echeveste, M. E. S. (2013). Organisational Capability Deployment Analysis for Technology Conversion into Processes, Products and Services. Journal of Technology Management & Innovation, 8 (4), 129-139.

Helfat, C. E. (2006). The SMS Blackwell Handbook of Organisational Capabilities. Blackwell Publishing, Retrieved from http://www.blackwellreference.com

Joint Staff, CJCSM 3500.04F. (2011). Universal Joint Task Manual. Washington, D.C.

Rauffet, P., Da Cunha, C., Bernard, A. (2010). Organisational capabilities assessment: a dynamic methodology, methods and a tool for supporting organisational diagnosis. Institut de Recherche en Communications et en Cybernétique de Nantes (IRCCyN). Retrieved from http://hal.archives-ouvertes.fr/hal-00497933.

Schienstock, G. (2009). Organisational capabilities: Some reflections on the concept. IAREG – Intangible Assets and Regional Economic Growth. Retrieved from http://www.iareg.org.

NEW PUBLIC MANAGEMENT

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Abstract: In the last three decades, public administration was struck by a wave of unprecedented reforms.The traditional model has come under the strike of strong criticism by citizens and the private sector, as well as theorists of governance. Basically, the reform lies upon the conclusion that the state has become too large and with too many responsibilities, and that the market offers superior mechanisms for more efficient delivery of public goods-and services. Therefore, political leaders found themselves under pressure from the public and the industry to increase the efficiency of government, reduce government spending and taxes, while maintaining a high level of public social services(Various*authors,*2002/03).

Programs of public administration reform which have made a strong impact on the international administrative policies are rooted in Westminster systems (Australia, New Zealand, UK and Canada) and the United States, countrieswhich are rightly considered the main representatives of the "New public management". A wave of administrative reforms actually started in the United Kingdom when in this country, a radical change was made in the program and methods of government activity and its administration so as to reduce the role of the government in economiclife, which led to a substantial consideration of the practice and concept of the existing system of public administration.

Keywords: *public management, public sector, reinventing of government, entrepreneurial country.*

1. FROM TRADITIONAL ADMINISTRATION TOWARDS A NEW PUBLIC MANAGEMENT

The reforms quickly spread in other countries, with the support and guidance of Bretton wood institutions that propagated the new public management, in order to reduce the role of the state in the production of goods and provision of servicesit.The non-existence of a state government that achieves satisfactory results was-considered a barrier to participation in the global economy, so the administrative reforms should provide a new system for the state, which would allow it to be properly globalized. The starting point was the premise that a strong, democratic state and globalization go together(Group of authors, 2002/03).Reforms included in this approach were aimed at reducing the number of administrative bodies and employees in the public administration, the elimination of the role of the state as a producer of goods and provider of services,-promotion of privatization, deregulation and decentralization, and fundamental changes in the nature of business of the government. A policy that was initially put the emphasis on maintaining macro-economic stability, stopping inflation, reducing budgetdeficits andpublic spending turned into a campaign for "reducing" and diminishingthe state organization, and thus its impact on the economy and society. The huge costs of social programs in Western Europe questioned the significance and sustainability of the welfare state that had been promoted and that had to be redesigned.

The need to improve efficiency in the public sector and to reduce public expenditure was accompanied by a package of measures which had the character of the introduction of market mechanisms in the public sector. Although success varies from country to country, these principles, however, can be regarded as the world trend. This trend was probably influenced by the value system whose construction was significantly impacted by multilateralorganizations, the media and civil society (Various authors, 2002/03).

Improvement of human resources in the public sector and the strengthening of institutionalcapacities of administration are not given equal attention as the liberalization of the economy.-Experience also points out the limitations of such a strategy. It has become obvious that macroeconomic programs are not sufficient to solve the fundamental problems of public administration. Moreover, the net effect of the adjustment policies was the neglect and weakening of strategic institutions, primarily of personnel systems in public administration, particularly in countries where the process of "state-building" is not over yet. The applicability of different models of the state raised the question whether the newglobal paradigm of public management is

being developed: New Public Management and the so-called "reinventing" government are the exact tools used in the process of improving public sector efficiency and reduction of costs " (Various authors, 2002/03).

2. NEW ADMINISTRATIVE PUBLIC SECTOR ENVIRONMENT

A.A hundred years ago the word 'bureaucracy' had a positive connotation: it signified the rational and advanced doctrine, i.e. the type of organization that was supposed to replace the arbitrary power of autocraticregimes. Bureaucracy introduced the same logic in state government, as the continuous production line introduced in factories. Hierarchical management and functional specialization, made it possible to effectively undertake such complex tasks. The bureaucratic model has functioned for a long time because it disabled basic problems that people then wanted to be resolved. It provided security from unemployment, which was characteristic of the previous period, stability, trust in the fairness and impartiality of the administration, standardized services that are suitable for all, which people needed and which they expected from the industrial era(Various authors, 2002/03).

Today, it does not exist anymore. We live in a time of globalmarket which represents an enormous competitive pressure on economic institutions.We live in an information society in which citizens obtain information almost as quickly as their politicians. We live in a knowledge-based economy in which educated workers do not put up with being commanded and demand autonomy in their work. Today, consumers are educated and aware of the quality standards of products and services and choices they have. In such an environment, bureaucratic organizations developed during the industrial era, both public and private, are letting us down. Today, organizations are turning to the specific needs of theconsumer, offering a wide variety of non-standardized services. They guide consultationsand incentives, which gives employees a sense of control, and even of "ownership". They develop an approach that would rather "empower" citizens, than to simply "serve" them, by giving them rightsand the ability to participate in the process, not just passively use services.

B."Empowerment" of citizens is a central motif in the managerial-doctrine. The hypothesis is that citizens are "damaged" by bureaucratic rules that limit choices and access to quality services. Moreover, it is assumed that the privatization, "the foreign supply" of public services and de-bureaucratization lead not only to greater satisfaction of citizens/consumers, but also to greater freedom and fullerdemocracy. In other words, "managerism"in terms of more efficient, entrepreneurial and results-oriented public sector management, opposes to administration bounded by rules.

Today, most state institutions still perform very complex tasks in a competitive environment that is rapidly changing, with consumers who demand quality and choice. In their iconic book "Reinventing government", David Osborne and Ted Gaebler stress out the following(Group of authors, 2002/03):"In a sense, this is a symptom of progress - a devastating crash that occurs when a new reality is faced with old institutions. Our information technology and our knowledge economy give us a chance to do things we never dreamed of fifty years ago. However, to take advantage of this opportunity, we need to clear out the ruins of our institutions from the industrial era and to build new ones."(Ristic, Z. 2012)

C.The origins of an activist, bureaucratic state, are practically the phenomenon of the twentieth century. The characteristics of the bureaucratic state were clearly, under the strong influence of Woodrow Wilson, defined by Max Weber in year 1920:

- there is a clear separation between politics and administration, and thus the clear role of political leaders (mostly of elected ones) and government officials (usually named)
- administration is to be permanent and predictable, and should function on the basis of written, unambiguous rules
- civil servants are employed on the basis of qualifications and are trained professionals
- the organization reflects the functional distribution of the workload and the hierarchical arrangement of tasks and personnel
- the funds belong to the organization, not individuals who work in the organization
- the main motivation is a sense of duty or of public interest, that transcends personal or organizational interests.

The perfecting of the traditional model of public administration came by applying the ideas of "scientificmanagement" based on the private sector, that have introduced effective operational methods based on the standardization of tasks, the principle of "one best way" to adjust the staff to the assignments and systematiccontrol of tasks, processes and people. These principles have easily adapted to the bureaucratic structure. Supplement to the traditional model was the application of knowledge in social

psychology, through the approach based on "interpersonal relations-".It is often compared with the approach of scientific management, but in practice, it scored higher efficiency in performing tasks, while paying attention to the need for motivation of workers rather than controlling and directing them (Ristic, Z..2012).

As an argument in favor of an activist state model there was the fact that state intervention was necessary for correcting the shortcomings and failures of the market. Level of control and state intervention varied considerably in practice: to the complete state ownership and market allocation. The decisive role was played by strong state bureaucracy. This activist model has been criticized by the traditional model of state bureaucracy and the government's inability to do its job properly(Group of authors, 2002/03).

D.While the welfare state justified itself by the need to remove the lacksof the market, the predominance of the above stated characteristics has led to a critical situation that requires the rectification of failures in the administration of the state (Group of authors, 2002/03).

- The Irresponsible state, whose abundant interventions limited the freedom of people to deal with their own affairs, developed a dependency instead of independence;
- Excessive state, where government has taken on too many powers, could not accomplish them efficiently and effectively;
- State of private interests, where the elite and the privileged groups exploited the opportunities that were offered by government jobs to meet their interests and maximize revenues.

The combination of criticism (inefficient bureaucracy and defective nature of activist government) produced a model of reform called "new public management". This model of reform is based on the assumption that large state administrations are inherently defective and useless, and that the market is better equipped than the state to provide most goods and services. Radical changes needed for bringing a transformed and entrepreneurial model of public management are implemented by the following(Group of authors, 2002/03):

1 Restructuring and reduction of the public sector, particularly by privatization,
2 Reorganization and "thinning" of the central public services,
3 The introduction of competition in the remaining public services, by use of internal markets, and contracting the provision of public services with the private sector, and
4 Improving the efficiency by realizing the concept of "value for money" by management based on the results achieved and audit of performance.

The new type of public management is characterized by:

1 The separation of the strategic policy from operational management,
2 Concern for the results, not the process and procedures,
3 Orientation towards the needs of citizens, and not the interests of the organization or bureaucrats,
4 Withdrawal from the area of direct service provision in favor of the role of "steering" or "empowerment", and
5 Altered, entrepreneurial management culture.

2.1. Birth of entrepreneurial state

A common thread for the solution of problems of governance was not hard to find: it was necessary to "re-invent" the mode of government activities in all segments and integrate the elements of a new organizational culture, primarily of entrepreneurial mentality. Most entrepreneurial governments encourage competition among providers of services (Various authors, 2002/03).

- They "empower" citizens by transferring control from the hands of the bureaucracy into the hands of society,
- They assess the success of the work of their organizations by focusing is on the results achieved, rather than on resources used,
- They are guided by the results and their mission, not by rules and regulations,
- They define their clients as "customers" and offer them a choice, for example, between different schools and educational programs,
- They prevent problems rather than react when they occur,
- They decentralize jurisdiction by developing participation,
- They prefer market mechanisms to bureaucratic ones
- They do not focus on self-provision of public services, but on catalyzation of all sectors - public, private and voluntary - into action, in order to solve the problems of the community.

A.The government and the company are completely different institutions. Business leaders are guided by profit: the leaders of the government are guided by the desire to be re-elected.

Companies receive most of their funds from their customers/consumers, while the statecollects most of the funds from taxpayers. Business is usually conducted in a competitive environment, while the states use monopolies, Osborne and Gaebler explain, and suggest that differences such as these create a completely different aspirations in the publicsector: "For example, the key question for managers in public institutions is not whether they deliver a product or generate profit but whether it satisfiesneeds, whether they are to the liking of elected politicians. Having in mind that stakeholders are behind politicians, managers in the public sector - unlike theircounterparts in the private sector - must always include the factor of stakeholders into their activities. "

All of these factors are combined to create an environment in which public sector employees see the risks and rewards completely different from employees in the privatesector. ‘’The government aspirations are focused on how not to make mistakes," said Lu Vinik from the Ford Foundation, "State budgets are encouraging managers-to waste money. If they do not spend their entire budget by the end of the fiscal year, three things happen: they lose money they were saving, they get less next year, and budget directors complain that they demanded more than they should in the previous year."

B. Models of the new government may be (Group of authors, 2002/03):

- Model 1 - "Market Government" - focuses on decentralization, salary based on performance and other operational techniques of the private sector.
- Model 2 - "Participatory Government" - emphasizes "thinner" organizational structure, total quality management, and teams.
- Model 3 - "Flexible government" - promotes virtual organization and temporary staff.
- Model 4 - "Deregulated government" - puts the emphasis on greater managerial freedom.

Each model is a product of various criticisms of the inadequacy of government, each offering different solutions.

C."For most of the leaders, there are only two ways out of the crisis in the public sector: either to raise taxes or cut costs. For almost three decades we are seeking the third option. We do not want a lower level of education, fewer roads, a lower level of care, but at the same time - higher taxes. We want better education, better roads, better health care, for the same or a lower amount of tax liability.
To be more precise, we need better governance/state management (Good Governance) - the process by which we collectively solve problems and meet the needs of our society, and this is why this forms a coherent whole, the new model of government(Ristic, K. and Ristic, Z..2014).

3.New Public Management

A.New Public Management is a worldwide phenomenon, but in different countries this term is understood differently in different situations. In the United States, this approach is characterized by the movement for "reinventing government" and the project designed bythe Vice-President Al Gore -"National Performance Review".The UK has started the Financial Management Initiative of Prime Minister Margaret Thatcher and continued with what is called Next Step.New Zealand has made the most drastic changes in the structure of government and managerial philosophy(Ristic, K. and Ristic, Z..2014).

It should be borne in mind that the search for new public management requires consideration of the role of the state. It is a fact that the state today is more an economic than a political agent. The crisis of legitimacy affects the political class and the administrative structures which are still based on the rule of law. Another fact is that identity and political history of every European country must be fully understood. Where there are management models, their implementation depends on their adaptation in a way that significantly varies-from country to country.The practice of the new public management is therefore proved to be very applicable in the Nordic countries, whose structures are characterized by a high level of decentralization, "guild" organizations and a rooted culture of social pluralism. Outside the Nordic countries, the implementation of new publicmanagementdestroys not only the administrative structures, but also the representative bodies of civil servants and service users.Reforms largely depend on the "clientelism"in Greece, the role of civil service unions in France, the politicization of jobs in the civil service in Austria, the role of political parties in Italy. New Public Management which promotes efficiency and flexibility, it is often in conflict with the massiveness and the inertia of legal norms.

B.New Public Management (NPM) - is a term used in many countries around the world. Seemingly, it describesa globaltrend of a certain type of administrative reform, but it soon becomes clear that in the

variousadministrative environments, it has different meanings. Even in the academic world, there is no consensus on what the term means. In any case, the term is somewhat faulty because its elements are not new, which is why there are charges that it is "new wine in old bottles." In addition, the reform of public management occurs in a wide variety of forms, in different-contexts, including the very different national priorities and needs. The transformation process in Central and Eastern Europe is just one of the examples(Ristic, K. and Ristic, Z..2014).

With the advent of managerism, the term "public administration" is rapidly replaced by the more popular "Public Management" even in many academic programs (e.g., human resource management). Essentially, the difference between these two terms is not so much in theirdefinitionas in the doctrine behind each of them. Although inthe Serbian language "management" easily translates as "administration", the nationalliteratureequally and interchangeably uses the term management. The translation of theterm "manager" - "administrator" does not fully comply with the spirit and practice of Serbian language,so the term 'director' is often used (which is in English, "leader")(Ristic, K. and Ristic, Z..2014).
The translation of the terms "New Public Management" and "Good Governance" can be a matter of discussion, as well as the translation of the term "public policy": we use the terms 'novi javni menadžment' and 'dobra vlada/vladavina. But what is the new public management? It is fair to say that it helped in highlighting the need to change the way the governments operate.

C.Two types of main concept of new public management emerged. According to the narrower concept, new public management is a marriage of two different streams of ideas. One stems from the new, institutional economics which examines new administrative principles such as competition, a wider choice for users of public services, transparencyanda strong emphasis on new mechanisms for motivating employees. The second stream stems from the application of the principles of private business management to the public sector. Practically, this narrow understanding of the new public management places the emphasis on contract management, the introduction of market mechanisms in the public sector and linking salary with performance.The main features of the reform of public management, for achieving the targeted result-oriented management are:transferring powers and providing flexibility, ensuring the results, control and accountability, the development of competition and choice, responsible provision of services to citizens, improving human resource management, use of information technology, improving the quality of regulation and strengthening the function of "steering" in the center.

A broader definition of the new public management has a more pragmatic approach, not looking at it from a philosophical perspective, but as a rational response to the pressures that the governments are facing. Since the pressures of globalization are similar in all countries, it would be expected that the reactions overlap to some extent. However, this does not mean that the implementation of the new public management in those countries will be identical. Such a broad definition does not impose a universal model, but makes the model of the new public management more transmittable from one country to another. This can involve a detailed radical reform of public management or individualadjustment depending on the institutional framework of those countries.

The term New Public Management is used to describe a management culture that emphasizes the central role of the citizen and user of services and accountability for results, suggesting structural or organizational choices that emphasize decentralized control across a wide spectrum of alternative mechanisms for the provision of public services, including quasi-markets in which the public and private suppliers compete for funds provided by investors and those in charge of public policy. New Public Management does not claim that the government or the management -should to stop doing certain jobs; it does not care whether the work is done or not, it is interested in getting the job done in the best possible way. The new public management was conceived as a means of improving the efficiency and accountability of political leaders, and it originates from parliamentary democracies with a strong executive leadership, centralized government and administrative law.

New Public Management can be seen as a "cascade chain of contractual relations", which leads to one manager (often aministry) interested in better results in areas where there are significant and relatively stable jurisdiction. Most of the principles of new public management-can be illustrated by the example of establishing semi-autonomous agencies for the provision of public services. The argument in favor of the existence of the agency is that those who should provide those services should be concentrating on their efficiency and quality, without disturbing the structures for the development of public policy(Ristic, K. and Ristic, Z..2013).

D.OECD study reveals that all member states are experimenting with some of the elements of the new public management, although the degree of implementation of these elements and the differences between them vary from state to state. Nonetheless, it soon becomes clear that the actual implementation raises different

difficult issues about the goals and outcomes. This is partly due to the strong orientation of new public management towards the economic value and its underdeveloped legal and political dimensions. Given the complexity and the fact that many reforms are still under way, virtually every state will have to make a careful assessment ofaspects which in any combination offer real progress in the light of its institutional and political context(Ristic, K. and Ristic, Z. .2014).
Public management must not only be a promotion of economic values. Before us is a task to put a stronger emphasis on products and outcomes in accordance with the political and legal principles of public administration. The emphasis placed-on these various principles and their connections will vary from country to country depending on their traditions and political and legal framework. This new paradigmcannot be reduced to a slogan, claimsBornis, and states that key ideas can be extracted(Ristic, K. and Ristic, Z..2014):

- The government should provide high quality service that will meet citizens' needs
- The autonomy of public managers, especially from the central state organs, must be increased,
- Organizations and individuals should be evaluated and rewarded based on how successfully they reach the required goals,
- Managers must ensure that they have at their disposal adequate human and technological resources needed to achieve the objectives
- Public sector managers must appreciate the value of competition and maintain open access to what in terms of services belongs to the private rather than to the public sector.

Two variants of the new public management - contract theory and the theory of empowerment - are intended to give the public managers the flexibility they need in order to improve results(Ristic, K. et al.(2013/2014).Those who adopt the theory of "empowerment" implicitly allow them to develop the skills of intelligent decision-making, to reasonably use the given flexibility and to be motivated primarily by intrinsic motives of working in public administration.It is necessary to support the vision of the public sector as an "organization in the process of learning" /0} which should constantly be progressing. Those who adopt the strategy of contracting, normally do this through precise, clearly written agreements on the results that leave little room for the kind of confidence present in the previous strategy, which motivates better results by special awards. There are no universal solutions to the public sector as a whole - different parts of the public administration require different systems of public management, depending, for example, on whether it comes to redistribution of resources, provision of services or the classic state activities. Some states, such as New Zealand and the United Kingdom, use contracts and incentives to "force managers to do their job." Others, such as Australia and Sweden, for example, "empower" their managers and thus "allow managers to do their job"(Ristic, K. and Ristic, Z..2013).

SUMMARY

New public management and "reinventing government" have significantly enriched the language of management with a number of new terms and graphic expressions.

- results, not the processes
- Downsizing, and now the rightsizing
- Lean and mean
- Contracting out, off-loading, outsourcing
- "Steering" rather than "rowing"
- "Empowerment" rather than serving
- Earning rather than spending

New Public Management is designed to continue to somewhat influence the development of the administration. The question is whether this impact can go beyond the field of methods and techniques into the field of value systems. It has to play a role in the ongoing efforts to implement "good government (governance)," primarily in the-developing countries. Therefore, it is important to understand the context, powers and limitationsof the new public management so the best could be taken from it.
The improvement of government performance is a complex undertaking. This means that differences have to be taken into consideration between people in different regions, at different times or for different issues of public policy. Every government, when it comes to improving the results, tries to make steps forward. Whenever government decides make a specific step, it needs a special strategy that will maximize its performance in this specific context.

REFERENCES

Group of authors, (2002/03),Javni menadžment i budzetski sektor, Belgrade, Ministry of Justice of the Republic of Serbia
Ristic, Z..(2012) Fiskalni menadzment i ekonomija javnog sektora, Belgrade: Etnostil.
Ristic, K. and Ristic, Z.. (2014), Fiskalna ekonomija i menadzment javnog sektora, Belgrade, Etnostil.
Ristic, K. and Ristic, Z.. (2013), Medjunarodne javne finansije i budzetska politika EU, Belgrade, Etnostil.
Ristic, K., Komazec, S. Ristic, Z.. (2013/2014), Globalni finansijski menadzment, Beograd, Etnostil.
Ristic, K. (2013), Ekonomija Evropske unije, Belgrade, Etnostil.
Ristic, K., Komazec, S. Ristic, Z..(2014), Ekonomija kapitala i finansiranje razvoja, Belgrade, Etnostil.

NEW COSTING MODEL IN MINING INDUSTRY

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Abstract:*The research introduces a kind of new costing model of handling of costs in developing and exploration i.e. full lifecycle of coal mining site. The new costing model in mining will use all good facts from previous approaches implemented in coal industry.Analytic and holistic approach is the tool used in this model in order to establish the new way of handling of business in mining companies. In order to create new costing model in mining industry, the comparative method is used for analysis of software solutions and description method in order to establish link between relations and rules in old mining models. Additionally, elaboration method is used in analysing of the costing model in RiTeUgljevik. An impact of EPR implementation on new costing model in mining is essential, because many processes in production of coal should be automatized in order to allow the cost tracking on analytic level (cube view). In this paper areexplained benefits from implementation of an adequate ERP system in mining industry.The benefits of creating the right costing model for mining company are substantial, not only in terms of cost reduction, but also in the ability to better focus resources, enhance value for extension of profit margin and newinvestments.*

Keywords*: Handling of cost, new costing model in mining, RiTEUgljevik, production of coal, ERP*

1. INTRODUCTION

The mining companies have significant costs in order to establish their business. One of the first types of cost is associated with the complex process of expropriation.

Developing of coal site lasts several years and include two main phase: Set up of coal site and Expropriation. Each phase require generating of significant costs. Mining companies carry out the various stages of development necessary prior to production over a long period of time, at high cost and in some cases with a high level of risk and uncertainty as to future commercial benefits. Adopting an appropriate accounting treatment for the costs incurred at each stage is therefore essential. Unfortunately, there is little specific guidance as to the extent to which costs associated with finding, acquiring and developing mineral reserves should be expensed immediately or deferred.

The special attention is paid on methods of handling of “externalities”, during production of coal, in the ways of multiple hazards for health and the environment. Accounting for the damages conservatively doubles to triples the price of electricity from coal per kWh generated, making wind, solar, and other forms of non-fossil fuel power generation, along with investments in efficiency and electricity conservation methods, economically competitive.

Generally, an expropriation from a landowner by the government typically involves the taking of privately-held land for a public purpose, such as the building of roads or improvements to existing roads, acquiring land for municipal expansion, acquiring land or an interest in land for the construction of public buildings, and so forth.

Where the minerals are beneath privately-owned land, the landowner has the right to be compensated for the interference with their land, and to take disputes with respect to compensation for their land to the provincially-appointed authority to determine compensation.

Also, there are many nus-effects for society from the expropriation phase. Typical sample of nus-effect have happened in New Scotia in Cannada in 2012.So, the Higgings family in Nova Scotia has lost their fight to prevent the expropriation of their land to a gold mining company.

The family runs a Christmas tree farm in Moose River Gold Mines. The provincial governmentexpropriated a section of their property. Australia’s DDV Gold Ltd. plans to start a $140 million open-pit gold mine and wanted the land.

On Friday, the Nova Scotia Court of Appeal unanimously dismissed an appeal by the family. That appeal backed an earlier Supreme Court judge who cleared the expropriation, which was ordered by Darrell Dexter's government in 2012(retrieved from: www.breakingthesilenceblog.com/general/family-loses-expropriation-case-against-gold-mine; 2013).

Apart from expropriation costs, the company must to count on many other costs for state authorities. One of these types of costs is concession. Normally, each country prescribes managing of access to coal via the mining concessions, to areas free for mining natural resources that do not belong to surface property and deposit`s owner.

In the case of mining laws, administrative procedures such as issuing of mining concession, approving operating plan and issuing permits or licenses to explore according to the water rights, the country authorities establish Mining authority. "In Germany, the classic procedure of mining license is the operation plan procedure, whereby the operator submits an operating plan to the Mining authority, which then examines it in order to ensure fulfilling of legal objectives (Schmidt, 2013)".

One review published in New York Academy of Sciences (AS, 2011) found out that the best estimate for the total economically quantifiable costs, based on a conservative weighting of many of the study findings, amount to some $345.3 billion, adding close to 17.8¢/kWh of electricity generated from coal. The low estimate is $175 billion, or over 9¢/kWh, while the true monetizable costs could be as much as the upper bounds of $523.3 billion, adding close to 26.89¢/kWh. These and the more difficult to quantify externalities are borne by the general public.

The third type of investment cost can be defined as activities performed in displacement of coal overburden layer. Measurement of overburden costs is very difficult. Generally, the cost depends of machines used to displace of this overburden layer. In practice, the machines in mining are segregated in two dimensions: Discontinuer and Continuer. Discontinuer is the name for machine which storage their production of coal on some medium (truck, train etc…) for transportation to Thermal Plant. Adversely, the coals are transported to Thermal production plant automatically by using of Continuer`s machines. RiTeUgljevik implemented only dis-continual way of transportation coal in further consumption of coal for production of electricity.

2. USE OF COAL

Coal is currently the predominant fuel for electricity generation worldwide. In 2005, coal use generated 7,334 TWh (1 terawatt hour = 1 trillion watt hours, ameasure of power) of electricity, which was then 40% of all electricity worldwide. In 2005, coal derived electricity was responsible for 7.856 Gt of CO_2 emissions or 30% of all worldwide carbondioxide (CO_2) emissions, and 72% of CO_2emissions from power generation - one gigaton = onebillion tons; onemetric ton=2,204 pounds (International Energy Agency, 2007). Non–power generation uses of coal, including industry(e.g., steel, glass-blowing), transport, residential services,and agriculture, were responsible for another 3.124 Gt of CO_2, bringing coal's total burden ofCO_2 emissions to 41% of worldwide CO_2emissions in 2005.

By 2030, electricity demand worldwide is projected to double (from a 2005 baseline) to 35,384 TWh, an annual increase of 2.7%, with the quantityof electricity generated from coal growing 3.1% perannum to 15,796 TWh(International Energy Agency, 2007). In this same time period,worldwide CO_2emissions are projected to grow 1.8% per year, to 41.905 Gt, with emissions fromthe coal-power electricity sector projected to grow 2.3% per year to 13.884 Gt(International Energy Agency, 2007)**.**In the United States, coal has produced approximatelyhalf of the nation's electricity since 1995,2and demand for electricity in the United States isprojected to grow 1.3% per year from 2005 to 2030,to 5,947 TWh.1 In this same time period, coalderivedelectricity is projected to grow1.5%per yearto 3,148TWh (International Energy Agency, 2007). Other agencies show similar projections;the U.S. Energy Information Administration (EIA)projects that U.S. demand for coal power will grow from 1,934 TWh in 2006 to 2,334 TWh in 2030, or 0.8% growth per year (Energy Information Administration. 2009).

To address the impact of coal on the global climate, carbon capture and storage (CCS) has beenproposed. The costs of plant construction and the "energy penalty" fromCCS, whereby 25–40% more coal would be needed to produce the same amount of energy,would increase the amount of

coal mined, transported, processed, and combusted, as well as the waste generated, to produce the same amount ofelectricity (House, Harvey, Aziz&Schrag, 2009). Construction costs, compression, liquefactionand injection technology, new infrastructure,and the energy penalty would nearly doublethe costs of electricity generation from coal plantsusing current combustion technology.

In order to perform and fulfilled the correctness, the mining company must to perform the demand analysis. This analysis was made for the development of coal mine safety monitoring system. It contains to build up the layout model of the standard coal mine underground production environment and set all kinds of underground transducers especially methane transducer. On this basis, the general design scheme of coal mine safety monitoring system was determined.

3. CAPEX AND OPEX COST IN „RITE UGLJEVIK“

Normally, the cost established in mining company can be divided on investment part, called Capex, and operational part called Opex. Capex cost are related to established and capital investment costs in mining operations, while Opex cost are related to daily production of coal.

Capex&Opex cost can be presented in terms of operation on the biggest mining company in Republic of Srpska “RiTeUgljevik”.

Capital mining investments, such as the project of opening mining site „Ugljevik - East“, are very complex due to the influence of various internal and external techno-economic as well as natural factors and constraints arising from social and economic environment. By investing in the opening of the mining site „Ugljevik - East“, the company „RudnikiTermoelektranaUgljevik“ (Mine and Thermal Power Plant „Ugljevik“) in the Republic of Srpska (Bosnia and Herzegovina), implemented previously defined goals of growth, developed policy and strategy of the company. This investment project required extensive financial assets, significant amount of other resources as well as time.

In order to assess the technical and technological, financial, market and social feasibility of the project, a Feasibility Study was made by the Center for surface mining, Belgrade, in 2013. This study contained a complex analysis of coal at the BogutovoSelo and Ugljevik East coal deposits, including all the components of sustainable mining, i.e., all the environmental and social impacts in addition to the economic impact. Production and technical data, designed in the technical part of the Study were used to design an economic model to determine the economic parameters of the project. Financial analysis is primarily based on planned production capacities of the mine, the investment and operating costs and the estimated selling price of coal. The amounts are given in BAM (KM), with the exchange rate of 1 EUR = 1,955 KM.

For the calculation of income, the price of coal of 44 BAM/t was used for the Thermal Power Plant (TPP) while the forecasted price of coal for general consumption was 65 BAM/t. The Price of 44 BAM per ton of coal for Thermal Power Plant is equivalent to the coal price of about 4.4 BAM/GJ, which is the average market price in Bosnia and Herzegovina and in the Republic of Srpska. The price of 65 BAM per ton of coal for household consumption is the price at which TPP Ugljevik is currently selling the coal.

According to the above study, there are not years with the negative financial result during the project implementation. Since this is an investment project which basically continues the current production with similar volume and similar costs, there are no negative financial results in the years of intensive investment. Instead, there is a significant decrease in net income in the period of repayment of interest on loan taken.

Based on the results of the Study (Center for surface mining, 2013), it can be concluded that the project is fully solvent, which can be seen from the cumulative inflow (2,267,361,382) and outflow (1,543,271,267). In addition to the observed dynamic indicators, the following static indicators were monitored as well:

- Profitability = Net Income / Total Investment = 9%
- Cost - effectiveness = Net Income / Total Income = 21%
- Reproducibility = (Net Income + Depreciation) / Total Investment = 13%

The average profit rate of the investment project is 28%.

The net present value of the project amounts to 160,369,022 BAM at a discount rate of 8%, while the internal rate of return (IRR) is 34.63% and return on the project investment is 10 years.The project is most vulnerable to changes in selling price, then to the production volume, and much less to the variation in the standardized materials, energy and investment cost.

By analyzing the turning point, a limit of the production level of 931,201 tons is defined, which is well below the planned average production level within the project lifecycle of 1,733,138 tons. The minimum price per unit of 30.63 BAM is also significantly lower than the forecasted average selling price of 44.60 BAM.

Dynamic sensitivity analysis indicates that in relation to selected key variables, the project is most vulnerable to changes in price and volume of production. Since there is a large difference between the planned and the minimum acceptable price, not even the largest analyzed deviations of 20% in comparison to the planned price,represent a hazard to the project.

From the point of impact onto the environment, the project is assessed as socially acceptable, while the sensitivity and risk analysis indicates that the project investments do not fall under the category of risky investments.

Opex costs are related to functioning of mining operation.It is very important to made distinction between Opex and Capex costs in mining industries.

Under the historical cost model, mineral reserves that result from a company's exploration activities do not appear as an asset. Information on mineral reserves is, however, vital to investors and analysts in predicting future cash flows and evaluating the prospects for a mining company. Thus, supplementary disclosure about mineral reserves outside the financial statements is important for a more complete appreciation of the value of the company.

Because quantities of minerals beneath the earth's surface cannot be known with absolute precision, reserves are usually categorized as "proven" or "probable," depending on the degree of confidence about the accuracy of the disclosed quantity. All of the companies we reviewed that disclose information on reserves provided quantities of proven and probable reserves, in some cases separately and in other cases combined. Many companies disclose in their annual reports information on mineral resources as well as reserves. Mineral resources are quantities of minerals for which there are reasonable prospects of eventual economic extraction. These are classified as "measured," indicated" or "inferred," depending on the degree of confidence. Only those parts of a company's mineral resources that have been determined to be economically extractable can be classified as reserves.

This distinction is important from an accounting perspective since only proven and probable reserves are used in calculating amortization on a unit-of-production basis and in measuring impairments. Most of the companies we reviewed state this explicitly in their financial statements, and those that do not are believed to follow this practice. Generally speaking, only proven and probable reserves are taken into account in determining fair values for acquisition accounting.

The resources used in mining production for RiTeUgljevik are fuel and electric energy. In 2012 year, there are cca. 50% of cost of machines (fuel&other energy costs and depreciation) of the total production costs. As the first stage of coal production, we gave basic coal. These basic coals should be cleaned. Afterwards, two sediments of coals are given: cleaned coal and dried coal.

In mining production, Opex phase, the production plan is essential. The production plan must to be in line with sales targets. Based on production plan, the company plans their resources (external and internal) on monthly and daily basic.

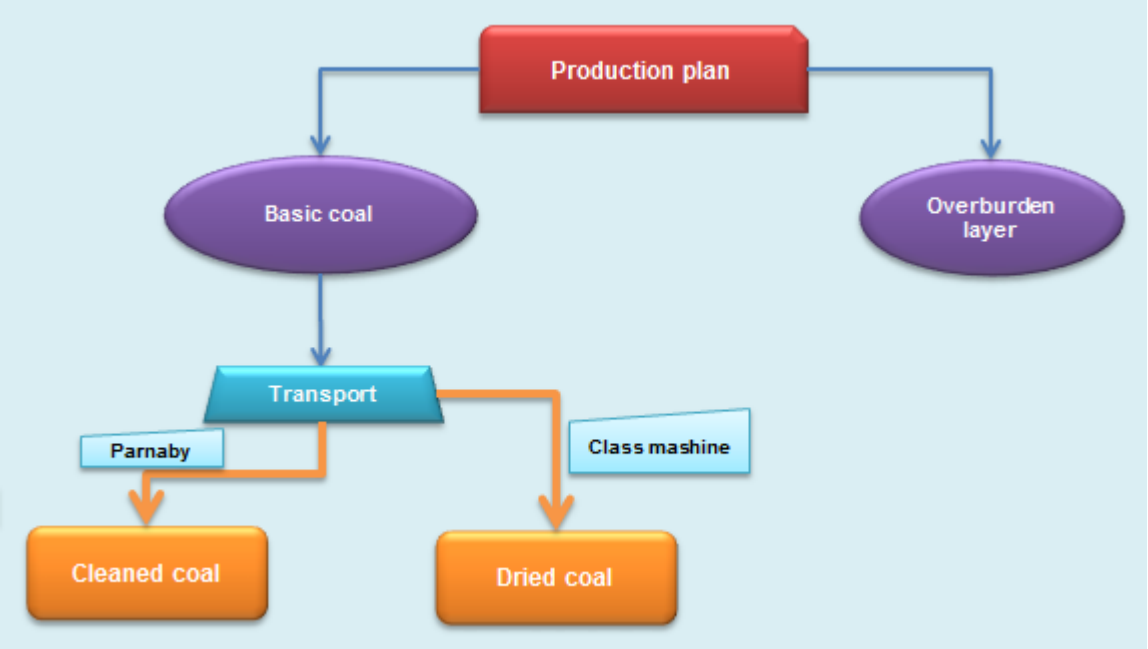

Figure 1: Production sheme in RiTeUgljevik

4. THE SOFTWARES IN MINING INDUSTRIES

There are two main players on worldwide level related to ERP software in mining industries: SAP and Oracle. The both software giants have derived solution for mining. Based on last research, ERP systemsearned more than 38% of total ERP software revenues in 2012 considering all companies world-wide (Pang, Dharmasthira, Eschinger, Motoyoshi and Brant, 2012). SAP and Oracle EBS offer up-to-date solution for mining processes. The choice of the right solution for companies is the last, but the most important stage in order to close the business model (Manojlov, Lutovac, 2012).

The common feature for SAP and Oracle is having a very good solution for mining, especially in cost calculation and measurement of maintenance costs. Oracle is launched Oracle`s mining solution map in order to better track costs and improve performances in business.

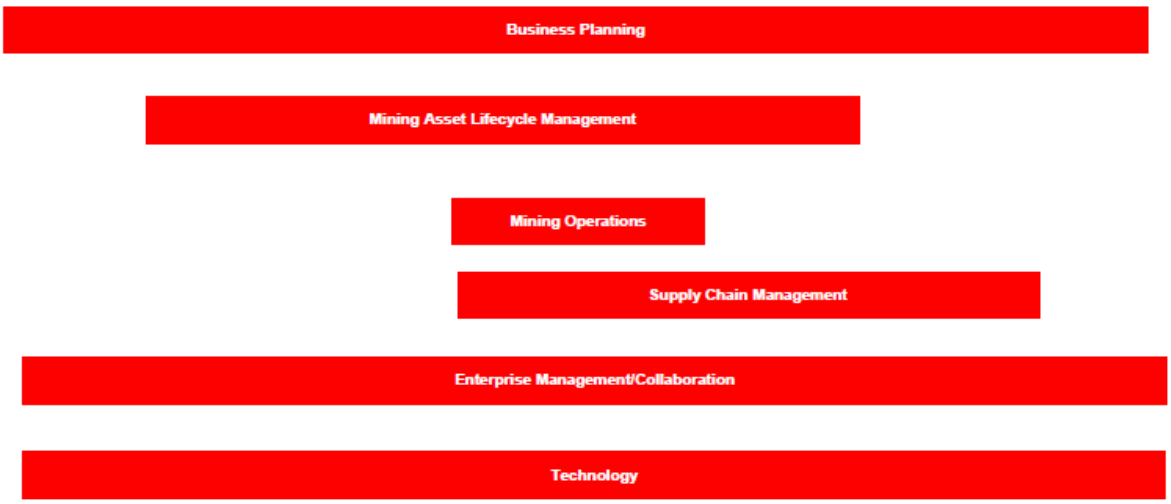

Figure 2: Oracle`s mining solution map

Oracle`s client called “Solid Energy” announce that investment in Oracle Enterprise Asset Management (eAM) is expected to yield rich dividends, enabling this capital-intensive resources enterprise to identify the true lifecycle cost of assets.

On the other hand, SAP deliver solution for mining called SAP for mining or IS-Mine. SAP for Mining consists of several technical components. One of these components is IS-Mine. The functions and tools delivered with IS-Mine are designed to handle the following key business processes in the mining industry:

Mining and primary distribution
- Maintain and optimize all mining processes
- Collect data on all mining processes

Secondary processing
- Plan long-and short-term production objectives
- Manage cost of entire supply chain
- Manage distribution processes

Normally IS-mine requires implementation of SAP ERP system previously. With SAP solutions, mining organizations can reduce operating expenses by improving efficiency in mining and processing operations, boosting asset uptime and utilization, enhancing overall logistics processes, and expanding efficiency improvements to areas like purchasing, finance, and controlling. For example, one mining company increased its overall equipment effectiveness by 75% by implementing SAP ERP (SAP AG, 2013). Additionally, mining companies can realize their sustainability strategy on safety and environmental compliance and help ensure financial success. With a clear view of profits and spending, they are in a better position to initiate internal improvement projects and drive effective negotiations with customers and suppliers. One copper mine realized a US$20 million reduction in stores inventory by implementing SAP ERP and reduced time from purchase order to requisition by 75% (SAP AG, 2013). Finally, with the SAP solutions, mining companies can realize a fast return on investment and reduce IT spending by integrating and standardizing enterprise software on a single platform. SAP solutions support organizations with acquisitions and mergers in a global environment and help them to overcome various localization issues in areas such as legal, finance, and HR when going global. SAP solutions help mining companies expand by providingthe security of long-term software vendor support. As an example, a tin mining company reduced the time required to create reports by 90% and the time required to close the monthly books by 40% (SAP AG, 2013).

5. NEW COST MODEL IN MINING COMPANY

Generally, new cost model in mining industry must to be tailored in order to cover operating and capital activities. The method is used to identify the cause and the connections between the cost inductors (cost drivers) and the cost of the activities by measuring the costs of the process the activities refer to and the cost objects. The main purpose of the method is reducing of cost and increasing of profit consequently. The basic prerequisite for the model is one final product i.e. coal.

There are several rules for implementation of new costing model for mining company:
- All costs collected on cost centers during the month will ultimately rest in the process centers.
- Costs will be moved to the process cost centers with various allocation methods.
- Overhead and utility costs will be allocated to Coal product through activity allocations during the period. At month-end, production activities will be revalued to actual and posted to Coal product. The allocation will be based on production statistics obtained from third-party systems. The management accountant will verify the production statistics before importing the data into system.
- All production orders will be settled to materials at month-end after all material movements, activity allocations and revaluations of activities have been processed for the period.
- All allocations will happen on a periodic basis.
- Differences between the moving average values/standard costs and actual costs on order related to Coal final product will be settled to materials at month-end after all material movements, activity allocations and revaluations of activities have been processed.

Table 1: The production in mining divided into two areas

Phase	Description
Production	It refers to all processes and activities related to surface stockpiling of mine. It starts with the hauling of mine from underground and ends at the surface

Shipping	Shipping refers to all processes and activities related to the shipment of coalmine to the various phase at the mining site

In order to give the correct cost in mining,the following workflow in costing is proposed:

1. Coal product order will be created to value the various phase:
   - Window coal mine.
   - High grade surface.
   - Medium grade surface.
   - Low grade surface.
   - High grade overburden layer.
   - Medium grade overburden layer.
   - Low grade overburden layer.
2. Cost collected in cost centers (one of the cost center will be shipment cost center) during the month will be allocated via activity allocation to the various orders in production.
3. The activity allocation to the various orders in production will be based on the production statistics data from the third party systems.
4. Raw material costs or additional mining costs will be allocated directly to the coal product order.
5. The coal product orders will settle to inventory at month-end.
6. Inventory valuation will be performed at the end of each period.
7. The moving average price calculated at the end of each period will be used for the next period.

All activities must to be in iteration with various users/departments in mining company. Normally, the controlling department would have some correction on period end closing activities; potential reversals of failed documents are expected in shipping, production and maintenance departments.

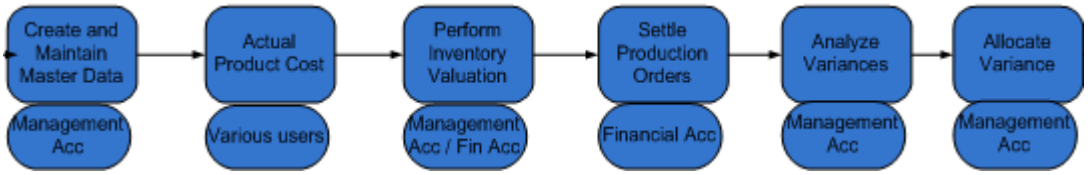

Figure 3: Departments in various phases of cost calculation

In product costing and inventory valuation, the calculation of inventory value is based upon a monthly weighted average. Each phase in coal mining will be numbered in accordance with the type of material and its stage of completion.Production costs will be derived from cost centersthroughallocation to coal product order

Apart from production orders, an investment order should take the main part in mining processes. There are two treatments of investment orders: the costs will be tracked via several accrual orders and accrual orders will be settled on periodic basis; the costs will be settled on fixed assets under construction and post on cost centers via depreciation after activation. The typical examples of these costs are: expropriation, the set up cost, initial concession for rented of mining site and overburden layer.

The presented model is very flexible. The modification of this model is possible and depends of specific of certain mining company.

6. CONCLUSION

The main benefit from establishing of new cost model in mining is cutting of cost in various phase of mining production. Segregation of production& maintenance costs in different phase and monitoring of variances is the base for the improvements of decision process.

Previous authors suggested “Phasing of coal processes” (Epstein, 2012), but nobody from them didn’t develop any comprehensive& analytical model for cost monitoring in different phase of coal processes

as well as presentation of these cost in final product. In this paper, a new modern approach is established through analyzing of all processes and conducting operations in mining companies.

The primary goal of thenew costing model presented in this paper is clear management picture of the cause of each cost. The model establishes the connections among the various cost inductors (cost drivers) in order to give the management the best option for manipulation of the costs. Additionally, themeasurement of the costs of activities is the backbone of the new costing model in mining companies.

The costing model takes into consideration the both capital expenses and operational expenses. The special attention is paid on treatment of costs of overburden layer during mining of coal.

The new costing model in mining company has analytic and holistic feature. It covers all phases in one lifecycle of mining company i.e. from set-up and expropriation till normal exploration of mining site. Also, activities in each phase in mining lifecycle have to be broken on many different parts for better monitoring of each cost.

Thispaper will be the starting point for mining companies to define their costing model and consequently expand their profit by cutting of costs in all phases of lifecycle of mining site. The next step will be practical validation of new costing model through implementation of the model in some mining company in Balkan region.

REFERENCES

International Energy Agency. 2007. World Energy Outlook 2007: China and India Insights. International EnergyAgency. Paris, France.

Lutovac M. and Manojlov D. (2012) „The Successful Methodology for Enterprise Resource Planning (ERP) Implementation“, Journal of Modern Accounting and Auditing, ISSN 1548-6583, December 2012, Vol. 8, No. 12, 1838-1847

Lutovac M. and Manojlov D. (2012), Impact of methodology in the success of enterprise resource planning (ERP) implementation, Paper presented at SymOrg 2012

Oracle, (2014) - Oracle Customers in the Metals & Mining, published by Oracle 2014

Pang C., DharmasthiraY.,Eschinger C., Motoyoshi K. and Brant K. (2014), Market Share Analysis: ERP Software Worldwide

Retrieved from: http://www.breakingthesilenceblog.com/general/family-loses-expropriation-case-against-gold-mine/

Schmidt R., (2013). Description of Basic Mining Legal Principles. Published in Advances in Biochemical Engineering/Biotechnology 2013

Stojanovic C., Ostojić I. (2013): Management model of investment projects by utilizing earned value method, ČasopisRudarskiradovi, Institutzarudarstvoimetalurgij Bor.

XueqiuH.,Hani N.,YunhaiW.,Ting X.,Wenxue C. &Xiangchun L. (2014).Progress in Mine Safety Science and Engineering. Published in Taylor & Francis group London, ISBN 978-1-138-00122-0

Yao X.(2013), Discussion on the Mining area Environmental pollution and Countermeasures of prevention and control - Taking coal mine as the angle of view. Published in Chinese Journal CNKI.

BUSINESS INTELLIGENCE AND DECISION MAKING IN MANAGEMENT

META-HEURISTIC BASED WRAPPER ATTRIBUTE WEIGHTING TECHNIQUES FOR NAÏVE BAYES CLASSIFICATION

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Abstract: *Naïve Bayes is one of the oldest and mostly used data mining algorithms. This is because there are no parameter which needs to be adjusted in order to generate more accurate models. Still Bayesian learner sometimes underperforms due to assumption that all attributes have equal importance. Therefore, it is crucially important to differentiate attributes that influence positively on model accuracy from attributes that don't. In this research, problem of attribute weighting is addressed with four different metaheuristic wrapper attribute weighting techniques. Experiments are conducted on 25 UCI Machine Learning datasets. Additionally, two methodologies for identification of the best performing feature optimization techniques for data at hand based on meta-features (dataset characteristics) was proposed. Further, clustering, with optimized number of clusters, was used to identify similar datasets and relate obtained clusters with performances of different meta-heuristic attribute weighting techniques.*

Keywords*: Attribute weighting, Naïve Bayes, Meta-heuristics, Clustering*

1. INTRODUCTION

In last few decades many cutting edge classification algorithms are developed or improved. Still, naïve Bayesian learning is widely and successfully used many data mining applications like cancer classification (Wu et al., 2012), risk analysis in public procurement (Balaniuk et al., 2013), finance (Humpherys et al., 2011) etc.

Naïve Bayes algorithm is recently selected as one of the most influential algorithm in data mining and it is identified as one of the top 10 algorithm in data mining (Wu et al., 2008). Reason for that ranking is due to its advantage over other algorithms (Hand & Yu, 2001) which are easy to construct, without any setting or adjusting of complex parameters (which needs expert knowledge and experience using specific algorithm), computational and time effectiveness, ability to work with large datasets (big data), interpretability and intuitiveness (final users can understand created model). On the other side, in order to create reliable naïve Bayes model every possible combination of attribute values needs to be present and used for model training. However, this is mainly not the case because there are not enough data in the training set. This problem is bypassed with conditional independence assumption, which means that all attributes are conditionally independent between themselves. Unfortunately, this assumption is often violated, and the final model performance is often trapped in local optimum. Therefore, Bayesian learning can be improved by mitigating this assumption.

Since conditional independence can pose serious threat in many data mining application, two approaches are present in literature. First, conditional independence assumption is relaxed between class label and other attributes (Webb et al., 2012, Zheng et al., 2012). Second approach use attribute weighting techniques in order to calculate predictive value of attributes. This approach (Hall, 2007, Zaidi et al., 2013) can be viewed as process of discovering weight of attributes in order to reduce theirs impact on prediction accuracy due to conditional dependence.

In this research attribute weighting was used. Attribute weighting is process of selection weight vector which will be used to transform dataset values in order to improve predictive accuracy (Guyon et al., 2006). It is used in many data mining or machine learning problems because irrelevant or redundant feature may exists, which further leads to poor classification accuracy. Also, attribute weighting is used to deal with effects of the curse-of-dimensionality if problem contains many irrelevant attributes. In those cases attribute weighting is particularly useful because model training results in exponential increase in the required training data as the number of features are increased.

In this research several meta-heuristic wrapper attribute weighting techniques for Naïve Bayes were evaluated and compared. Namely, those are simulated annealing, variable neighborhood search, and evolutionary Search and particle swarm optimization. Experiments are conducted on 25 datasets obtained on UCI Machine Learning repository (Bache & Lichman, 2013). Additionally, a method for generalization of the

results based on the analysis of the dependence between attribute weighting performances and dataset descriptions (meta-features), which can be obtained on OpenML platform (van Rijn et al., 2013), was proposed. First clusters of datasets with similar characteristics were created. Then, attribute weighting techniques and their performances on different clusters was analyzed. With this approach data analyst should simply identify best attribute weighting algorithm for data at hand and to the best of our knowledge there are no researches that used similar approach. Second, a meta-model for prediction of performance for weighted naïve Bayes algorithm was proposed, which allows data analyst to see which attribute weighting technique will perform best for data at hand.

Even though many feature weighting methods were developed, most of them have been applied in the domain of nearest neighbor algorithms, but using these methods with naïve Bayesian learning received relatively less attention. There have been only a few methods for combining attribute weighting with naïve Bayesian learning (Huang & Wang, 2006, Hall, 2007, Huang & Dun, 2008, Lee et al., 2011).

The remainder of this paper is organized as follows. Section 2 presents weighted naïve Bayes algorithm. Section 3 reviews research methodology and presents results of experiment. In this paper, 4 attribute weighting techniques for Naïve Bayes for classification problems were evaluated. Conclusion and future work are described in Section 4.

2. THEORETICAL CONCEPTS

2.1. WEIGHTED NAÏVE BAYES ALGORITHM

General discussion of the naïve Bayes method, its pros and cons, are given in (Lewis, 1998, Wu et al., 2008). Weighted Naïve Bayes algorithm generalizes ordinary Naïve Bayes algorithm by introduction of attribute weight vector.

The naïve Bayesian learning uses Bayes theorem in order to assign a class label to a new instance. Let $A=a_1, a_2,..., a_n$ be values for feature $f_1, f_2, ..., f_n$ respectively of a new instance d. Let C be the target attribute where c represents the value under C domain. A new instance will be classified to the class with the maximum posterior probability. Mathematically, classifier is defined as follows:

$$V_{mad(d)} = argmax_c\ P(c)\ P\ (A|c) \quad (1)$$

Assuming that all attributes will be independent of the given class value.

$$P(A|c) = \prod_{i=1}^{n} P(a_i|c) \quad (2)$$

Therefore, the maximum posterior classification in Naïve Bayes can be presented as:

$$V_{nb(d)} = \text{argmax}_c\, P(c) \prod_{i=1}^{n} P(a_i|c) \quad (3)$$

Assumption that all features are conditionally independent does not hold in real world application and there have been some attempts to relax this assumption in naïve Bayesian learning. The most logical approach for relaxing this assumption is to weight attributes of given problem. It is shown in previous section that the accuracy of naïve Bayes algorithm can be improved by removing or weighting attributes. This makes sense if these attributes violate the assumption that attributes are independent of each other. When attribute weighting technique is applied to naïve Bayesian learning it can be formalized as follows:

$$V_{awnb(d,w(i))} = argmax_c\ P(c) \prod_{i=1}^{n} P(a_i|c)^{w(i)} \quad (4)$$

where $w(i) \in [0, 1]$

In this formula each attribute i has its own weight $w(i)$, where $w(i)$ presents significance or predictive value of attribute i with values between zero and one. It presents generalization of attribute selection problem (in attribute selection problems $w(i) \in \{0, 1\}$). Considering that attribute weighting can have infinite number of combinations. Therefore, use of intelligent search over space of values is required.

If weights are appropriate it can reduce the error of classification. For example, if some attribute does not have variance, the weight of that attribute could be set to zero, because it does not have any predictive value. Similarly, if there are at least two attributes, which are perfectly correlated between each other, then one of them is unnecessary. Therefore, weight of one of them could one and weight of other one zero. The other solution is to both of them have weight 0.5 ($1/a$ in general case, where a is number of perfectly correlated attributes).

In general, attribute weighting is strictly more powerful than attribute selection as it is possible to obtain at least the same result as attribute selection, due to generalization property.

2.2. WRAPPER FEATURE WEIGHTING OPTIMIZATION TECHNIQUES

In this research 4 wrapper attribute weighting techniques were analyzed:

- Simulated annealing (SA) is single unit local search metaheuristic that simulate process of annealing of solids and is best known for solving large combinatorial optimization problems. Analogy to physics, annealing is a physical process in which a solid in heated up a heat bath at a maximum temperature, where all particles of the solid randomly arrange themselves, followed by slowly lowering the temperature of the heat bath. This way, all particles of heated solid arrange themselves in the low energy ground state of a corresponding lattice (optimal state). In this research initial maximum temperature were 0.9, cooling to 0.4 with step of 50%. At each step 15 naïve Bayes algorithms were evaluated with maximum 20% Gaussian change of attribute value. (Laarhoven & Aarts, 1987)
- Variable Neighborhood Search (VNS) is also single unit local search metaheuristic which change neighborhood in order to avoid being trapped in local optima. It is well known for solving complex combinatorial problems (Hansen et al., 2010). Contrary to many local search metaheuristics VNS does not follow trajectory, but explore distant parts of feasible space and jump to better solution. This way most variables with optimal values will be kept and used. For exploring neighborhood another local search method must be used. In this setting as method that explores attribute weight space SA that use 10 naïve Bayes algorithms at each step was used. Additionally, three neighborhoods were used, each expanding its boundaries by 20%. (Mladenović & Hansen, 1997)
- Evolutionary Search (ES) is inspired by adaptation of many species to new-come problems and it is generalization of genetic algorithm. This adaptation is search for good enough solution over huge number of genotype (Hinton & Nowlan, 1987). It is population metaheuristic requiring number of units in population and number of generations. In this experimental setting three units were used evolving in 10 generations. In each generation tournament selection scheme were used with 25% size and 20% of variance as adaptation parameter. Crossover of unit is uniform. (Goldberg, 1989)
- Particle Swarm Optimization (PSO) is population metaheuristic inspired by simplified social model of bird flocking, fish schooling and swarming theory in general. Similarly as ES, it needs unit size and number of generations. It gained popularity because it is intuitive and became one of the most used population metaheuristics in general (Poli et al., 2007). In this research three units, which evolved in 10 generations were evaluated.

3. RESEARCH METHODOLOGY AND RESULTS

General idea of this research is to identify good performing wrapper optimization techniques for new datasets without the need for evaluation of all feature optimization techniques. And so, experiments are divided in two parts. First, datasets are clustered based on their meta-features. In order to determine whether there are connections between similar datasets (similar meta-features) and performances of different feature weighting techniques. Second, feature weighting techniques are evaluated by the means of the classification accuracy of Naïve Bayes on every algorithm. These performances are related to different clusters. Experiment was implemented in RapidMiner (Mierswa et al., 2006).

Data used in our experiments originate from UCI Machine Learning repository (Bache & Lichman, 2013) and list of dataset with basic details is shown in Table 1.

Table 1: Benchmark datasets from UCI repository used in this study

Dataset	Classes	Attributes	Size
anneal	6	39	898
anneal-orig	6	39	898
audiology	24	70	226
breast cancer	2	10	286
bridges	6	13	107
car	4	7	1728
cmc	3	10	1473
credit german	2	21	1000
dermatology	6	35	366
haberman	2	4	306

kr-vs-kp	2	37	3196
kropt	18	7	28056
mfeat-pixel	10	241	2000
mushroom	2	23	8124
nursery	5	9	12960
postoperative-patient-data	3	9	90
primary-tumor	22	18	339
soybean	19	36	683
splice	3	62	3190
tae	3	6	151
tic-tac-toe	2	10	958
trains	2	33	10
vote	2	17	435
vowel	11	14	990
zoo	7	18	101

First part of this experimental study was clustering of datasets by their characteristics with K-means algorithm. In order to create better clustering several models with different number of clusters (from 2 to 5) and cluster quality is measured by Davies Bouldin index (Davies & Bouldin, 1979). Minimum value of Davies–Bouldin index indicates the best clustering solution. Optimal number of clusters based on Davies-Bouldin index is three. Cluster centroids are shown in Figure 1.

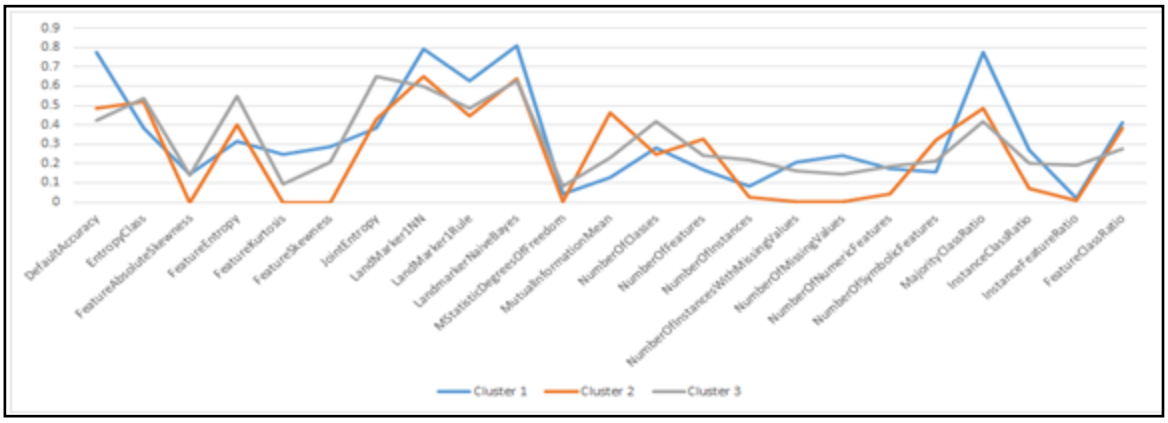

Figure 1: Values of cluster centroids

From Figure 1 difference between characteristics of datasets in different clusters.

First cluster is characterized by:

- High class imbalance - cluster have high values of LandMarker meta-features and MajorityClassRatio.
- Mising values - cluster have high values: NumberOfMissingValues and NumberOfInstances with missing values.
- High kurtosis and skewness.

Second cluster is characterized by:

- High number of symbolic and low number of numeric features.
- Low level of missing values.
- Low Instance/class and instance/feature ratios.
- Low kurtosis and skewness.

Third cluster is characterized by:

- Balanced classes - high values of FeatureEntropy and JointEntropyand low values of MajorityClassRatioand DefaultAccuracy.
- Large number of classes and instances.

Further, evaluation of each feature weighting algorithms on each dataset is performed. In order to prevent over training by feature optimization, each wrapper was trained and evaluated on 70% with 10-fold cross validation. Each dataset is divided into 10 subsets with the same number of different classes (stratified

sampling). Final evaluation of weighted Naïve Bayes performance is done on 30% of the data (unseen cases).

Table 2: Average accuracy and standard deviation of attribute weighting groups

Dataset	Algorithm					Cluster
	Default	SA	VNS	ES	PSO	
anneal	0.61360 (±0.04231)	0.62030 (±0.05916)	0.57432 (±0.02983)	*0.79709 (±0.11743)*	**0.93425 (±0.15232)**	Cluster 1
anneal-orig	0.60359 (±0.04583)	0.63567 (±0.03834)	0.65646 (±0.03317)	*0.81751 (±0.16661)*	**0.93115 (±0.17675)**	Cluster 1
audiology	*0.80099 (±0.05196)*	0.78340 (±0.05196)	0.67629 (±0.07733)	0.80099 (±0.07092)	**0.80138 (±0.13390)**	Cluster 1
breast cancer	0.71416 (±0.10412)	0.70714 (±0.08222)	0.71737 (±0.08591)	**0.72451 (±0.10218)**	*0.71761 (±0.09360)*	Cluster 2
bridges	**0.65273 (±0.07192)**	0.63364 (±0.07969)	0.49636 (±0.09915)	0.62636 (±0.06140)	*0.63455 (±0.10344)*	Cluster 3
car	**0.86400 (±0.02191)**	*0.77427 (±0.01949)*	0.76396 (±0.06156)	0.71759 (±0.07662)	0.77034 (±0.05908)	Cluster 3
cmc	*0.49763 (±0.04615)*	0.49427 (±0.04626)	**0.49767 (±0.04195)**	0.47255 (±0.04980)	0.49084 (±0.04472)	Cluster 3
credit german	*0.75400 (±0.03000)*	**0.75400 (±0.02450)**	0.73800 (±0.02049)	0.74200 (±0.02933)	0.74200 (±0.02049)	Cluster 3
dermatology	0.87710 (±0.03886)	0.87432 (±0.04254)	0.88514 (±0.04604)	**0.91802 (±0.04266)**	*0.90165 (±0.05079)*	Cluster 2
haberman	**0.75828 (±0.04583)**	0.73882 (±0.04528)	*0.74839 (±0.04528)*	0.74172 (±0.03674)	0.74172 (±0.04313)	Cluster 3
kr-vs-kp	0.87734 (±0.02000)	0.83637 (±0.01949)	0.79037 (±0.01844)	*0.87797 (±0.04074)*	**0.91332 (±0.06261)**	Cluster 1
kropt	**0.36032 (±0.00707)**	0.30589 (±0.00633)	0.28212 (±0.00633)	*0.34902 (±0.04960)*	0.34902 (±0.05148)	Cluster 3
mfeat-pixel	0.92400 (±0.01581)	*0.92400 (±0.01483)*	0.91550 (±0.01673)	**0.92550 (±0.01789)**	0.92200 (±0.02098)	Cluster 2
mushroom	0.99397 (±0.00316)	0.97772 (±0.00204)	0.94092 (±0.00216)	*0.99742 (±0.03131)*	**0.99852 (±0.17731)**	Cluster 1
nursery	**0.90340 (±0.07120)**	0.76605 (±0.05621)	0.62940 (±0.07120)	0.89452 (±0.17731)	*0.89552 (±0.17237)*	Cluster 3
postoperative-patient-data	0.38889 (±0.08956)	*0.42222 (±0.08313)*	0.34444 (±0.21081)	0.42222 (±0.21545)	**0.55556 (±0.20154)**	Cluster 1
primary-tumor	**0.46052 (±0.07589)**	0.43369 (±0.05431)	0.42184 (±0.05119)	*0.46034 (±0.04604)*	0.44269 (±0.05577)	Cluster 3
soybean	**0.93704 (±0.02915)**	0.92389 (±0.03017)	0.90475 (±0.02366)	*0.93408 (±0.02828)*	0.93263 (±0.03688)	Cluster 3
splice	*0.95486 (±0.00633)*	0.93350 (±0.00447)	0.89154 (±0.00633)	0.95486 (±0.02429)	**0.95643 (±0.05441)**	Cluster 1
tae	*0.53708 (±0.15210)*	0.49667 (±0.13000)	0.45125 (±0.14149)	**0.53708 (±0.13035)**	0.53042 (±0.16709)	Cluster 3
tic-tac-toe	0.70046 (±0.03808)	0.70147 (±0.03256)	0.68894 (±0.02775)	**0.72972 (±0.04796)**	*0.72445 (±0.03317)*	Cluster 2
trains	*0.40000 (±0.49000)*	*0.40000 (±0.49000)*	**0.50000 (±0.49000)**	*0.40000 (±0.49000)*	*0.40000 (±0.50000)*	Cluster 3
vote	*0.90312 (±0.04427)*	**0.91237 (±0.04313)**	0.89408 (±0.04159)	0.87336 (±0.03755)	0.89176 (±0.04278)	Cluster 3
vowel	**0.62525 (±0.04680)**	*0.59394 (±0.06573)*	0.47172 (±0.05718)	0.58384 (±0.07962)	0.57677 (±0.13576)	Cluster 3
zoo	0.95000 (±0.05000)	**0.97000 (±0.04914)**	0.92091 (±0.04827)	*0.95091 (±0.04583)*	0.94091 (±0.08701)	Cluster 2
First	8	3	2	5	7	
Second	7	5	1	9	6	

Performances and standard deviation are presented in Table 2 (cluster labels from previous experiment are also added). The best performance on each dataset was bolded, while second performance was presented in italic. The bottom rows show number of best and second best performances of each attribute weighting technique through all datasets. As we see default setting of naïve Bayes algorithm performed best 8 times and were second 7 times. The best attribute weighting technique was PSO, which performed best 7 times and second 6 times. ES performed best 5 times and were second 9 times. SA has also shown good performances having 3 best and 5 second best performances. VNS performed worst of tested metaheuristics having only two best performances and one second best performance.

Detailed analysis of the classification performances and clusters showed that on cluster 1 PSO have outperformed other algorithms, especially anneal and anneal-orig where difference was greater than 10% to second best and greater than 25% to others. On second cluster ES performed better than other algorithms, while on third cluster default naïve Bayes algorithm was mostly the best. This brings to conclusion that PSO performs well on highly imbalanced datasets, while ES performs good on datasets where there are low number of instances and high number of symbolical features.

4. CONCLUSION

In this paper meta-heuristic based attribute weighting techniques were evaluated in order to improve performance of Naïve Bayes algorithm. Four wrapper metaheuristic attribute weighting techniques were tested on 25 UCI datasets. Experiments showed that metaheuristic attribute weighting techniques in some cases improved performance of naïve Bayes algorithm. In order to generalize the results we clustered datasets by their meta-features (characteristics). Generated clusters identified groups where different metaheuristics performed well. Therefore, conclusion is that attribute weighting can influence performance of algorithm but also that it depends on dataset meta-features. In order to further generalize this assumption it is necessary to conduct all these experiments on more datasets As a part of our future work we plan to use described methodology on other algorithms (like SVMs and Neural Networks) Also, we plan to broaden the analysis with different types of attribute weighting techniques, such as statistical or information theory models.

REFERENCES

Bache, K., & Lichman, M. (2013). UCI machine learning repository. Irvine, CA: University of California, School of Information and Computer Science.

Balaniuk, R., Bessiere, P., Mazer, E., & Cobbe, P. (2013). Collusion and Corruption Risk Analysis Using Naïve Bayes Classifiers. In *Advanced Techniques for Knowledge Engineering and Innovative Applications* (pp. 89-100). Springer Berlin Heidelberg. DOI=http://dx.doi.org/10.1007/978-3-642-42017-7_7.

Davies, D. L., & Bouldin, D. W. (1979). A cluster separation measure. *Pattern Analysis and Machine Intelligence, IEEE Transactions on*, (2), 224-227. DOI = http://dx.doi.org/10.1109/TPAMI.1979.4766909.

Goldberg, D. E. (1989). Genetic algorithms in search, optimization, and machine learning (Vol. 412). Reading Menlo Park: Addison-Wesley.

Guyon, I., Gunn, S., Nikravesh, M., & Zadeh, L. (2006). Feature extraction. *Foundations and applications*. Springer Berlin Heidelberg. DOI=http://dx.doi.org/10.1007/978-3-540-35488-8.

Hall, M. (2007). A decision tree-based attribute weighting filter for naive Bayes. *Knowledge-Based Systems*, 20(2), 120-126. DOI = http://dx.doi.org/10.1016/j.knosys.2006.11.008.

Hand, D. J., & Yu, K. (2001). Idiot's Bayes—not so stupid after all?.*International Statistical Review, 69*(3), 385-398. DOI=http://dx.doi.org/10.1111/j.1751-5823.2001.tb00465.x.

Hansen, P., Mladenović, N., & Pérez, J. A. M. (2010). Variable neighbourhood search: methods and applications. *Annals of Operations Research, 175*(1), 367-407. DOI=http://dx.doi.org/10.1007/s10479-009-0657-6.

Hinton, G. E., &Nowlan, S. J. (1987). How learning can guide evolution. *Complex systems, 1*(3), 495-502. DOI = http://dx.doi.org/10.1016/j.dss.2010.08.006.

Huang, C. L., & Dun, J. F. (2008). A distributed PSO–SVM hybrid system with feature selection and parameter optimization. *Applied Soft Computing, 8*(4), 1381-1391. DOI = http://dx.doi.org/10.1016/j.asoc.2007.10.007.

Huang, C. L., & Wang, C. J. (2006). A GA-based feature selection and parameters optimizationfor support vector machines. *Expert Systems with applications, 31*(2), 231-240. DOI = http://dx.doi.org/10.1016/j.eswa.2005.09.024.

Humpherys, S. L., Moffitt, K. C., Burns, M. B., Burgoon, J. K., & Felix, W. F. (2011). Identification of fraudulent financial statements using linguistic credibility analysis. *Decision Support Systems*, *50*(3), 585-594. DOI=http://dx.doi.org/10.1016/j.dss.2010.08.009.

Laarhoven, P. V., & Aarts, E. H. L. (1987). Simulated annealing: theory and applications. *Mathematics and its applications*. Springer Netherlands.

Lee, C. H., Gutierrez, F., & Dou, D. (2011, December). Calculating feature weights in naive bayes with kullback-leibler measure. In *Data Mining (ICDM), 2011 IEEE 11th International Conference on* (pp. 1146-1151). IEEE.

Lewis, D. D. (1998). Naive (Bayes) at forty: The independence assumption in information retrieval. In *Machine learning: ECML-98* (pp. 4-15). Springer Berlin Heidelberg.

Mierswa, I., Wurst, M., Klinkenberg, R., Scholz, M., & Euler, T. (2006, August). Yale: Rapid prototyping for complex data mining tasks. In *Proceedings of the 12th ACM SIGKDD international conference on*

Knowledge discovery and data mining (pp. 935-940). ACM. DOI=http://dx.doi.org/10.1145/1150402.1150531.

Mladenović, N., & Hansen, P. (1997). Variable neighborhood search. *Computers & Operations Research, 24*(11), 1097-1100. DOI=http://dx.doi.org/10.1016/S0305-0548(97)00031-2.

Poli, R., Kennedy, J., & Blackwell, T. (2007). Particle swarm optimization. *Swarm intelligence, 1*(1), 33-57. DOI=http://dx.doi.org/10.1007/s11721-007-0002-0.

van Rijn, J. N., Bischl, B., Torgo, L., Gao, B., Umaashankar, V., Fischer, S., ... & Vanschoren, J. (2013). OpenML: A Collaborative Science Platform. In *Machine Learning and Knowledge Discovery in Databases* (pp. 645-649). Springer Berlin Heidelberg. DOI=http://dx.doi.org/10.1007/978-3-642-40994-3_46.

Webb, G. I., Boughton, J. R., Zheng, F., Ting, K. M., & Salem, H. (2012). Learning by extrapolation from marginal to full-multivariate probability distributions: decreasingly naive Bayesian classification. *Machine Learning, 86*(2), 233-272. DOI=http://dx.doi.org/10.1007/s10994-011-5263-6.

Wu, M. Y., Dai, D. Q., Shi, Y., Yan, H., & Zhang, X. F. (2012). Biomarker identification and cancer classification based on microarray data using laplace naive bayes model with mean shrinkage. *IEEE/ACM Transactions on Computational Biology and Bioinformatics (TCBB), 9*(6), 1649-1662. DOI=http://dx.doi.org/10.1109/TCBB.2012.105.

Wu, X., Kumar, V., Quinlan, J. R., Ghosh, J., Yang, Q., Motoda, H., ...& Steinberg, D. (2008). Top 10 algorithms in data mining. *Knowledge and Information Systems, 14*(1), 1-37. DOI=http://dx.doi.org/10.1007/s10115-007-0114-2.

Zaidi, A. N., Cerquides J., Carman J. M., & Webb I. G. (2013).Alleviating Naive Bayes Attribute Independence Assumption by Attribute Weighting. *Journal of Machine Learning Research, 14*, 1947-1988.

Zheng, F., Webb, G. I., Suraweera, P., & Zhu, L. (2012). Subsumption resolution: an efficient and effective technique for semi-naive Bayesian learning. *Machine learning, 87*(1), 93-125. DOI=http://dx.doi.org/10.1007/s10994-011-5275-2.

ANALYSIS OF ETL PROCESS DEVELOPMENT APPROACHES: SOME OPEN ISSUES

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Abstract: *The focus of this paper is the development of the Extract-Transform-Load (ETL) process, as one of the most crucial and demanding phases in the data warehouse development process. Because the development of these processes is extremely complex and time-consuming and requires significant financial resources, there is a growing need for its formalization and automation. Furthermore, it can be argued that this requirement becomes even more important in light of the constant changes in the business and technological environments and the demand for data warehouses to rapidly absorb these changes. A good deal of research effort has been dedicated to this issue and an analysis of the most relevant approaches has been given in this paper with the aim of exploring the possibility for the further improvement of ETL process development. To this end some open issues, which have not been fully addressed by the reviewed approaches, have been identified and discussed.*

Keywords*: ETL process, data warehouse, formalization, automation, MDD, DSM*

1. INTRODUCTION

The aim of data warehouse systems, as a specific type of information system, is to support the decision-makers in making better and faster business decisions in a constantly changing and increasingly demanding business environment, by providing them with the necessary tools for transforming business data into strategic information. In other words, in order to be competitive in such an environment the establishment of a data warehouse (DW), in which all of the relevant business data can be easily stored, processed and analyzed (i.e. transformed into strategic business information), becomes imperative. According to *(Jarke, Lenzerini, Vassiliou, & Vassiliadis, 2003)* data warehouses are expected to have the right information in the right place at the right time with the right cost in order to support the right decision.

The substantial body of existing research in the field of data warehousing has already significantly promoted the understanding of this domain and led to considerable progress being made with regard to the formalization and automation of data warehouse development. Various reference architectures have been proposed *(Golfarelli & Rizzi, 2009; Kimball, Ross, Thornthwaite, Mundy, & Becker, 2010; Linstedt & Graziano, 2011)* along with a number approaches for data warehouse development *(Luján-Mora & Trujillo, 2004; ; Mazón & Trujillo, 2008; Golfarelli & Rizzi, 2009; Kimball, Ross, Thornthwaite, Mundy, & Becker, 2010; Linstedt & Graziano, 2011; Corr & Stagnitto, 2011)* which provide guidelines for the use of particular architectures, prescribe the necessary activities and the order of their execution and recommend the artifacts that need to be created. At the same time, different data models have been developed specifically for the data warehouse domain, in order to enable the fulfillment of the specific requirements regarding the structuring of data, such as the Anchor Model *(Regardt, Rönnbäck, Bergholtz, Johannesson, & Wohed, 2009)*, Data Vault *Model (Linstedt & Graziano, 2011; Jovanović & Bojičić, 2012; Jovanović, Bojičić, Knowles, & Pavlić, 2012)* and the prominent Dimensional Model *(Kimball, Ross, Thornthwaite, Mundy, & Becker, 2010; Adamson, 2010)*.

In addition, research and practice have also focused on one of the most demanding phases in the data warehouse development process – the development of the process for the acquisition and integration of business data, its transformation into appropriate strategic business information and the subsequent storage of the transformed data in a format that facilitates business analysis (the Extract-Transform-Load process – ETL). The transformation process involves the execution of a set of activities through which the actual data transformations are achieved.

The design of appropriate ETL processes (which adequately fulfill their purpose) requires overcoming several challenges. First, it is necessary to integrate the available business data coming from diverse data sources which are usually very heterogeneous in nature (i.e. they may be based on different technologies, use various data models etc.). In order to resolve the numerous structural and semantic conflicts that may exist, a wide array of transformations must be performed. Furthermore, such transformed data must then be

translated into a form suitable for its further analysis. On the other hand, the sheer volume of data that is to be gathered, processed, stored and delivered, imposes strict constraints not only regarding the way the data must be structured but also with regard to the requirements related to the performance and scalability of data warehouse systems. Finally, these processes must be designed to be flexible so that they are able to respond to the constant changes not only in the state and structure of existing data sources (while at the same time allowing for the inclusion of new data sources) but also to the changes in business requirements (imposed by the dynamic business environment). A change in business requirements calls for new business analysis to be conducted, which in turn means that new strategic information must be provided. In other words, according to *(El Akkaoui, Mazón, Vaisman, & Zimányi, 2012)* in order to address the requirement for agile and flexible ETL tools (which can quickly produce and modify executable code based on constantly changing needs of the dynamic business environment) ETL processes must be able to easily identify which data is required and how to include it in the data warehouse. Taking this into consideration, it could be said that the manner in which these processes are designed and implemented significantly impacts the quality of the obtained information, and consequently the usability and success of the system as a whole. Moreover, it has been shown that as much as 70% of the time and effort invested in the development of data warehouses is spent on the development of ETL processes *(Kimball & Caserta, 2004; Kimball, Ross, Thornthwaite, Mundy, & Becker, 2010)*. Consequently, it is evident that an appropriate methodological approach for the development of ETL processes must be adopted.

Due to the fact that the development of ETL processes is extremely complex and time-consuming and that it requires significant financial resources, there is a growing need for the formalization and automation of their development and a good deal of research effort has been dedicated to this issue. An analysis of the most relevant approaches, proposed during the past couple of decades for ETL process development, will be given in this paper. However, it is also the aim of this paper to show that these approaches, despite their significant contribution, still have not managed to adequately resolve some of the problems inherent to this process such as: high development and maintenance expenses, low productivity, failure to adequately satisfy user requirements, etc. As previously stated, these problems stem from the complexity of modern business systems, frequent changes in the organizational and technological environment and the emerging need for businesses to adapt to these changes, especially in recent years in light of the pervasiveness of the Internet and the transition to e-business.

Therefore, an analysis of the most relevant approaches for ETL process development will be given in the following section and some open issues, which have not been fully addressed by the reviewed approaches, will be identified and discussed. This section is divided into two subsections which correspond to the actual phases of ETL process development, namely their specification and the subsequent implementation of the given specification. Finally, Section 3. concludes the paper and gives an outline of a possible solution to some of the identified issues which is intended as a subject of further work in this area.

2. ANALYSIS OF RELEVANT APPROACHES

The existing body of research on ETL process development is constantly expanding to respond to the growing need for the formalization and automation of the development. The leading approach to software development today is Model Driven Development (MDD). The main goal of MDD is to enable the automation of software development in order to increase development productivity, reduce development time and cost, and improve the quality and flexibility of the obtained solution. To this end it promotes the use of abstractions which enable the analysis of a problem at different levels of detail. MDD is based on the premise that the most important product of software development is not the source code itself but rather the models representing the knowledge about the system that is being developed. In other words, in MDD, models are primary software artifacts and the development process is automated through appropriate model transformations which should ultimately result in a concrete implementation i.e. executable code. In light of the complexity of ETL processes and the problems related to their development (as explained in Section 1.) it can be stipulated that they should be developed in accordance with the MDD approach. It should be emphasized that in order to enable automatic model transformations the models must be formal. Therefore, in the next subsections an analysis of the most relevant approaches proposed for the formal specification of ETL processes will be given as well as an analysis of the different approaches for the automated implementation of such specifications. Moreover some open issues will be identified and discussed.

ETL Process Specification

The first phase in ETL process development is the specification (i.e. conceptual modeling) of ETL processes. The main goal of this phase is to define “what” the software solution should provide in terms of its basic functionality. In other words, conceptual models are high-level abstractions representing the knowledge i.e. semantics of the system that is being developed. Since ETL process development presumes the active

participation of domain experts (as they possess the necessary in-depth understanding of the domain) the modeling languages, used for the specification of ETL processes, should be easily understandable not only to software developers but also to the domain experts. According to *(Fowler, 2010)* communication between software developers and domain experts is the most common source of project failure. Therefore, it can also be stipulated that the models should be expressed in terms of concepts specific to this particular domain i.e. the concepts and terms used by the domain experts. In addition, the modeling languages should also be as simple as possible (that is, they should provide a minimal set of necessary concepts) but at the same time semantically rich to enable the specification of the various aspects of the ETL process domain at the appropriate level of abstraction. Finally, if the modeling languages are to properly represent the domain concepts, along with their semantics, they should also include the rules of the domain to ensure the correct usage of the concepts. These rules should be included in the modeling languages to prevent structural and semantic mistakes.

Thus far, two distinctive approaches have emerged for realizing MDD, which differ primarily in the languages used for the specification of the models. One advocates the use of general purpose modeling languages (GPMLs) and their extension, while the other advocates the use of specially designed domain-specific languages (DSLs). It could be said that, in general, the existing body of research on ETL process development can be classified along the same lines.

Based on the premise that ETL processes can be regarded as a special type of business process, and emphasizing the need for standardization, the use of existing general purpose modeling languages (such as Unified Modeling Language – UML or Business Process Model and Notation – BPMN) has been proposed for the conceptual modeling of ETL processes. These languages have been appropriately extended in order to incorporate the concepts specific to the ETL process domain. More precisely, the extension of UML has been proposed in *(Trujillo & Luján-Mora, 2003; Luján-Mora, Vassiliadis, & Trujillo, 2004; Muñoz, Mazón, Pardillo, & Trujillo, 2008; Muñoz, Mazón, & Trujillo, 2009)*, while the extension of BPMN has been proposed in *(El Akkaoui & Zimányi, 2009; El Akkaoui, Zimányi, Mazón, & Trujillo, 2011; El Akkaoui, Mazón, Vaisman, & Zimányi, 2012).* However, it can be argued that since GPMLs were envisaged to support the description of the various aspects of any given business process in any given domain (in order to promote standardization) they include a large number of domain-neutral concepts which are defined at a low level of abstraction. According to *(Kelly & Tolvanen, 2008)* GPMLs do not raise the level of abstraction above code concepts. The complexity of these languages (i.e. too many concepts whose semantics are imprecise) along with the fact that they are often too technical for domain-experts to master, lead to a number of issues related to the acceptance, utilization and value of these languages. Furthermore, since the core GPMLs do not contain knowledge of a particular domain, different concepts could be used and connected regardless of the domain rules *(Kelly & Tolvanen, 2008).* In other words, it is up to the designer to know the semantic rules (e.g. the legal connections and structures, the necessary data etc.) and ensure that they are fulfilled when defining the specification. It can further be argued that the extension of these languages only adds to their complexity while most of the drawbacks of GPMLs still remain. Moreover, in order to extend these languages it is necessary to be familiar with their concepts in order to be able to identify those which can be specialized.

At the same time, the use of DSLs which are tailored to a particular domain has also been proposed in *(Vassiliadis, Simitsis, & Skiadopoulos, 2002, May; Vassiliadis, Simitsis, & Skiadopoulos, 2002, November; Vassiliadis, Simitsis, Georgantas, & Terrovitis, 2003; Simitsis & Vassiliadis, A methodology for the conceptual modeling of ETL processes, 2003; Vassiliadis, Simitsis, Georgantas, Terrovitis, & Skiadopoulos, 2005; Simitsis, Vassiliadis, Terrovitis, & Skiadopoulos, 2005; Simitsis, 2005; Simitsis & Vassiliadis, 2008)*. The main benefit of DSLs, according to *(Kelly & Tolvanen, 2008)* is that, unlike GPMLs, they raise the level of abstraction beyond current programming languages and their abstractions, by specifying the solution in a language that directly uses the concepts and rules from a particular problem domain. Furthermore, they state that with GPMLs it is not possible to know how and when to reuse data from models, check design correctness based on the domain, separate the model data into different aspects relevant in the domain and so on, for the simple reason that these are impossible to standardize as they differ from one domain and company to another. The aim of DSLs is to provide only a minimal set of domain-specific concepts, with clear and precise semantics, along with a set of strict rules controlling their usage and the way in which they can be composed. Since DSLs allow for the inclusion of domain rules (in the form of constraints) both the syntax and the semantics of the concepts can be controlled, thus incorrect or incomplete designs can be prevented by making them impossible to specify. Therefore, in comparison with GPMLs, DSLs are more expressive (i.e. they enable a precise and unambiguous specification of the problem) while at the same time being more understandable and easier to use by domain experts (since they do not include unnecessary general purpose concepts). In addition, the use of such languages facilitates communication among the various stakeholders (from both the business as well as the technical communities) thereby promoting teamwork which is one of the main principles of current agile approaches to software development.

It can, thus, be concluded that since DSLs allow for the formalization of semantically rich abstractions (which capture the existing knowledge and experience in the ETL domain) they are more appropriate for the formal specification of ETL processes.

On the other hand, taking into account the complexity of ETL processes, it is obvious that the various aspects of an ETL process (e.g. the control flow, the data flow, etc.) should be modeled separately else the specification would lead to an overly complex, convoluted model, in which all of the various aspects of an ETL process are interwoven. Though such approaches have been proposed, it should be noted that in most of them the authors have only focused on some of the aspects of an ETL process. Specifically, in *(Vassiliadis, Simitsis, & Skiadopoulos, 2002, November; Simitsis & Vassiliadis, 2003)* an approach for the "conceptual" modeling of ETL processes (i.e. for the specification of the mappings and the transformations needed in an ETL process) is given which, however, does not enable the specification of the execution order of the transformations. Next, in *(Vassiliadis, Simitsis, & Skiadopoulos, 2002, May; Vassiliadis, Simitsis, Georgantas, & Terrovitis, 2003; Vassiliadis, Simitsis, Georgantas, Terrovitis, & Skiadopoulos, 2005; Simitsis, Vassiliadis, Terrovitis, & Skiadopoulos, 2005)* the authors move their focus to the "logical" modeling of ETL processes in order to describe the data flow i.e. to describe the route of data from the sources towards the data warehouse, as they pass through the activities. The authors then state that it is actually the combination of the data flow (i.e. what each activity does) and the execution sequence (i.e. the order and combination of activities) that generates the semantics of the ETL workflow. Consequently, in *(Simitsis, 2005; Simitsis & Vassiliadis, 2008)* they propose a semi-automatic transition from the conceptual model to the logical model, along with a method for the determination of the correct execution order of the activities in the logical workflow using information adapted from the conceptual model. The approach proposed in *(Trujillo & Luján-Mora, 2003)* also deals only with the static aspect of an ETL process and the authors then expound on the proposed approach in *(Luján-Mora, Vassiliadis, & Trujillo, 2004)* to allow for tracing the flow of data at various degrees of detail. In *(Muñoz, Mazón, Pardillo, & Trujillo, 2008; Muñoz, Mazón, & Trujillo, 2009)* the authors recognize the need for the modeling of the dynamic aspects (i.e. behavior) of an ETL process and therefore propose an approach in which the elements of an ETL process are specified at the highest level of abstraction while, the flow of sequence of activities of an ETL process (i.e. the control flow) is specified at the lower level of abstraction. Finally, in *(El Akkaoui & Zimányi, 2009; El Akkaoui, Zimányi, Mazón, & Trujillo, 2011; El Akkaoui, Mazón, Vaisman, & Zimányi, 2012)* the authors propose an approach which allows for the modeling of both the control flow and data flow. However, it can be argued that the use of a single modeling language (be it an extended GPML or a DSL) would not be conducive since it would include a vast amount of disparate concepts. It is therefore stipulated that each aspect of an ETL process should be modeled by a separate language, which should include only the concepts which are relevant for that particular aspect, thereby keeping the languages straightforward and easy to use. These languages would then constitute a conceptual framework for ETL process specification.

As a final point it should be emphasized that some of these approaches do not provide explicit concepts which allow for the formal definition of the semantics of the data transformations. For example, in *(Vassiliadis, Simitsis, & Skiadopoulos, 2002, November; Simitsis & Vassiliadis, 2003; Luján-Mora & Trujillo, 2004)* notes or annotations are used for the explanation of the semantics of the transformations (e.g. type, expression, conditions, constrains etc.), while in *(Trujillo & Luján-Mora, 2003)* even the actual attribute mappings are defined through notes. Since in these approaches the authors allow for the notes to be given in a natural language (and often without any restrictions on their content) they do not represent a formal specification. However, in order to enable automated development, MDD requires that the models be formally expressed. It can therefore, be stipulated that it is necessary to provide the means for formally specifying the data transformation semantics and the approaches proposed *in (Muñoz, Mazón, Pardillo, & Trujillo, 2008; El Akkaoui & Zimányi, 2009; El Akkaoui, Zimányi, Mazón, & Trujillo, 2011; El Akkaoui, Mazón, Vaisman, & Zimányi, 2012)* have, to some extent, managed to address this issue.

ETL Process Implementation

The second phase in ETL process development is the actual implementation of the ETL process specification. It should first be emphasized that only a few approaches exist which enable the automated development of ETL processes in the context of MDD. Generally, in order to enable the automation of the development in accordance with MDD, it is necessary to first map the domain concepts to design concepts and then on to programming language concepts. The way in which the actual automation of software development is achieved (Model Driven Architecture - MDA or Domain Specific Modeling - DSM) is another point of difference between the general purpose approach and the domain-specific approach.

In the MDA approach, software development can be partially or fully automated through the successive application of model transformations, starting from the model representing the specification of the system (i.e. the conceptual model) and ending in a model representing the detailed description of the physical

realization, from which the executable code can ultimately be generated. The development of ETL processes in accordance with the MDA approach is proposed in *(Muñoz, Mazón, Pardillo, & Trujillo, 2008; Mazón & Trujillo, 2008)*. Thus, the conceptual models are defined as platform independent models – PIM which are then automatically transformed into platform specific models – PSM (through a set of formally defined transformations) from which the code (necessary to create data structures for the ETL process in the corresponding platform) can be derived. However, since the PSMs must be specially designed for a certain technology of ETL processes (i.e. each PSM must be based on the resources of a specific technology) the proposed approach presumes that a metamodel must be manually defined for each specific tool in order to create the transformations from the proposed conceptual model to each deployment platform. On the other hand, the MDA approach in general, is based on the refinement of models through successive model transformations, yet this process usually also requires that the automatically generated models be manually extended with additional details. These manual extensions could lead to a discrepancy between the original and generated models (i.e. the original models would become obsolete). This discrepancy is further emphasized when the modification of models, that were previously created by partial generation, is required. Since the correct modification of these models remains an unresolved issue, MDA advocates using a single GPML, namely UML, at all the levels (thereby lowering the abstraction levels of models) which not only entails all of the previously discussed issues regarding the use of GPMLs for modeling ETL processes, but also brings additional complexity to the development of model transformations *(Fowler, 2010)*. Thus, an improvement of the proposed approach has been suggested in *(El Akkaoui, Zimányi, Mazón, & Trujillo, 2011)* to directly obtain the code corresponding to the target platform, bypassing the need for the defining of an intermediate representation (metamodel) of the target tool. Thus, the conceptual model can be automatically transformed into the required vendor-specific code to execute the ETL process on a concrete platform.

On the other hand, in the DSM approach the implementation is automatically generated from the specification (which can be modeled using domain-specific concepts) by code generators which specify how the information is extracted from the models and transformed into code. In other words, the generator reads the model based on the metamodel of the language and maps it to code. The generators are also domain-specific (i.e. they produce the code according to the solution domain) since, according to *(Kelly & Tolvanen, 2008)*, this is the only way to enable full code generation i.e. the generation of code that does not need to be additionally modified. Usually the code generation is further supported by a domain-specific framework which provides implementation concepts, closer to the domain concepts used in the specification, thus narrowing the gap between the solution domain and the problem domain that would otherwise need to be handled by the code generator. The main benefit of DSM according to *(Kelly & Tolvanen, 2008)* is that generators, along with framework code, provide an automated direct mapping to a lower abstraction level (i.e. there is no need to make error-prone mappings from domain concepts to design concepts and on to programming language concepts) thus providing full code generation instead of resulting in a partial implementation. Because the generated code can be compiled to a finished executable without any additional manual effort, the specification (i.e. model) in fact becomes truly executable.

It can, thus, be concluded that, if the goal is to formalize and automate the development of ETL processes to a significant extent, the DSM approach should be adopted not only, because it allows for the formalization of semantically rich abstractions in a form which can be reused, but also because it enables the automatic generation of executable code from models representing the specification of the system. On the other hand, the modeling concepts of GPMLs do not relate to any specific problem domain on the modeling side while on the implementation side, they do not relate to any particular software platform, framework, or component library. Furthermore, MDA assumes the existence of several models at different levels of abstraction obtained through progressive refinement (which can be both automatic and manual) thus automation is usually only partially achieved. An additional benefit is that in the DSM approach, both the models and the code generators can be easily changed (and the code then only needs to be regenerated) which makes the development process more agile. Finally, according to *(Kelly & Tolvanen, 2008)* domain-specific approaches are reported to be on average 300–1000% more productive than GPMLs or manual coding practices.

As a final point, it is argued that the application framework (supporting the implementation of the ETL process specification in the DSM approach) should define specific implementation concepts which are more close to the real domain concepts introduced in the DSLs used for the specification of ETL processes. If both the specification and the application framework use formal concepts close to the real ETL domain concepts the transformation between them can be fully automated, thus significantly increasing development productivity and efficiency while lowering the development and maintenance costs. In other words, by elevating the semantic level and supporting it technologically development can be significantly automated and fewer steps will be needed to implement the abstract specifications. Furthermore, the obtained solutions would have good performances and be scalable and maintainable yet, at the same time, flexible (i.e. they could be easily extended to adapt to the constant changes in the environment and new requirements).

It should be noted that the approach, closest to fulfilling all of the posed requirements, is proposed in *(El Akkaoui & Zimányi, 2009; El Akkaoui, Zimányi, Mazón, & Trujillo, 2011; El Akkaoui, Mazón, Vaisman, & Zimányi, 2012)* in which the authors have even provided built-in mechanisms to validate the syntactic and semantic correctness of the created models. However it is based on the use of a single modeling language which is built by extending a general purpose modeling language, namely BPMN.

3. CONCLUSION

An analysis of the most relevant approaches proposed during the past couple of decades for developing ETL processes, as one of the most crucial and demanding phases in the data warehouse development process, has been given. It can be concluded that these approaches have not managed to adequately resolve some of the problems inherent to the ETL development process, especially in light of the need for the formalization and automation of the development. Several issues, which have not been fully addressed by the reviewed approaches, have been identified and discussed.

First, it can be stipulated that ETL process development must be based on abstractions as they are the only valid methodological means for overcoming complexity. Moreover, it can be argued that semantically richer abstractions are desired for the specification of ETL processes because they can capture greater knowledge thereby increasing productivity and efficiency *(Greenfield, Short, Cook, & Kent, 2004)*. Furthermore, since a greater level of automation is sought it is also necessary to formalize the existing knowledge and experience in such a form that would allow for its reuse. The possibility of reuse further increases productivity and efficiency, while at the same time lowering the cost of data warehouse system development. In addition to overcoming complexity, abstractions are also represent a means for capturing similarities and differences (i.e. achieving a separation of concerns) thereby allowing for parts of the system with the same functionality to be specified and then implemented independently from the specification which, ultimately, enables their reuse.

Since domain experts play a key role in the specification of ETL processes (as they possess an in-depth understanding of the domain i.e. the semantics of the data that is to be transformed) the models should be expressed in terms of concepts specific to the particular domain (i.e. the concepts and terms used by the domain experts). In addition, the modeling languages should be as simple as possible (i.e. they should provide a minimal set of necessary concepts) but at the same time semantically rich to enable the specification of the various aspects of the problem domain at the appropriate level of abstraction (i.e. as stated in *(Greenfield, Short, Cook, & Kent, 2004)* the more general an abstraction, the wider its application, but the smaller its contribution). On the other hand, they should also be formal in order to enable automatic model transformations. Thus, for the formal specification of ETL processes, the use of DSLs is preferred over the extension of GPMLs since they provide only a minimal set of semantically rich domain-specific concepts which makes them more approachable to domain experts. Furthermore, in order to reduce the complexity of the ETL process specification, the different aspects (e.g. the control flow, data flow, etc.) should be modeled separately. The rationale for introducing several languages, instead of just one, is to reduce the complexity of the ETL process conceptual model by separating the different aspects into different models while keeping the languages straightforward and easy to use.

The implementation of these abstract specifications is another crucial aspect. By elevating the semantic level and supporting it technologically development can be significantly automated and fewer steps will be needed to implement the abstract specifications. In other words, if both the specification and the application framework use formal concepts close to the real ETL domain concepts the transformation between them can be fully automated.

The focus of future research is to define a novel approach for ETL process development and the aim of this solution would be to automate this development to a significant extent. To this end the DSM approach would be adopted for the development of ETL process since it allows for the formalization of semantically rich abstractions in a form which can be reused and enables the generation of executable code from models representing the specification of the system. In order to reduce the complexity of the ETL process specification the different aspects of an ETL process would be modeled separately using several DSLs. In addition, a specific application framework would be introduced to support the implementation of the specification. The proposed approach would, thus, be based on a formal specification of ETL processes and its automated transformation into this application framework. By defining implementation concepts which are close to the real domain concepts the semantic level of the solution would be significantly elevated. Ultimately, the automated transformation between the specification and the application framework would additionally increase development productivity and efficiency as well as its flexibility.

REFERENCES

Adamson, C. (2010). *Star Schema The Complete Reference.* McGraw-Hill Education.

Corr, L., & Stagnitto, J. (2011). *Agile Data Warehouse Design: Collaborative Dimensional Modeling, from Whiteboard to Star Schema.* DecisionOne Press.

El Akkaoui, Z., & Zimányi, E. (2009). Defining ETL worfklows using BPMN and BPEL. *In Proc. DOLAP '09, (China),* pp. 41-48.

El Akkaoui, Z., Mazón, J.-N., Vaisman, A., & Zimányi, E. (2012). BPMN-Based Conceptual Modeling of ETL Processes. *Data Warehousing and Knowledge Discovery, LNCS 7448*, pp. 1-14. Springer Berlin Heidelberg.

El Akkaoui, Zimányi, E., Mazón, J.-N., & Trujillo, J. (2011). A model-driven framework for ETL process development. *In Proc. of DOLAP '11, (UK),* pp. 45-52.

Fowler, M. (2010). *Domain-Specific Languages.* Addison-Wesley Professional.

Golfarelli, M., & Rizzi, S. (2009). *Data Warehouse Design: Modern Principles and Methodologies.* McGraw-Hill, Inc.

Greenfield, J., Short, K., Cook, S., & Kent, S. (2004). *Software Factories: Assembling Applications with Patterns, Models, Frameworks, and Tools.* John Wiley & Sons.

Jarke, M., Lenzerini, M., Vassiliou, Y., & Vassiliadis, P. (2003). *Fundamentals of Data Warehouses.* Springer.

Jovanović, V., & Bojičić, I. (2012). Conceptual Data Vault Model. *In Proc. of SAIS'12*, *(USA)*, pp. 131-136.

Jovanović, V., Bojičić, I., Knowles, C., & Pavlić, M. (2012). Persistent staging area models for data warehouses. *Issues in Information Systems, 13(1)*, pp. 121-132.

Kelly, S., & Tolvanen, J. P. (2008). *Domain-Specific Modeling: Enabling Full Code Generation.* Wiley.

Kimball, R., & Caserta, J. (2004). *The Data Warehouse ETL Toolkit: Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data.* John Wiley & Sons.

Kimball, R., Ross, M., Thornthwaite, W., Mundy, J., & Becker, B. (2010). *The Kimball Group Reader: Relentlessly Practical Tools for Data Warehousing and Business Intelligence.* John Wiley & Sons.

Linstedt, D., & Graziano, K. (2011). *Super Charge Your Data Warehouse: Invaluable Data Modeling Rules to Implement Your Data Vault.* CreateSpace Independent Publishing Platform.

Luján-Mora, S., & Trujillo, J. (2004). A Data Warehouse Engineering Process. *Advances in Information Systems, LNCS 3261*, pp. 14-23. Springer Berlin Heidelberg.

Luján-Mora, S., Vassiliadis, P., & Trujillo, J. (2004). Data Mapping Diagrams for Data Warehouse Design with UML. *Conceptual Modeling-ER 2004, LNCS 3288*, pp. 191-204. Springer Berlin Heidelberg.

Mazón, J.-N., & Trujillo, J. (2008). An MDA approach for the development of data warehouses. *Decision Support Systems, 45(1)*, pp. 41-58.

Muñoz, L., Mazón, J. N., & Trujillo, J. (2009). Automatic generation of ETL processes from conceptual models. *In Proc. of DOLAP '09, (China),* pp. 33-40.

Muñoz, L., Mazón, J. N., Pardillo, J., & Trujillo, J. (2008). Modelling ETL Processes of Data Warehouses with UML Activity Diagrams. *On the Move to Meaningful Internet Systems: OTM 2008 Workshops, LNCS 5333*, pp. 44-53. Springer Berlin Heidelberg.

Regardt, O., Rönnbäck, L., Bergholtz, M., Johannesson, P., & Wohed, P. (2009). Anchor Modeling. *Conceptual Modeling-ER 2009, LNCS. 5829*, pp. 234-250. Springer Berlin Heidelberg.

Simitsis, A. (2005). Mapping conceptual to logical models for ETL processes. *In Proc. of DOLAP '05, (Germany*), pp. 67-76.

Simitsis, A., & Vassiliadis, P. (2003). A methodology for the conceptual modeling of ETL processes. *In Proc. of the Decision Systems Engineering - DSE '03, (Austria)*, pp. 305-316.

Simitsis, A., & Vassiliadis, P. (2008). A method for the mapping of conceptual designs to logical blueprints for ETL processes. *Decision Support Systems, 45 (1)*, pp. 22-40.

Simitsis, A., Vassiliadis, P., Terrovitis, M., & Skiadopoulos, S. (2005). Graph-Based Modeling of ETL Activities with Multi-level Transformations and Updates. *Data Warehousing and Knowledge Discovery, LNCS 3589*, pp. 43-52. Springer Berlin Heidelberg.

Trujillo, J., & Luján-Mora, S. (2003). A UML Based Approach for Modeling ETL Processes in Data Warehouses. *Conceptual Modeling-ER 2003, LNCS 2813*, pp. 307-320. Springer Berlin Heidelberg.

Vassiliadis, P., Simitsis, A., & Skiadopoulos, S. (2002, May). Modeling ETL activities as graphs. *In Proc. of DMDW'02,* pp. 52-61.

Vassiliadis, P., Simitsis, A., & Skiadopoulos, S. (2002, November). Conceptual modeling for ETL processes. *In Proc. of DOLAP '02, (USA),* pp. 14-21.

Vassiliadis, P., Simitsis, A., Georgantas, P., & Terrovitis, M. (2003). A framework for the design of ETL scenarios. *Advanced Information Systems Engineering*, *LNCS 2681*, pp. 520-535. Springer Berlin Heidelberg.

Vassiliadis, P., Simitsis, A., Georgantas, P., Terrovitis, M., & Skiadopoulos, S. (2005). A generic and customizable framework for the design of ETL scenarios. *Information Systems, 30 (7),* pp. 492-525.

THE DECISION MAKING IN PUBLIC E-PROCUREMENT BASED ON FUZZY METHODOLOGY

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Abstract: *One of the major issue in Serbian Government is public electronic procurement (public e-procurement) which is significant electronic service in electronic government (e-government) in Serbia. In this paper, the main phases of public e-procurement with an accent to bidder selection phase are described. The process of selection of the most suitable bidder in public e-procurement may be reduced to a multi-attribute decision making, because it includes both qualitative and quantitative factors. In order to select the most suitable bidder, it is necessary to make a trade-off between these tangible and intangible factors, which can pose conflict. For an efficient bidder selection in public e-procurement, an electronic decision support system (e-DSS) based on fuzzy Analytic Hierarchy Process (FAHP) is proposed and implemented in Java programming language. The paper describes the main architecture of e-DSS and practical application of this system in a case study from the public administration sector in Serbia. Upon definition of basic criteria and sub-criteria, a hierarchical tree is structured, while priority weights are obtained using e-DSS. The bidder with the highest priority is chosen as the most suitable one.*

Keywords*: Bidder selection, Multi-attribute decision making, DSS, Fuzzy analytic hierarchy process, Decision makers.*

1. INTRODUCTION

The information society as a new qualitative step in the development of human social life is characterized by extremely fast growth in the use of new capacities enabled by information and communication technology (ICT). Worldwide phenomenon of using ICT, especially the Internet, Influenced transformation of all life processes, including functions of the public administration. Governments could not stand aloof from these trends and is forced – just as the private sector – to implement innovations and to explore new possibilities (Heeks, 2003; Stragier et al., 2010;). The communication in public administration is increasingly taking place over the Internet, which is used as a potential channel for distribution of information and is becoming more and more a permanently open government information window (Bobar, 2013). Modernization of public administration by using ICT, as a principle of public administration reform (Public Administration Reform Strategy in Serbia, 2009) enables that the traditional form of public administration is transformed into electronic form as much as possible. The development of the Internet has contributed to the traditional model of public administration translates into an electronic model which leads to the concept of electronic government (e-government). Public e-procurement, as one of the significant electronic services of e-government, which refers to the relation of government towards businesses, should be implemented as web electronic service because it increases transparency and reduces costs in the work of public administration, at the same time. Therefore, in this paper, the attention is given to the concept of public e-procurement and design of fuzzy e-DSS for bidder selection in public e-procurement.

The bidder selection in public e-procurement may be reduced to a multi-attribute decision making where we have a number of quantitative (price, distance, delivery time) and qualitative (quality, technological capability, finances), often conflicting criteria are considered. Presence of qualitative criteria in public e-procurement led to using the fuzzy methodology because public e-procurement may be described as uncertain. FAHP represents a systematic approach to choosing alternatives and solving problems by means of a concept of fuzzy set theory (Zadeh, 1965) and AHP method, which is implemented by using triangular fuzzy numbers (Chang, 1996). In this paper, we use Chang's (1992) extent analysis method as a base for implementing e-DSS for bidder selection in public e-procurement.

The paper is organized as follows: Chapter 2 covers the background of public e-procurement. Chapter 3 explains the Chang's extent analysis method. In Chapter 4, we shortly described process of design and implementation of e-DSS based on mentioned Chang's extent analysis method. The e-DSS is applied in

order to solve the problem of selecting the most appropriate telecommunications equipment bidder in the public administration sector. The work is ended with conclusive remarks in Chapter 5.

2. PUBLIC E-PROCUREMENT

In this paper, public procurement means the procurement of goods, services and work by the government authority, in the manner and under conditions prescribed by the Public Procurement Law (2012). The public e-procurement is the process of purchasing goods, works or services electronically, usually over the Internet (Bobar, 2013). Public e-procurement consists of two main phases: pre-award phase and post-award phase (see **Figure 1**).

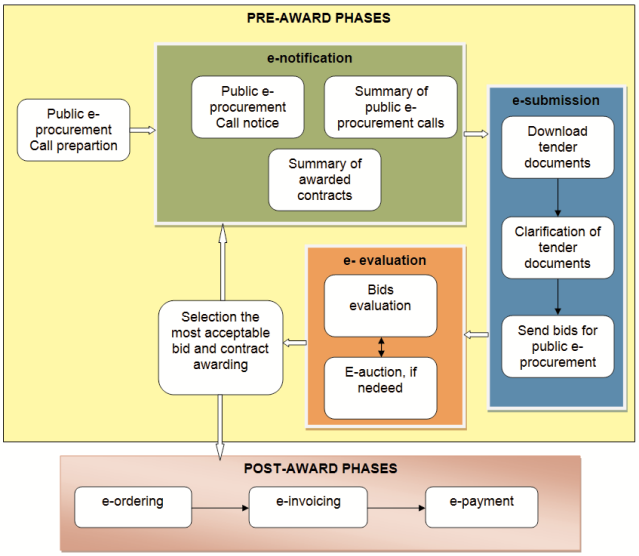

Figure 1: The phases of Public e-Procurement in Serbia

Pre-award phase has sub-phases which described by Bobar (2013). *Call preparation for public e-procurement* is a phase where contract authority creates tender documentation with all conditions and criteria. *E-notification* is a phase that provides online publication of call for public procurement, review of all public procurement calls (previous, current and future) and of all contracts which are awarded in past procurement process. *E-submission of bids* is a phase that ensures the online access to tender documentation, whether through an Internet site of a government institution or through separate software created for that purpose. Bidders can review documentation online or download it. This phase enables possible addition clarification of tender documentation on bidder's request. After completing the documentation and creating the bid, the bidder sends it to the contracting authority, also electronically (upload). *E-evaluation* is the most important phase of public e-procurement which ensures maximum uniformity for evaluation of bids based on predefined criteria. In evaluating bids it is possible to use the electronic auction or multi-criteria decision making methodologies which will be integrated into the background of the public e-procurement software. The result of the evaluation of bids is a recommendation of the most acceptable bid and awarding of the contract to a bidder who offers the most acceptable bid. *Selection of the most acceptable bid and contract awarding* is a phase where contract authority decides for a bid based on results from e-evaluation phase and after that creates a contract with selected bidder.

Post-award phase has following sub-phases (Bobar, 2013): e-ordering, e-invoicing and e-payment. *E-ordering* is a phase in which a contract is drafted, after which, the bidder must supply an electronic catalogue of his products or services and the contract authority made an order. Based on the catalogue, the contract authority will place an order, by submitting it to the bidder who will confirm the order electronically. *E-invoicing and e-payment* are the phases that ensure a uniform link between the accounting systems of the contract authority and bidder, allowing for the invoice to be directly forwarded from the bidder's accounting to the contract authority's accounting for payment.

The selection of the most acceptable bid and contract awarding is one of the most important phase in public e-procurement where evaluation of bids and selection of the most acceptable bid is conducted by applying the criteria of lowest price or of the most economically advantageous tender (Public Procurement Law, 2012). For this selection, many various mathematical models and operations can be used for decision making, such as weighting coefficients, the analytic hierarchy process (AHP) or fuzzy logic. In view of this,

the process of selection of the most acceptable bid can be viewed from the perspective of decision making phenomena, where selection of the most acceptable bid based on different criteria, in fact, represents the objective of a decision making problem. In the process of public e-procurement, alternatives are the bids or bidders who possess specific resources that they wish to place in the service of satisfying the purchaser's needs. Criteria are attributes for describing offered alternatives and they indicate the extent to which individual alternatives realize the set objective. Very frequent criteria for public procurement by government institutions are offered price, quality of offered goods or services, payment terms, delivery period, references, etc. (Public Procurement Law, 2012). In this paper, we present an illustrative example of the application of the specific e-DSS based on FAHP in the process of public e-procurement of telecommunications equipment for use by a government institution.

3. METHODOLOGY OF FAHP

Let $X = \{x_1, x_2, ..., x_n\}$ is an object set and $G = \{g_1, g_2, ..., g_m\}$ be a goal set. According to the method of Chang (1992) extent analysis, each object is taken and extent analysis for each goal g_i is performed, respectively. Therefore, *m* extent analysis values for each object can be obtained as $M_{g_i}^1, M_{g_i}^2, ..., M_{g_i}^m$, *i=1,2,..n*. All the $M_{g_i}^j$, *j=1,2,..,m* are triangular fuzzy number. The Chang's extent analysis (Chang, 1992) can be described as follow: The value of fuzzy synthetic extent with respect to the i^{th} object is defined by $S_i = \sum_{j=1}^{n} M_{g_i}^j \otimes \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{g_i}^j\right]^{-1}$. In order to obtain $\sum_{j=1}^{n} M_{g_i}^j$ it is necessary to perform the fuzzy addition of numbers in the matrix such that $\sum_{j=1}^{n} M_{g_i}^j = \left(\sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j\right)$ and to obtain $\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{g_i}^j\right]^{-1}$ which is performed by using the operation of fuzzy addition of all values such that $M_{g_i}^j$, *j=1, 2, m* $\sum_{i=1}^{n}\sum_{j=1}^{m} M_{g_i}^j = \left(\sum_{i=1}^{n} l_i, \sum_{i=1}^{n} m_i, \sum_{i=1}^{n} u_i\right)$.

The vector $\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{g_i}^j\right]^{-1}$ is determined as $\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{g_i}^j\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i}\right)$. The degree of possibility of $M_2 = (l_2, m_2, u_2)$ and $M_1 = (l_1, m_1, u_1)$ is defined by

$$V(M_2 \geq M_1) = hgt(M_1 \cap M_2) =$$

$$= \mu_{M_2}(d) = \begin{Bmatrix} 1, & if & m_2 \geq m_1 \\ 0, & if & l_1 \geq u_2 \\ \dfrac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} & other & \end{Bmatrix}.$$

To compare M_1 and M_2, we need both the values of $V(M_1 \geq M_2)$ and $V(M_2 \geq M_1)$. The degree of possibility for a convex fuzzy number to be greater than k convex fuzzy numbers M_i, *i=1,2,..,k* can be defined as $V(M \geq M_1, M_2, ..., M_k) = \min V(M \geq M_i)$, *i=1,2,..,k*. If we assume that $d'(A_i) = \min V(S_i \geq S_k), k \neq i$, *k=1,2,..,n,* then the weight vector is given as $W' = (d'(A_1), d'(A_2), ..., d'(A_n))^T$ where A_i, i=1,2,..,n is a matrix with n elements. Using normalization, the normalized weight vector is given as $W = (d(A_1), d(A_2), ..., d(A_n))^T$ where *W* is not fuzzy number.

4. DESIGN AND IMPLEMENTATION OF e-DSS BASED ON FAHP

Using steps of FAHP described in Chapter 3, and using JAVA technology, an e-DSS based on FAHP is proposed. **Figure 2** represents a UML class diagram of FAHP module. Basic elements of this module are classes *Criteria* and *Alternative*. They are generalized from abstract class Element. Class *FuzzyNumber* represent a triangular fuzzy number. Classes Degree, *SyntheticExtent, Result* and *FinalResult* help classes for calculation of fuzzy AHP. *Calculate* is an abstract class which represents the template method software pattern. It is generalized to classes *FuzzyAHP* and *ChangFuzzyAHP*. Because of this template method, this software module can be extended with new methods, not only fuzzy AHP's, but methods like fuzzy TOPSIS or any other method that requires pair wise comparison of each pair of factors in the same hierarchy level. *Util* class is a singleton that provides a single point of access to this module.

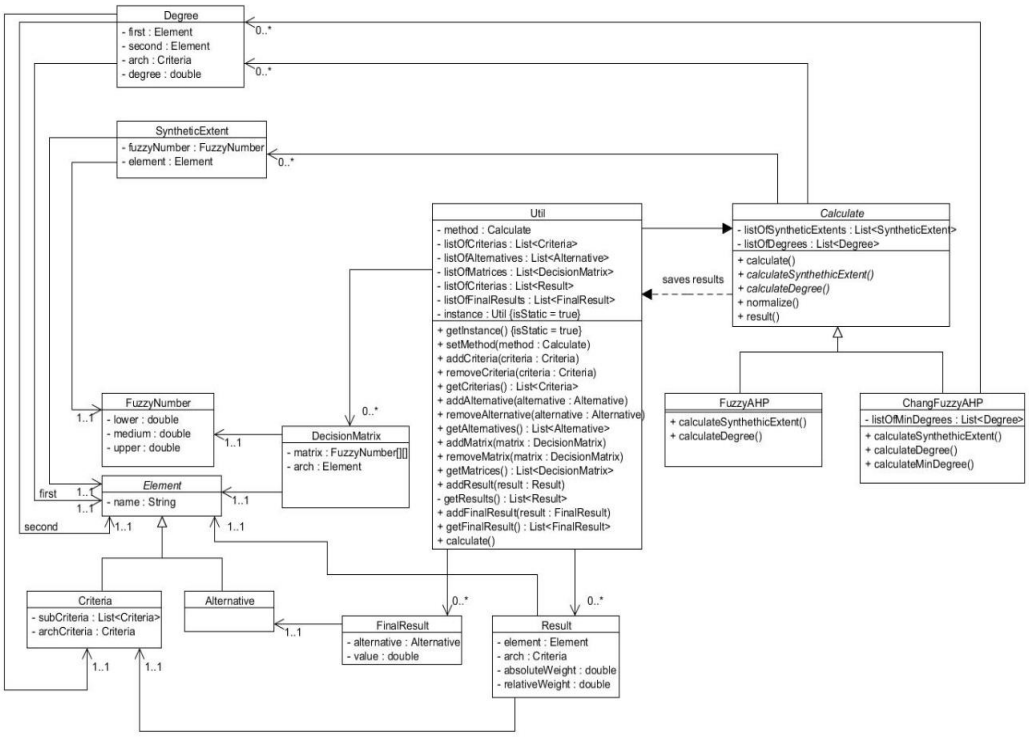

Figure 2: The Class Diagram of e-DSS

An example of program code for *ChangFuzzyAHP* calculation gives as follows:

```
public class ChangFuzzyAHP {
        private List<SyntheticExtent> listOfSyntheticExtent;
        private List<Degree> listOfDegrees;
        @Override
        public void calculate() {try {calculateSyntheticExtent();
                calculateDegree();
                calculateMinDegree();}
        catch (Exception ex) {
                Throw new Exception(ex.getMessage());}}
        …
        public void calculateDegree() {
                double value = 0;
                for (SyntheticExtent se : listOfSyntheticExtent) {
                for (SyntheticExtent visitingSe : listOfSyntheticExtent) {
                                if       (!se.equals(visitingSe)       &&       se.getElement().getArch
().equals(visitingSe.getElement().getArch ())) {
                                if                (se.getWeight().getMediumValue()                    >=
visitingSe.getWeight().getMediumValue()) {    value = 1;
                                }      else      if      (visitingSe.getWeight().getLowerValue()      >=
se.getWeight().getUpperValue()) { value = 0;
                                }    else    {value    =    (visitingSe.getWeight().getLowerValue()    -
se.getWeight().getUpperValue())          /          (criteria.getWeight().getMediumValue()          -
se.getWeight().getUpperValue()          -          visitingSe.getWeight().getMediumValue()          +
visitingSe.getWeight().getLowerValue());
                                }
Degree degree = new Degree (se.getElement(), visitingSe.getElement(), se.getArch(), value);
                        listOfDegree.add(degree);}}
```

This e-DSS is created as a part of electronic platform for public procurement in Serbia and it helps commission for public procurement to make quick and good decision for bidder selection in public e-procurement process. In the next section, the application of the proposed e-DSS on a real life problem is given.

4.1. Application of e-DSS in bidder selection in public administration sector in Serbia

As a case study, in this paper, described e-DSS is applied to the selection of a most suitable bidder in public e-procurement of transmission frequency repeaters which allow for area coverage without GSM signal or with a very weak signal inside public administration buildings. For that purpose, contracting authority formed commission for public e-procurement which consists of experts from the Technical Department. After the public opening of the bids, commission for public e-procurement selected three bidders (B_A, B_B and B_C) who met the legal requirements for participation in public e-procurement. Evaluation and selection of the most economically advantageous bidders among these three bidders is based on criteria and sub-criteria showed in **Figure 3**.

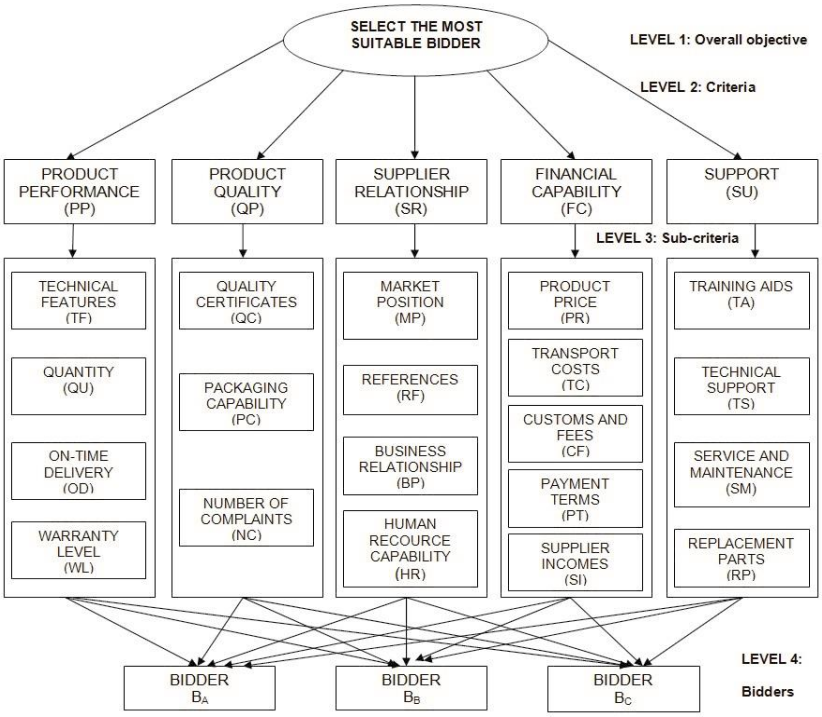

Figure 3: Hierarchical tree dedicated to bidder selection problem

All criteria and sub-criteria that may affect the selection of the best telecommunications equipment bidder have been determined using Public Procurement Law in Serbia (2012) and in cooperation with experts from the Technical Department of the contracting authority. The priority weights of each criterion, sub-criteria and alternatives from **Figure 3** are calculated using e-DSS based on FAHP method. Comparison of criteria, sub-criteria and alternatives is facilitated for the experts by means of a Linguistic Importance Scale (**Table 1**). Within **Table 1** (Kilincci and Onal, 2011), linguistic variables are converted into triangular fuzzy numbers.

Table 1: Linguistic scale of importance

Linguistic scale of importance	Triangular fuzzy scale	Triangular fuzzy reciprocal scale
Equal	(1,1,1)	(1,1,1)
Weak	(1/2,1,3/2)	(2/3,1,2)
Fairly strong	(3/2,2,5/2)	(2/5,1/2,2/3)
Very strong	(5/2,3,7/2)	(2/7,1/3,2/5)
Absolute	(7/2,4,9/2)	(2/9.1/4,2/7)

The experts from Technical Departments are involved in the comparison process. The ratings of the three bidders by technical experts under all criteria are given in **Table 2**.

Table 2: The ratings of three bidders by technical experts under all criteria

Criteria	PP	QP	SR	FC	SU
PP	Equal	Weak	Fairly storng	Weak	Fairly storng
KP	Weak	Equal	Very strong	Weak	Very strong
OP	Very strong	Absolute	Equal	Very strong	Weak
FK	Weak	Weak	Fairly storng	Equal	Weak
PD	Very strong	Absolute	Weak	Weak	Equal

Using data from **Table 1**, linguistic variables from **Table 2** can be converted to triangular fuzzy numbers (see **Table 3**).

Table 3: The fuzzy matrix for main criteria according to commission for public e-procurement

Criteria	PP	QP	SR	FC	SU
PP	(1,1,1)	(2/3,1,2)	(3/2,2,5/2)	(1/2,1,3/2)	(3/2,2,5/2)
QP	(1/2,1,3/2)	(1,1,1)	(5/2,3,7/2)	(1/2,1,3/2)	(5/2,3,7/2)
SR	(2/5,1/2,2/3)	(2/7,1/3,2/5)	(1,1,1)	(2/5,1/2,2/3)	(1/2,1,3/2)
FC	(2/3,1,2)	(2/3,1,2)	(3/2,2,5/2)	(1,1,1)	(1/2,1,3/2)
SU	(2/5,1/2,2/3)	(2/7,1/3,2/5)	(2/3,1,2)	(2/3,1,2)	(1,1,1)

The e-DSS uses the hierarchy tree from **Figure 3** for creating hierarchy into system (see **Figure 4**) and uses fuzzy numbers from **Table 3** (see **Figure 5**) and automatic calculates final results (see **Figure 6** and **Figure 7).**

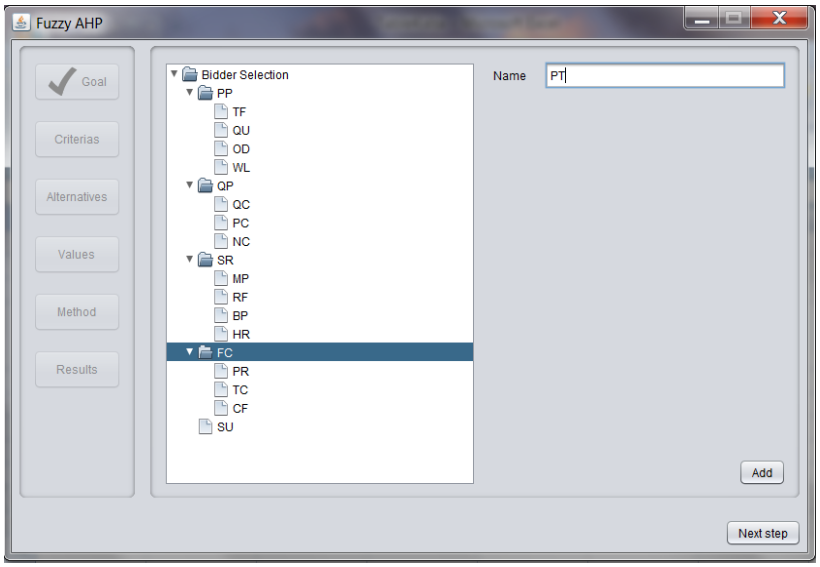

Figure 4: Creating hierarchy into e-DSS

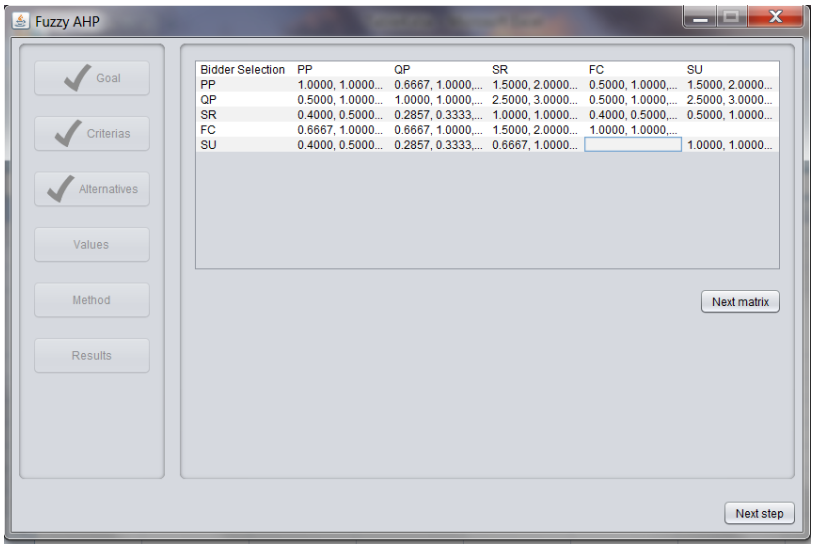

Figure 5: Creating of fuzzy matrix of criteria comparison

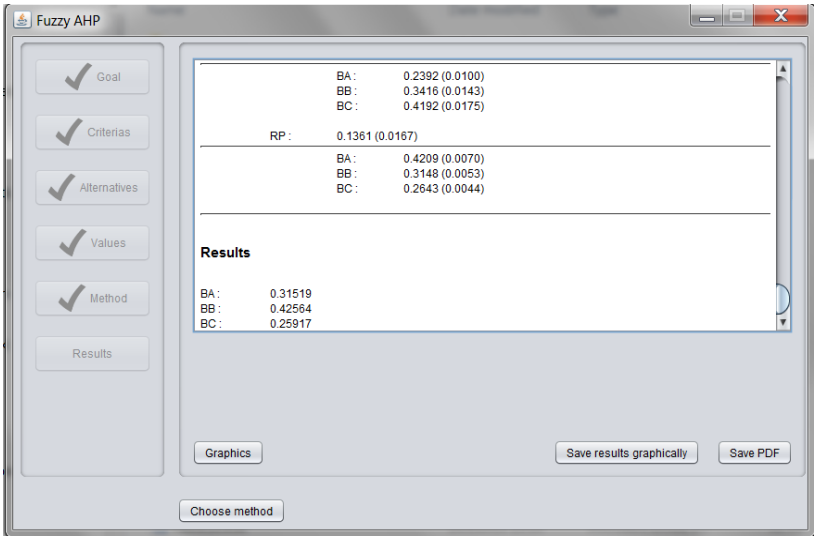

Figure 6: The final results

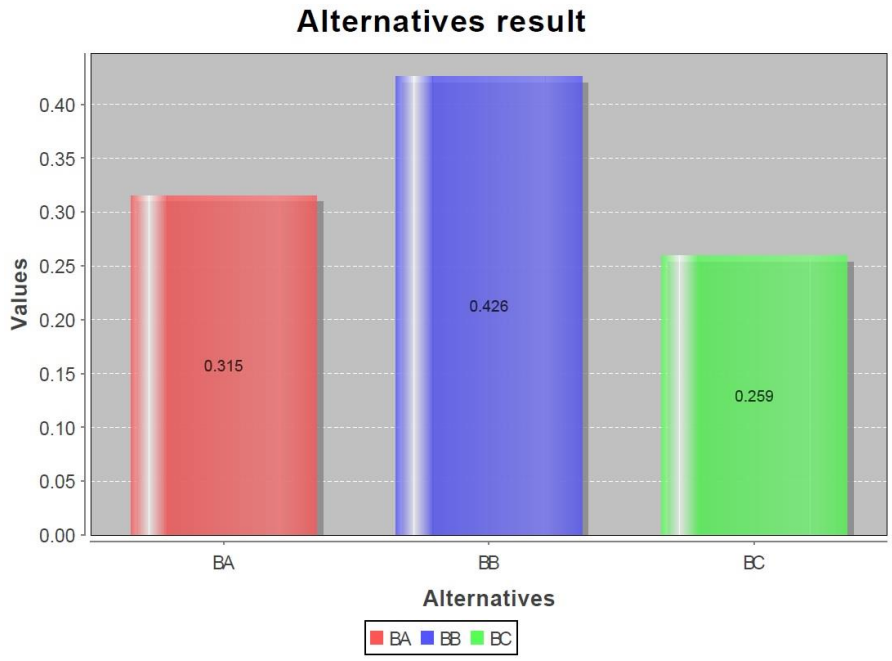

Figure 7: The Alternatives Order – the graphical representation

Analysis of results from **Figure 7** shows priority weightings for alternatives (0.31, 0.43, 0.26). According to the final results, we may conclude that bidder $\mathbf{B_B}$, with a total priority value of 0.43, is the most suitable bidder for this public e-procurement. The supplier $\mathbf{B_A}$ comes second with a total priority of 0.31, while supplier $\mathbf{B_C}$ ranks lowest with a total priority of 0.26.

5. CONCLUSION

Public procurement represents one of the key areas where electronic methods are used that significantly simplifies the procurement process, particularly in the government sector, which is known for lengthy procurement procedures (up to 6 months) (Bobar, 2013). This process can possible to transform from the traditional form into the electronic form by using ICT. This contributes to costs reduction, enabling efficiency and high level of transparency and as a result we have savings for economy subjects and government authorities. The basic benefit of using the system of public e-procurement is the possibility of consolidating numerous information systems into a single place by establishing a standardized purchasing method and supplier interface (Bobar, 2013).

The bidder selection in public e-procurement is one of the key phases of this process. This selection represents a multi-attributes decision making problem which includes both qualitative and quantitative factors. In order to select the most suitable bidder, it is necessary to make a trade off between these tangible and intangible factors same of which may conflict. This paper proposes an electronic decision support system for bidder selection in public e-procurement. This system is developed JAVA technology in combination with FAHP and it represents a part of the complex electronic platform for public procurement in Serbia. With the application of fuzzy numbers, the FAHP method has clear advantages over other similar methods. It effectively improves the flexibility of the conventional AHP in dealing with the uncertainties and ambiguities associated with the judgments of different decision makers. This paper has shown the practical usage of e-DSS to make bidder selection in one real-life case study of public procurement in Serbia. In this paper, five essential criteria and twenty sub-criteria have been analyzed for three alternatives, i.e. bidders. Essential criteria and sub-criteria have been determined according to Serbian Public Procurement Law and in cooperation with experts from the Technical Department. Comparison of essential criteria, sub-criteria and bidders has been facilitated through Linguistic Importance Scale, while weighting has been performed by means of the FAHP method.

It is worth to mention that e-DSS platform is extensible, so new modules can be created and applied. Additionally, user could select which module (method) to use in which public e-procurement.

Further research will be directed towards the inclusion of other methods of the multi-attribute decision-making, such as fuzzy TOPSIS and fuzzy PROMETHEE into described e-DSS in order to get more precise results.

ACKNOWLEDGMENT

The authors would like to thank Sandro Radovanovic, Ph.D. student at Faculty of Organizational Sciences, for his contribution in developing described e-DSS, helpful comments and useful discussion regarding this research.

REFERENCES

Bobar, V. (2013). Methodology of Concept Application for Multi-criteria Decision Making in the Public e-Procurement Process. Metalurgia International, 13 (4), 128-138.

Bobar, V. (2013). Metodološki i institucionalni okvir za razvoj elektronske javne nabavke kao G2B servisa elektronske uprave. InfoM Journal, 47, 10-15.

Chang, D.Y. (1992). Extent analysis and synthetic decision. Optimization Techniques and Applications, 1, 352–355.

Chang, D.Y. (1996). Applications of the extent analysis method on fuzzy AHP. European Journal of Operational Research, 95(3), 649–655.

Heeks R. (2003). Reinventing government in the information age. International practice in IT-enabled public sector reform, Routledge.

Kilincci, O. & Onal, S.A. (2011). Fuzzy AHP approach for supplier selection in a washing machine company. Expert systems with applications, 38, 9656-9664.

Ministry for public administration and local self-government (2009). Public Administration Reform Strategy in Serbia, ISBN 978-86-87843-06-6.

National Assembly of the Republic of Serbia (2012). Public Procurement Law. Official Gazette, No. 124/12.

Stragier J., Verdegem P. & Verleye, G. (2010). How is e-Government Progressing? A Data Driven Approach to E-government Monitoring. Journal of Universal Computer Science, 16 (8), 1075-1088.

Zadeh, L.A. (1965). Fuzzy sets, Information and Control, 8(3), 338-353.

IMPROVEMENT OF MODEL OF DECISION MAKING BY DATA MINING METHODOLOGY

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Abstract: *The field of the research of this paper is the analysis of concept of data mining methodology and possibilities of improvement of model of decision making. There will be presented the practical application and best practices of data mining methodology with overview to influence and benefits it brings to management of modern companies. There will be presented the benefits that the decision makers have by the use of models of decision making from the field of business intelligence. Research in this paper will be focused on importance and application of data mining methodology in business system. There will be described the model of application of business intelligence with the use of modern software architecture. The goal of the research is proving that data mining concept has strategic importance in increasing the effectiveness of decision making.*

Key words: *Data Mining, Decision Making, Knowledge.*

1. INTRODUCTION

Decision making is very important and complex function of management that demands the methods and techniques that simplify the process of choosing one of more alternatives. In modern business the challenge is finding the possibilities for improvement of decision making of managers. Managers' decisions directly affect the making of profit, business and positioning of company at the market, etc.

Business intelligence is very important field in the phenomenon of decision making. In modern business it is the challenge to analyze and find the possibilities for improvement of process of business intelligence, in order for overall improvement of business decision making. The paper will be presenting the business intelligence concept, its methods and techniques, as well as their influence to improving the model of decision making.

In order to support decision making in organizations in modern businesses, the most often the concept of business intelligence has been in use. Business intelligence is defined as the pull of information technologies, organization rules, as well as the knowledge and skills of the employed in organization that together generate, write, integrate and analyze data, with the goal to get to the knowledge needed for decision making. The goal of business intelligence is to give support to strategic planning.

2. BUSINESS INTELLIGENCE IN MODERN DECISION MAKING

Systems of business intelligence combine operational data with analytical tools in order to give the descriptive meaning to that data and to give to the manager competitive information. The term *Business Intelligence* has replaced the terms systems for decision making, executive information systems and management information systems. The concept of *Business Intelligence* has been defined as:

Systems of business intelligence combine techniques of collecting data, data warehousing and knowledge management with the help of analytical tools, in order to present the complex internal and competitive information to decision makers. (Negash, 2004).

Mission of application of business intelligence is to give support to strategic and operational planning. Its most often use is in management of performances inside company, optimization of relationships with users and creation of reports for management. With the help of techniques and methods of business intelligence, the data has been transferred to useful information, and with the help of analyses of skilled analytics, that useful information has been transferred to knowledge. Business intelligence has been used to understand the possibilities inside the company. The possibilities are modern tendencies, future market positioning and technologies. There are also the steps and behavior of competitive organizations analyzed. Business

Intelligence provides that complex data transfer to useful information that is presented as characteristic knowledge for decision makers. The goal is to improve the timeline and data quality during decision making. Business intelligence is the system made of technical and organizational elements that give its users useful information for analysis to make effective decision making and support to management, in order to improve the organizational performances (Isik et al. 2013). Business intelligence continues to be the priority in many organizations and possibilities that provide are useful and interesting to management of companies. Companies fight to use and make logical large amounts of data that generated externally and internally. Business intelligence has become key component to many companies, as well as the topic of research of many academic institutions. Possibilities of business intelligence are critical functions that help organizations to improve performances and adapt to changes.

Data mining (Suknović, Delibašić, 2010) is the scientific discipline that has the goal to reveal in data certain rules, models and rules based on decision can be made. Data mining are methods, techniques and algorithms from different fields such as statistics, mathematics, data bases and it has been provided for processing of large amounts of data. Rules and patterns that achieved in this way have been in use later for business decision making, generating new ideas and generally influence to competitiveness of systems. Data mining is the technology that puts together traditional methods for data analysis with sophisticated algorithms that process the large amounts of data and open possibilities for research and analysis of new types of data.

In the paper there will be presented the model of business intelligence applied into real problems of modern decision making. The goal of the presented model is the description and the pointing to importance and benefits of concept of business intelligence, its methods and techniques that has in customer relationship management. The goal of the model is the application of business intelligence for creation the headlines for management of companies, in order to increase the efficiency and effectiveness of process of decision making.

3. MODEL OF APPLICATION OF BUSINESS INTELLIGENCE BY THE USE OF MODERN SOFTWARE ARCHITECTURE

In the paper there is the model of application of business intelligence on real business problem of modern decision making by the use of modern software architecture. Software “Orange” presents very popular data mining tool that serves as help to managers in decision making process. Orange, as very convenient and user-friendly software, has numerous data mining options for data processing, such as creation of model, testing, data visualization, application of model, etc. One of the most important technologies of data mining is CRISP-DM methodology. This methodology consists of following phases:

1. Business understanding
2. Data understanding
3. Data transformation
4. Modeling
5. Evaluation
6. Deployment of model

Orange has options for each of this phase of CRISP-DM methodology. In the paper it has been described the example of business problem if the buyers with certain attributes are convenient or not for marketing and CRM activities of companies. It has been shown the preparation of data in order to create the successful model of classification of buyers if they are CRM convenient or not. There is the validation of the project solution, as well as its application in practice.

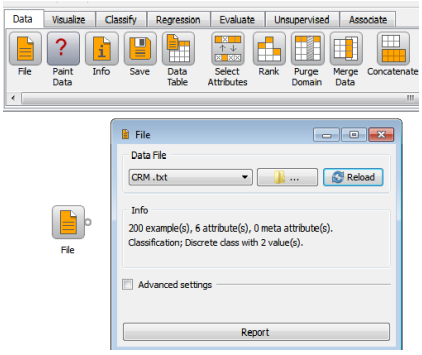
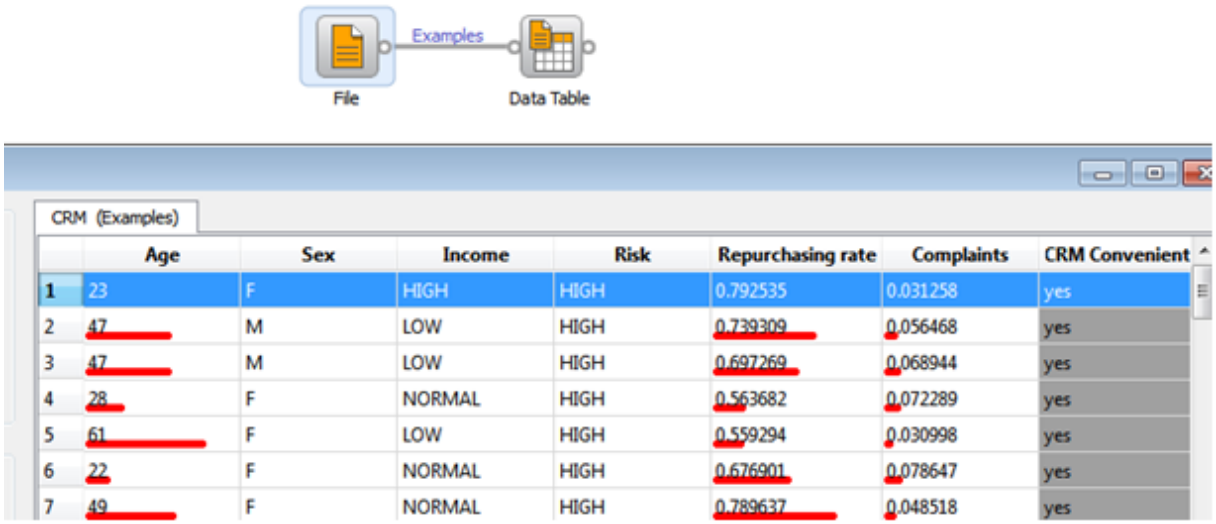


Figure 1: Desktop of Software Orange with Beginning Step of Data Input

On Figure 1 there is the desktop of Orange software. On toolbar there is the main menu with project functions. Application software Orange has numerous Data Mining functions: data processing, visualization, classification, evaluation, association rules. On desktop the input is the table consisting of data put to the node for further processing.



	Age	Sex	Income	Risk	Repurchasing rate	Complaints	CRM Convenient
1	23	F	HIGH	HIGH	0.792535	0.031258	yes
2	47	M	LOW	HIGH	0.739309	0.056468	yes
3	47	M	LOW	HIGH	0.697269	0.068944	yes
4	28	F	NORMAL	HIGH	0.563682	0.072289	yes
5	61	F	LOW	HIGH	0.559294	0.030998	yes
6	22	F	NORMAL	HIGH	0.676901	0.078647	yes
7	49	F	NORMAL	HIGH	0.789637	0.048518	yes

Figure 2: The Overview of the Table with Attributes of Buyers with Node Data Table

Business problem that will be presented is the data analysis about buyers by using the Data Mining methodology in order to get the most suitable solution in the field of customer relationship management. Therefore, it is needed to carefully process the data got by research about buyers attributes. On Figure 2, there is the part of the table with 6 attributes (age, sex, income, risk, repurchasing rate, complaints) where there are the 200 cases and none of the missing data. There are different data types, numerical and categorical. Output attribute has two values – *yes* and *no*. It has been analyzed if the buyers are convenient for companies' efforts in customer relationship management - CRM (yes) or not to continue the business communication (*no*).

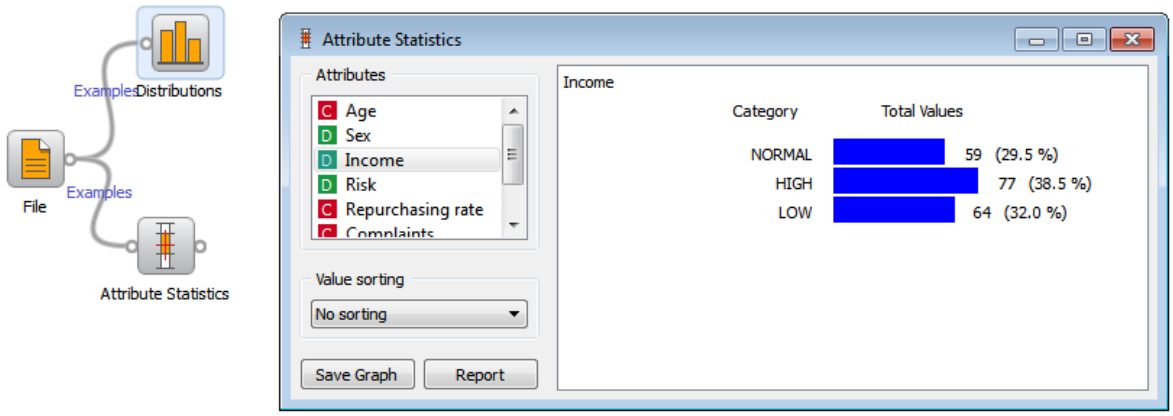


Figure 3: The Overview of Data Visualization

The Figure 3 shows the example of data visualization in Orange with the node *Attribute Statistics*. The user is getting the possibility of graphical overview of chosen attributes, in order to see the pattern. On the example the conclusion is that the biggest percentage of company's buyers (38.5%) has high income, than 32% follows with lower income and the least are buyers with normal (average) income. The conclusion is that there should be made different marketing and CRM activities that are later directed towards certain buyers' category. Data visualization can be successfully finished by node *Distributions*.

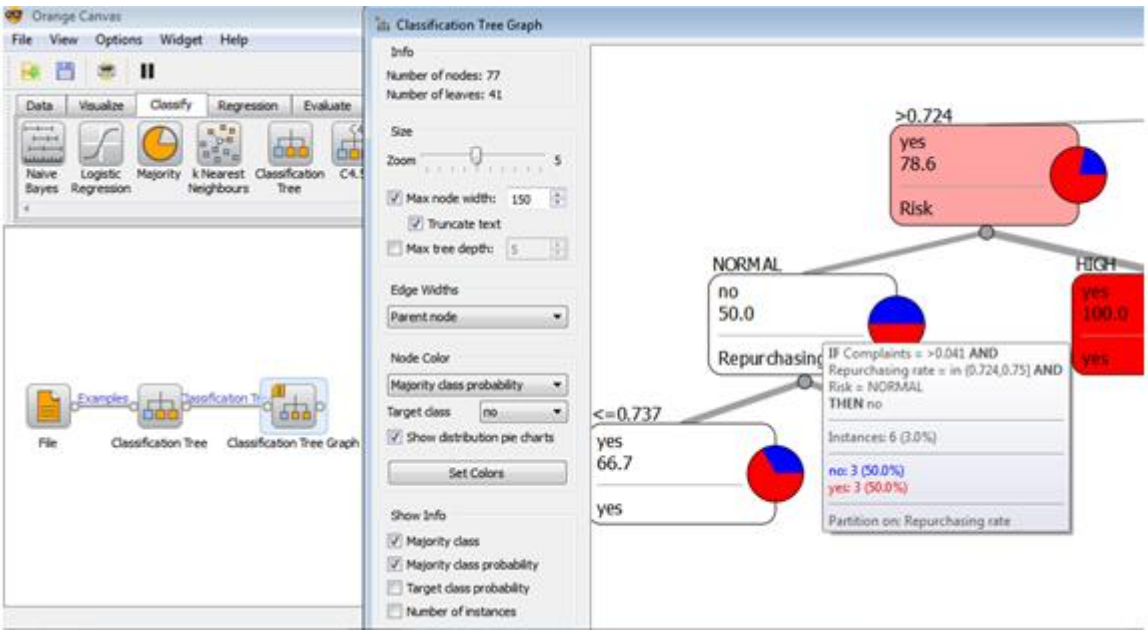


Figure 4: Generic Tree Graph

Classification problem is the problem of creating the way of classifying objects (cases) into right class. There are many algorithms for creating the classification model, and these are available through nodes of *Classify* group. One of the most popular and most precise way of classification in this program is through node *Classification Tree.* Data file should be connected to node Classification Tree, which is later connected to node Classification Tree Graph, in order to generate the classification tree. On this example there is the classification of input data given by research of buyers' attributes (age, sex, income, repurchasing rate and complaints). Data has been processed in order to get the outcome information about buyers' classes. Information about the buyers if they are CRM convenient or not, are in the outcome in created class. The goal is creating the knowledge should the companies invest in CRM and marketing activities towards certain buyers or not, depending on what class they belong to.

The model shows the path through the CRM convenience of buyers has been determined. Having CRM and marketing as very important segments of companies' budget, the presented model of business intelligence application can be of significance importance for savings and creation of the most suitable business solution that will maximize the profit.

If percentage of complaints is higher than 0.041% and repurchasing rate is 0.724 with normal risk, than the conclusion is that the buyer is not CRM convenient. However, certain limitation should be taken into account - the relationship with data from past was 50:50%.

Before using the model, it is recommended to validate its quality, in order to get the level of safety which can be applied. Process where the quality of model has been tested by using data is the validation. In order to complete the validation, node Test Learning has been used, that demands input training and test data, as well as the classification tree. Training data are those based on which the model of classification has been built, whereas test data are new data that check the quality of the model. Validation of built model of business intelligence applied to real business problem from field of CRM and marketing proves the higher level of safety in decision making.

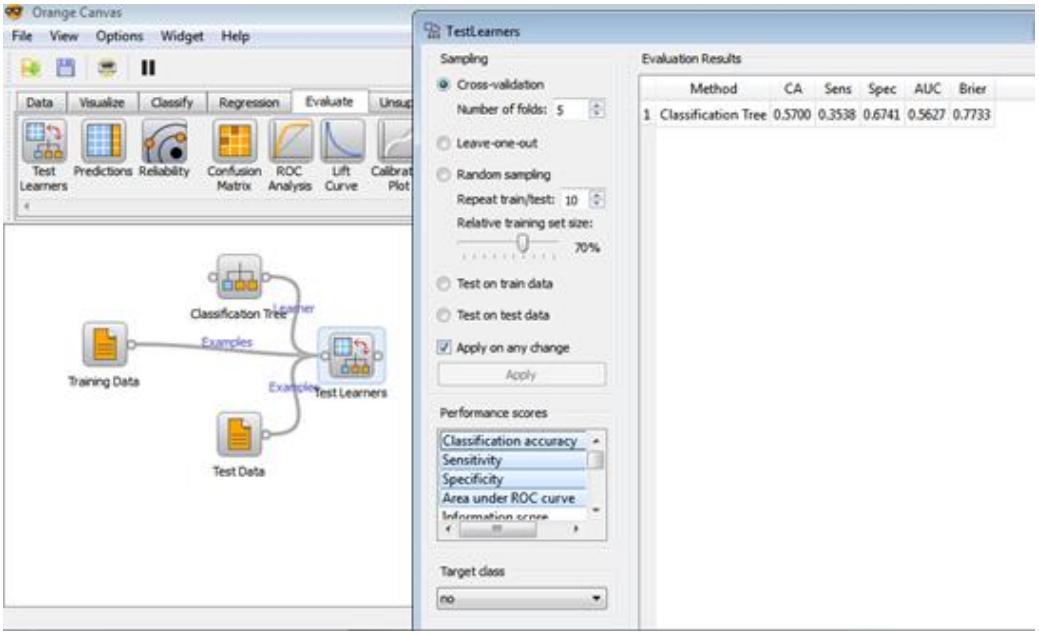


Figure 5: Validation of Model Quality with Node Test Learners

In lower left angle of dialog box Test Learners the user can specify what method to check the quality model (Classification Accuracy, Sensitivity, Specificity...). The most often used is the Classification Accuracy, which shows the accuracy of classification of 57%. When the accuracy is not satisfying, before the application of model there are corrections or creation of new model.

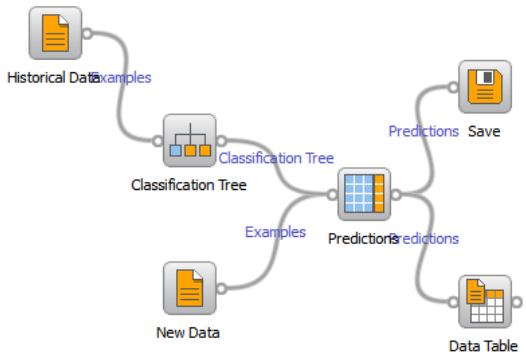


Figure 6: The Process of Function of Node Predictions
in Model Prediction

Classification model can be used in the future for prediction if future buyers based on attributes should have marketing and CRM efforts of the company or not. Furthermore, the node File that imports new data towards the node Predictions applying data mining in making patterns. At the end, the nodes Data Table for overview of given data and node Save for saving the same.

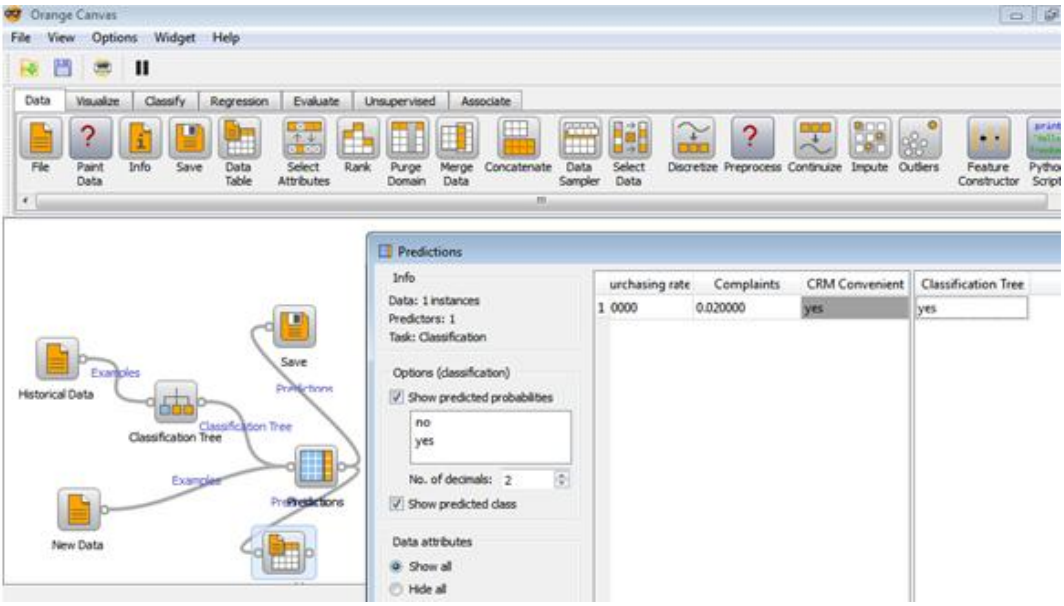


Figure 7: Model Application

On Figure 7, there is the application of classification model. For the buyer that has following attributes – age 43, female, normal income, risk normal, repurchasing rate 0.8, percentage of complaints 0.2, there is the conclusion of model that buyer is convenient for marketing and CRM activities of the company.

4. CONCLUSION

Business Intelligence concept has strategic importance for modern decision making. Data mining, very important and popular part of business intelligence, improves the effectiveness of decisions of managers in business system. Modern software architectures improve the finding of the most suitable solution of data mining methodology that has the application in different fields of business decision making: in marketing, customer relationship management, human resource management, etc. In the paper the model of business intelligence has been described that improved the quality and effectiveness of decision making management.

In order to be successful, data mining techniques need to become integral part of bigger business processes. Overall business strategies should be oriented to using the techniques of business intelligence. Increasing the effectiveness of decision making as complex process of getting the decisions that best fit certain criteria can be helped by the use of data mining techniques. Managers should have modern, interdisciplinary knowledge from the fields of information technologies, data mining and customer relationship management in order to get the most suitable business decisions for certain business challenges.

REFERENCES

Cleveland B., (2009). Call Centar Management on Fast Forward. United Business Media. ICMNI press. USA

G. Raab, R. Ajami, V. Gargeya, G. Goddard, (2008). Customer Relationship Management, a Global Perspective. Ashgate Publishing Group, Surrey. Great Britain.

Kriegel, H.-P., Borgwardt, K. M., Kröger, P,. Pryakhin, A., Schubert, M., & Zimek, A., (2007). Future trends in data mining. Data Mining and Knowledge Discovery. Vol. 15(1), pp. 87–97. doi: 10.1007/s10618-007-0067-9.

Krüger, A., Merceron, A., & Wolf, B., (2010), Data Model to Ease Analysis and Mining of Educational Data. Database, pp. 131–140.

Kotsiantis, S. B., (2011), Use of machine learning techniques for educational proposes: a decision support system for forecasting students' grades. Artificial Intelligence Review,, doi: 10.1007/s10462-011-9234-x.

Kumar, V., (2011). An Empirical Study of the Applications of Data Mining Techniques in Higher Education. International Journal of Advanced Computer Science and Applications. Vol 2(3), pp.80–84.

M. Bramer, (2007). Principles of Data Mining. Springer London limited.

Suknović,M., Delibašić B., (2010). Business Intelligence and Systems for Decision Making, FOS, Belgrade.

Čupić, M., Suknović M., (2008). Decision Making. FOS, Belgrade.

Thearling, K., (2010). Data Mining for CRM. Data Mining and Knowledge Discovery Handbook. Springer Science & Business Media.

USING PROCESS MINING TO DISCOVER SKIING PATTERNS: A CLUSTERING APPROACH

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Abstract: *This paper analyses skier movement data on Mt. Kopaonik, Serbia, and identifies movement patterns using process mining and spectral clustering. Movement patterns allow ski resort management to improve organisation of the ski resort, as well as to examine the injury risk of each movement pattern, making it possible to distinguish safe and unsafe movement patterns on the mountain. In this paper we focus on identifying movement patterns and leave injury risk analysis for further research. For discovering patterns we use a recently proposed process mining methodology. We apply it on the analysis of the event logs of ski lift gates entrances. As skiers movements are highly diversified, a method for robust clustering methods was preferred. The process starts by calculating a similarity metric between traces generated from the event log. Afterwards, a robust estimator based on that metric is calculated, an affinity matrix is created, and a spectral clustering method is applied. Traces (movement patterns) were calculated for two skiing days. We used Adjusted mutual information (AMI) to identify movement patterns that are valid on both days. The most frequent skiing patterns, represented in the form of a process model are suitable for further quantitative and qualitative analysis.*

Keywords*: skiing, movement patterns, process mining, spectral clustering*

1. INTRODUCTION

The reasons for finding patterns in skiers' movement are numerous. Ski resorts can analyse frequent skier trajectories, detect bottlenecks, improve capacities of ski lifts; all resulting in increased level of security and end-user experience for skiers.

Every skier's entrance through the ski-lift gate is being recorded through RFID technology in a central database. The question is how to use this big data to discover knowledge? Currently there are only a few papers that analysed this kind of data (Kisser, Goethals, & Wrobel, 1996), (D'Urso & Massari, 2013)

Process mining is an emerging field that lies between data mining, computational intelligence and business process management. One of its primary activities is to discover processes hidden in event logs (Aalst, Process Mining Manifesto, 2012).

Discovery of movement patterns in this paper is based on clustering skiers' paths into previously unknown groups, so that cases would be highly similar one to another, compared within those groups, but as much as possible different, compared between the groups. The final result of this process is a discovery of common characteristics of skiers in those groups, represented in the form of a process model.

One extra problem, regarding this kind of data, is that these kinds of processes are highly diversified, and it is very difficult to choose which cases should be included in a distinct cluster as every one of them could be the cluster itself. Therefore, the most commonly used clustering methods and similarity measures do not provide satisfactory results if they are applied on raw data (Medeiros, et al., 2008). To overcome this problem, a robust similarity measure that was recently proposed in (Delias, Doumpos, Manolitzas, Grigoroudis, & Matsatsinis, May 2013) was used to pre-process the data for the spectral clustering. Other clustering approaches applied in process mining problems can be found in (Veiga & Ferreira, 2010), (Song, Günther, & Aalst, 2009), (Jung, Bae, & Liu, 2009), (Bose & Aalst, 2009), (Luengo & & Sepúlveda, 2012), however the method used in this work is preferred because it proposes a way to deal not only with high variability but with large number of unique paths as well and skiers' movements appear to be such a case. This highly diversified and chaotically connected kind of process, in process mining terminology is called a spaghetti-like process. As the volume of unique paths in this kind of data is very high, it was necessary to use robust methods for clustering. The illustration of a real process of skier movements is shown in Figure 1.

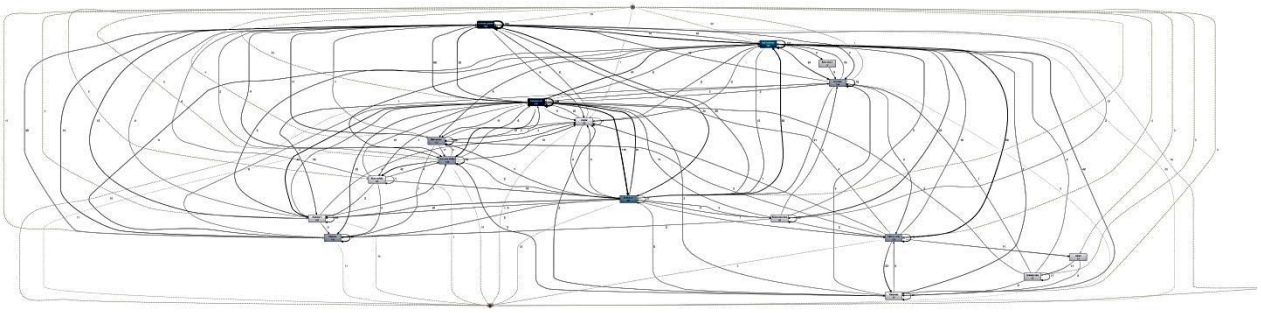

Figure 1: Real flow of skiers on the tracks – illustration of a spaghetti-like process, generated with Fluxicon Disco process mining software

About location and ski gates

Mt. Kopaonik is one of the largest mountains in Serbia, located in the central part of the country. Its highest point, Pančić's Peak, is 2017 m (6617 ft) above sea level. On average, 200 sunny and 160 days of natural snow coverage per year make Kopaonik the major ski resort of Serbia, with skiing season usually lasting from early December until late April, depending on the weather conditions.

It has total of 25 ski lifts with capacity of 32000 skiers per hour, equipped with RFID scanners collecting the data about skiers' pass.

Regarding Kopaonik's beautiful ski-tracks, there are 15 easy, 10 medium, and 7 difficult tracks, sorted by difficulty into three categories, respectively from easiest to the most difficult – Blue, Red, and Black. All tracks are connected one to another. Tracks "Karaman greben", "Pančićev vrh" and "Duboka" have installed systems for artificial snowing.Track "Malo jezero" is suitable for night skiing.

The map of the ski-tracks (figure 2):

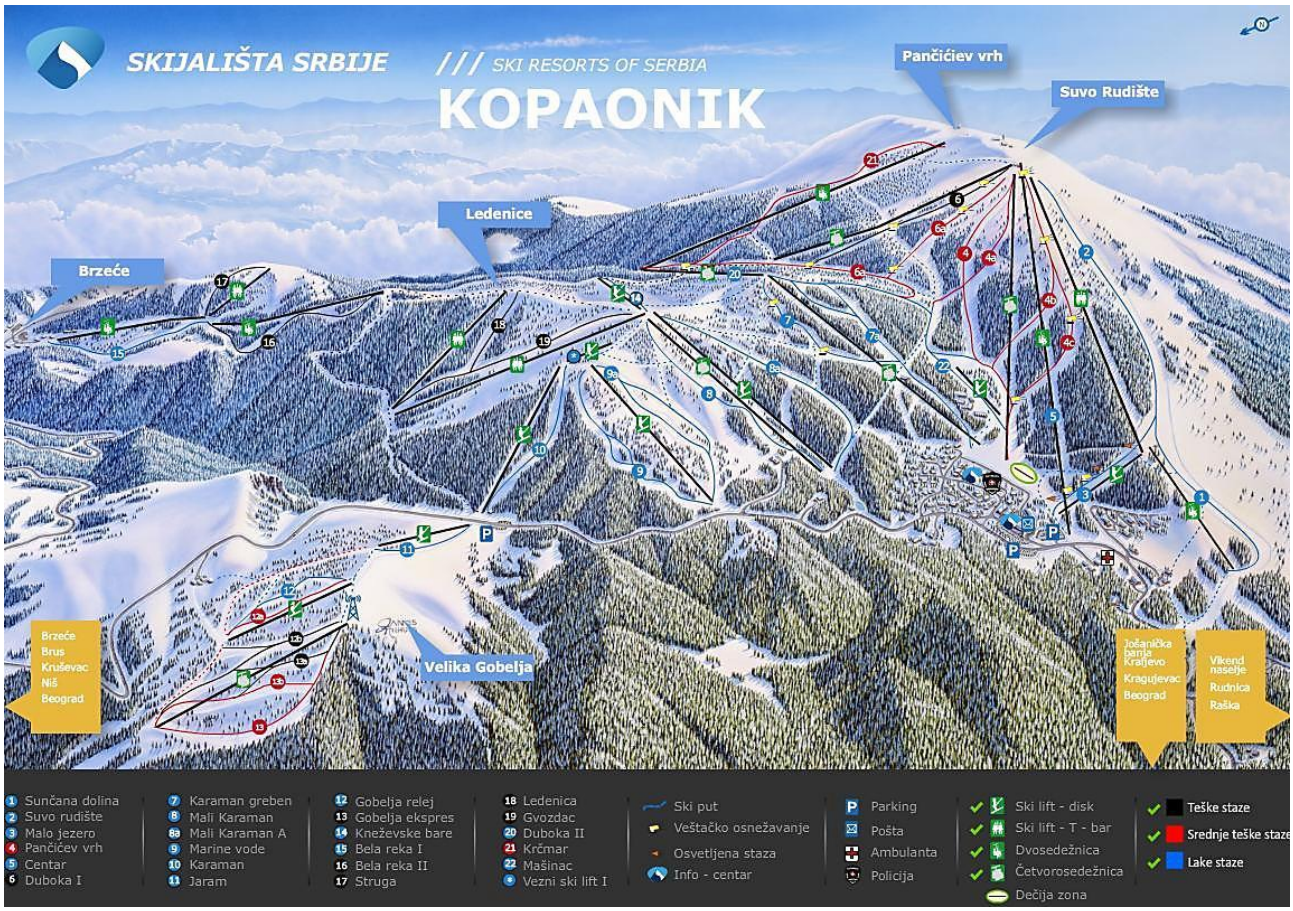

Figure 2: Map of ski-lift gates and slopes

2. METHODOLOGY

The methodology used in this paper was recently proposed by (Delias, Doumpos, Manolitzas, Grigoroudis, & Matsatsinis, May 2013), and consists of five steps. We added the last two steps in order to be able to compare skiing trajectories between different days. The steps are:

- Step 1: Creation of the Event log from the RFID ski-lift gate entrance scans
- Step 2: Creation of traces from the Event log
- Step 3: Calculation of cosine similarity of activities' and transitions' vectors
- Step 4: Calculation of the robust similarity matrix
- Step 5: Spectral clustering (through calculation of the eigenvectors and eigenvalues of the similarity matrix)
- Step 6: Using adjusted mutual index (AMI) calculation for analysing pairs of clusters on different days, and
- Step 7: Creation of the most representative cluster process model based on AMI analysis.

For the purpose of this paper, we have analysed two event logs for two representative, successive, skiing days, generated from ski-lift gate entrance RFID scans.

The process starts with data pre-processing. First, the Event log is being created transforming the data collected from RFID scans. The structure of this event log used for process mining is provided in Table 1. The Skier column/attribute represents an ID for the case in the process mining terminology, the Location attribute represents an Activity ID (node on the graph, ID of the track), and every row (instance) represents a single event. After grouping these rows by ID, ordered by timestamp, we get the whole case trace. Traces are vectors representing cases (skiers), and its components representing sequence of visited places (tracks). All these data are mandatory and minimum for process mining, although event logs could hold additional information for analysis of different perspectives (Aalst, Process Mining Manifesto, 2012).

Table 1: Structure of the Event log based on the data collected from the RFID scans

Skier	Location	Complete.Timestamp
341468	59	8:59:46
…	…	…

When traces are known, it is possible to calculate vector of frequencies of visited places (activities) and transitions (movement from location x to location y). This information is used in the next step to calculate similarity matrix of activities and transitions using cosine metric, which compares similarity of two vectors (Formula 1). These two similarities are later joined into overall similarity, where similarity of cases based on shared activities weights 40%, and similarity of cases based on transitions weights 60%. In this work, the weights are inferred arbitrarily, while a slight advantage is given to transitions similarity, because the activities set is rather small and is quite probable to have skiers visiting the same gates. Afterwards, the robust similarity is calculated using local densities concept (Chang & Yeung, 2008), so that outlier traces (low-frequent ones) could be more easily spotted and could avoid influencing the clustering process. However, we have to mention that even infrequent traces are clustered. The main idea is that if an object is surrounded with more objects, we should promote its chances to be grouped together with its neighbours. The measure used for estimating local density is given in Formula 3.

$$SIMactivities\ (Ti,Tj) = \frac{a(i)\cdot a(j)}{|a(i)||a(j)|}\frac{\sum_k a_k(i)\times\ a_k(j)}{\sqrt{\sum_k a_k(i)^2\times\ \sum_k a_k(j)^2}}$$

$$SIMtransitions(Ti,Tj) = \frac{a(i)\cdot a(j)}{|a(i)||a(j)|}\frac{\sum_k t_k(i)\times\ t_k(j)}{\sqrt{\sum_k t_k(i)^2\times\ \sum_k t_k(j)^2}} \quad (1)$$

$$s(Ti,Tj) = Sij = Wa\cdot SIMactivities(Ti,Tj) + Wt\cdot SIMtranstitions(Ti,Tj) \quad (2)$$

$$l_i = \sum_{j \in \aleph_i} S_{ij} \text{where } \aleph_i \text{ is neighborhood of an object i} \tag{3}$$

$$s'_{ij} = s_{ij} l_i l_j$$

After visualisation, we get the image of similarity of filtered data, represented by heatmap where cells coloured green represent the least similar cases, black coloured medium, and the red coloured the most similar cases. (Figure 3)

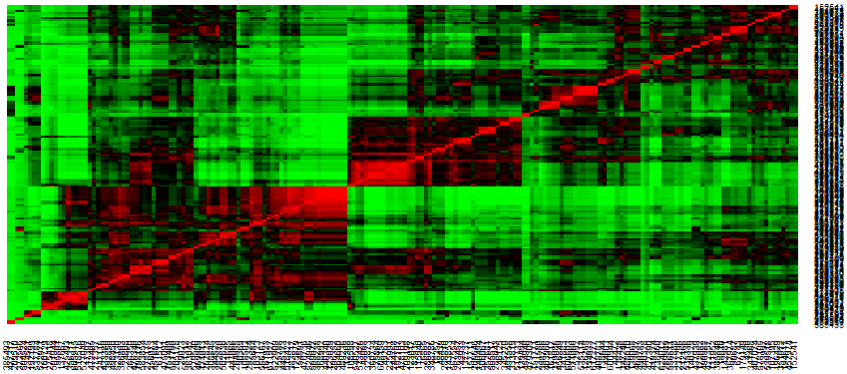

Figure 3: Heatmap representing cases similarity

The next step is to run spectral clustering. Spectral clustering is a methodology which analyses Laplacian matrix and finds its eigenvectors and their corresponding eigenvalues, so the dimensions of the space could be reduced to a lower dimension subspace which best represents a view on the data we are analysing. After this analysis, for chosen number of eigenvectors, k-means clustering algorithm was run with the same seed value, so the process could be fully repeatable. The concept of spectral clustering is similar to principal component analysis, as the idea is to find the variables which bring the highest information gain (highest variability) if used, although it is based on the graph theory, instead of covariance calculation (Luxburg, 2007).

In the next step, eigenvectors, and their values are being plotted to determine how many eigenvectors should be used to represent the data in the best possible way. The number of eigenvectors included in further analysis represents the number of dimensions of a new subspace. From Figure 4 and 5, which represents previously mentioned plot of eigenvectors and corresponding eigenvalues, it is still difficult to tell the best number of eigenvectors (clusters) to use, as there is no obvious cut-off point.

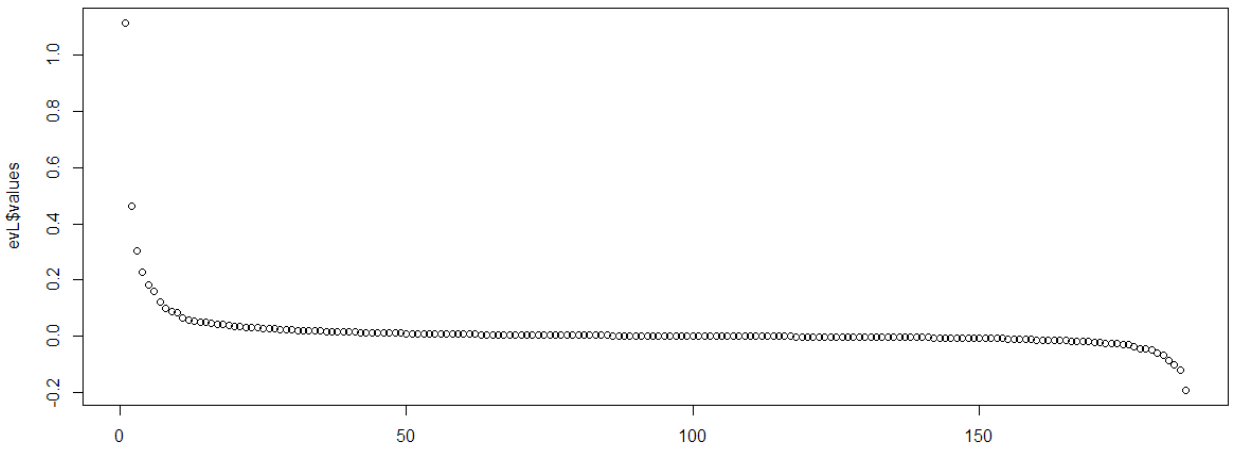

Figure 4: Eigenvectors and eigenvalues plot – all eigenvectors

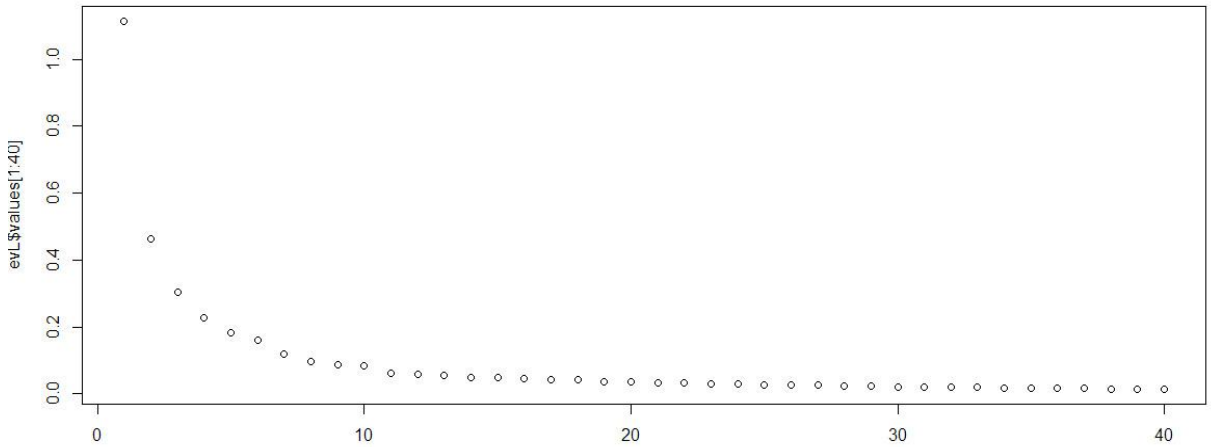

Figure 5: Eigenvectors and eigenvalues plot - first 40 eigenvectors

Therefore, we run k-means algorithm iteratively for clusters size 2 to 20, as 20 seems to be the theoretically best cut-off point, although practically may not be, and finally save the clustering results for each cluster size.

Once again, this process is repeated for the data regarding second day of analysis.

Having generated from 2 to 20 clusters for each day of analysis, we exclude the cases not contained in data for both days, for both groups of files containing information about clusters. Later on, we compare similarity of clusters using adjusted mutual index (AMI), which is based on combinatory measurement of clusters' similarity, and plot the results (Xuan Vihn, Epps, & Bailey, 2010). As it can be seen in Figure 6, the best representatives are cluster size cases where the AMI value is highest – scenario 1: two clusters, scenario 2: eight clusters. Therefore we generate process models for each of these cases

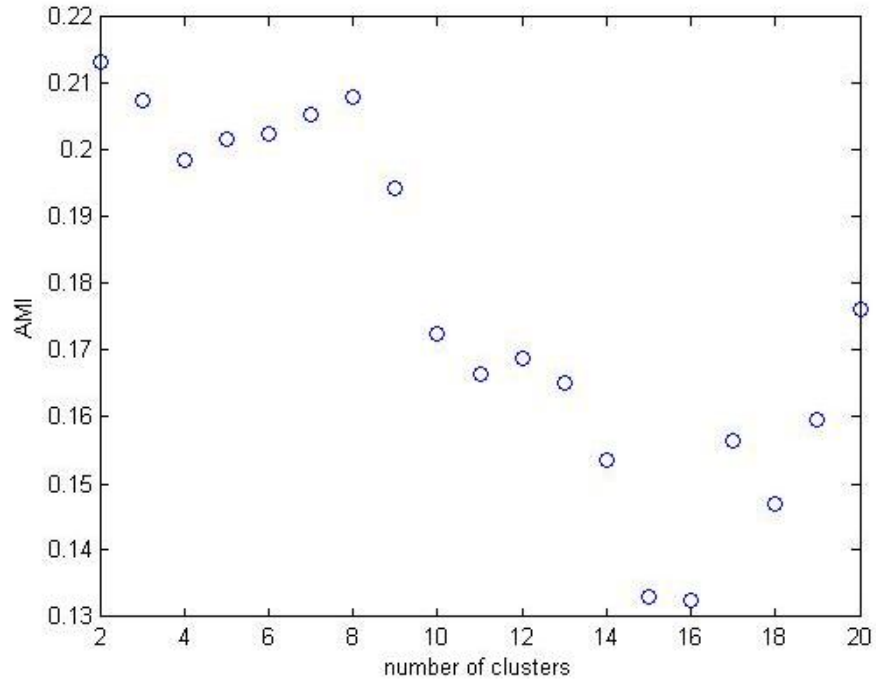

Figure 6: AMI graph

3. RESULTS

For scenario 1, where there are two clusters, we have obtained process models represented with Figure 7 and Figure 8. For the reason of better legibility, Figures 9 and 10 are also given. They represent the same models from Figure 7 and 8 but at the higher level of abstraction. We would like to stress that these figures are not generated with usage of any additional metrics or filtering cases, but with changing the level of details shown at the process map.

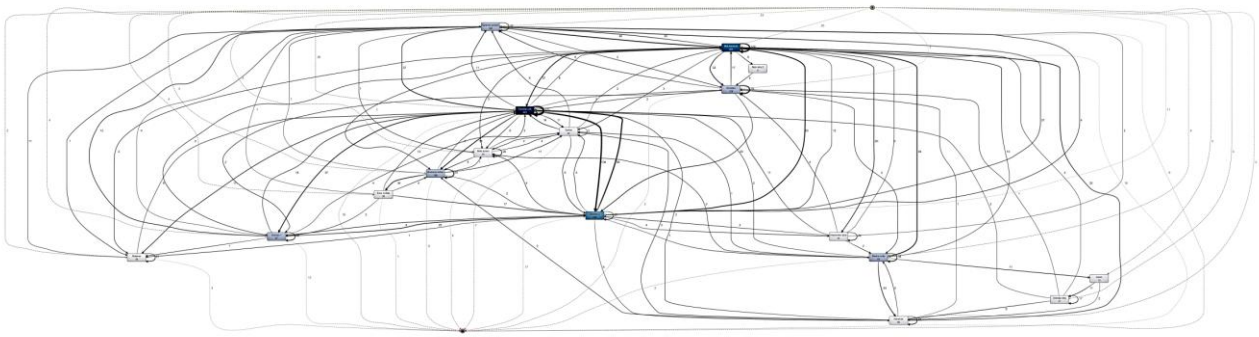

Figure 7: Full detail process map of Cluster 1 from Scenario 1, generated with Fluxicon Disco, 100% of activities, and 100% of paths visible

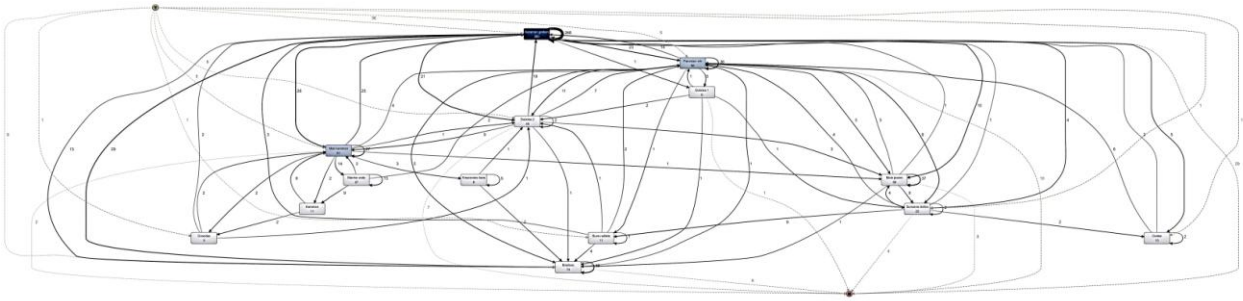

Figure 8: Full detail process map of Cluster 2 from Scenario 1, generated with Fluxicon Disco, 100% of activities, and 100% of paths visible

In cluster one (Figure 9), there are 63% of the cases (skiers), and they generate 69% of the events (passes through gates) in the Event Log.

In this cluster, it is noticeable that Ski-lifts (represented as nodes in Figure 9) “Pancicev vrh”, “Mali Karaman”, and “Duboka 2” are the most frequently used (in Figure 9 skiers’ pass frequency represented as arcs). Also, the biggest part of the skiers (30-50%, depending on the location) is using the same ski-lifts over and over again.

Some of the strongest patterns, besides previously mentioned loop-a-likes, are:

- Karaman greben ->Pančićev vrh
- Pančićev vrh ->Duboka 2
- Duboka 2 -> Mali Karaman
- Mali Karaman -> Marine vode
- Mali Karaman ->Kneževske bare

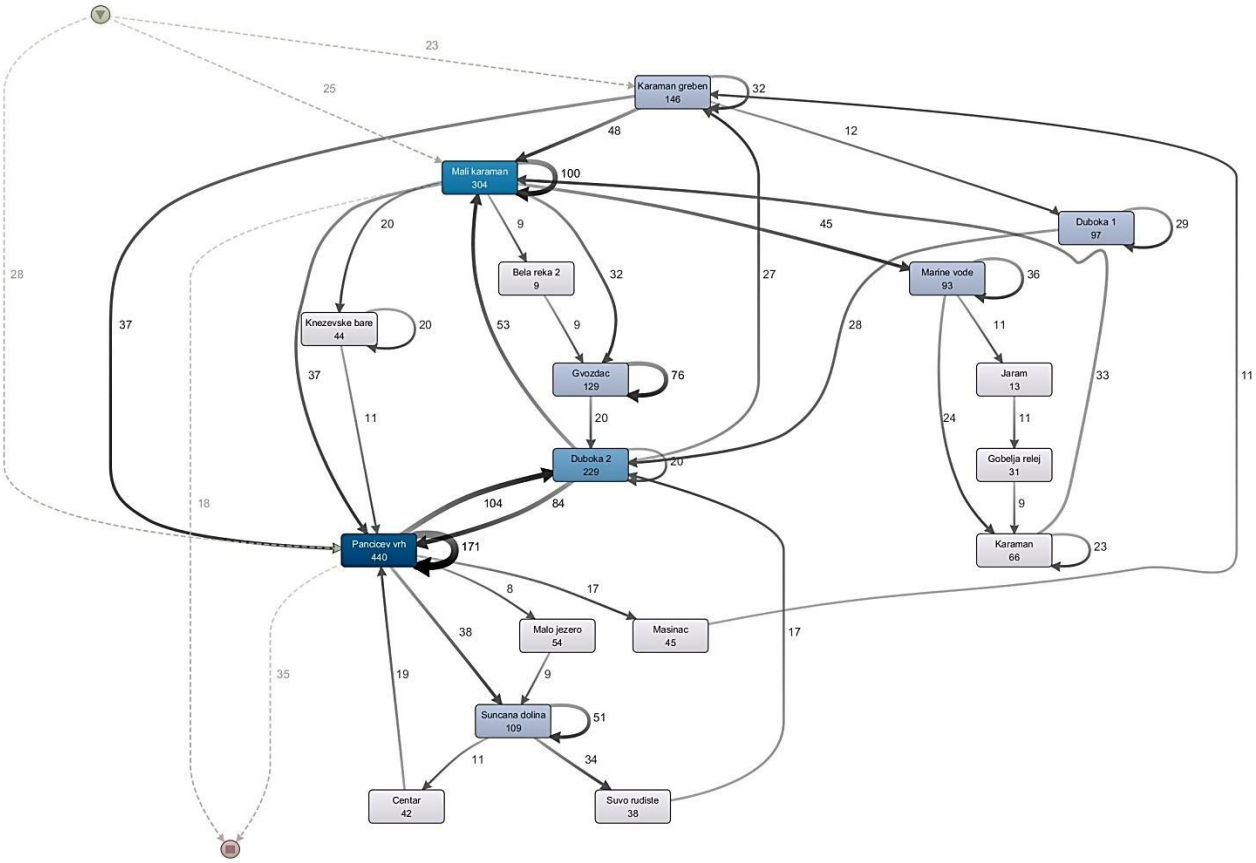

Figure 9: Higher level of abstraction of Cluster 1 from Scenario 1, generated with Fluxicon Disco, 100% of activities, and 20% of paths visible

In cluster two, 36% of the cases (skiers) generate 30% of the events (passes through gates) in the Event Log (Figure 10).

The most used ski-lifts in this cluster are Karaman greben, Pančićev vrh and Mali karaman.

Some of the strongest patterns discovered in this cluster are:

- 65% of skiers using Karaman greben ski-lift are returning over and over again
- 40% of skiers go from Masinac back to Karaman greben
- Karaman greben ->Karaman mali
- Karaman greben ->Pančićev vrh

The same kinds of models are generated for Scenario 2, but are left out due to space constraints.

As an illustration of capability for performance analysis of the process, figure 11 shows mean time skiers spend on paths, for cluster two. This kind of information is very useful for detecting bottle-necks. Figure 11 shows most popular paths (as time spent on them is noticeably longer than on others):

- Karaman greben -> Malo jezero (on average, skiers spend 6.3 hours on it)
- Karaman greben -> Centar (on average , skiers spend 9.4 hours on it)
- Knezevske bare -> Masinac (on average, skiers spend 5.8 hours on it)

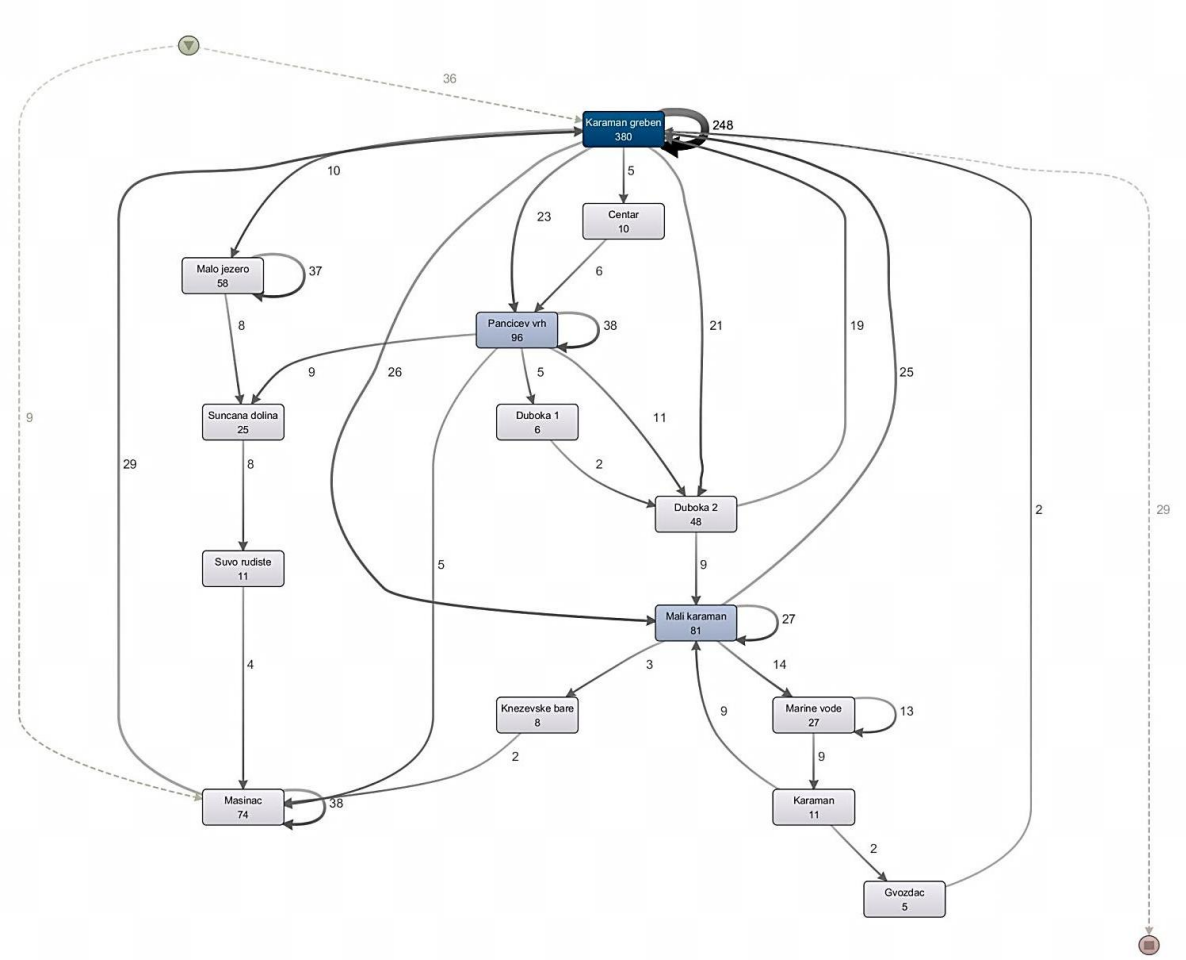

Figure 10: Higher level of abstraction of cluster 2 from scenario 1, generated with Fluxicon Disco, 100% of activities and 20% of paths visible

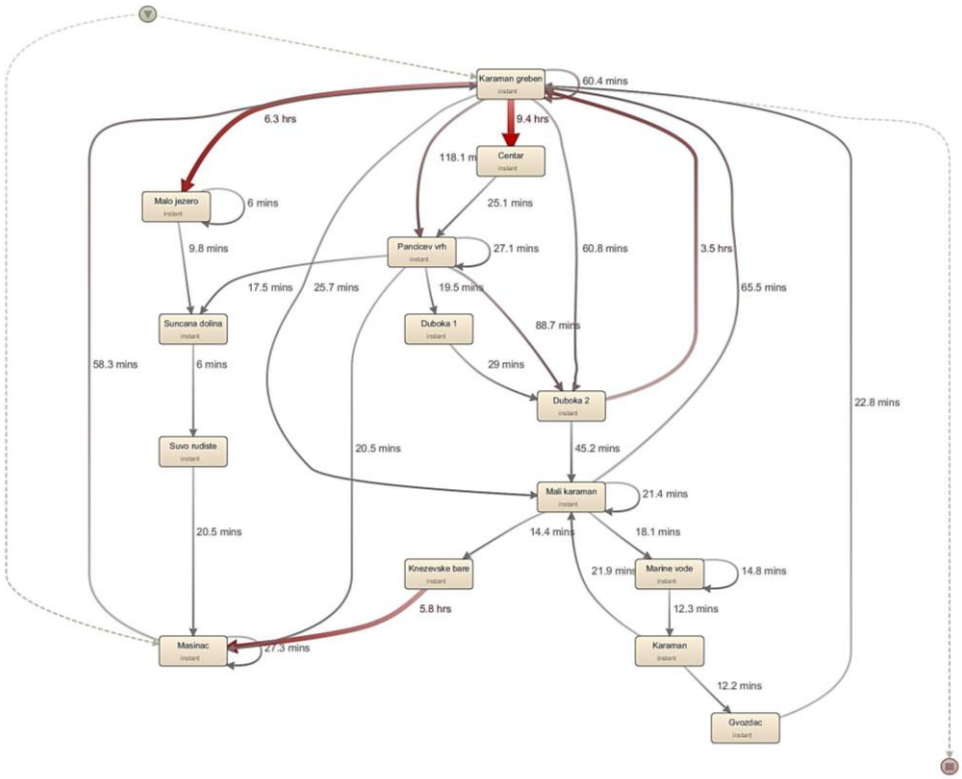

Figure 11: Average time spent on paths for cluster 2, scenario 1, generated with Fluxicon Disco, 100% of activities and 20% of paths visible.

4. CONCLUSION

In this paper we have analysed skier movement data on Mt. Kopaonik, Serbia, and have identified the most frequent movement patterns using a recently proposed spectral clustering process mining methodology which analyses event logs searching for underlying processes, supported with robust similarity metric for heterogeneous data filtering.

As there are only a few of papers analysing this kind of data, the results acquired are even more important from both theoretical and practical point of view, especially because analysing noisy data is in particular difficult from process mining perspective, due to fact that high variability in processes is caused by human behaviour, which is thereby often irrational and hard to understand or predict. Therefore, in such inconsistent and long-distance connected, spaghetti-like processes, it is very challenging for the most commonly used algorithms to discover suitable clusters, and additional data cleaning is necessary for successful analysis. The main advantage of using robust similarity metric for this task lies in fact that it is very easy to understand and implement, it is efficient, and its settings are highly customisable to a new instance of problem, which is very important due to fact that data are analysed on the daily basis which causes frequent changes in data.

Although using the movement patterns for examination of injury risk is not in the focus of this paper, as we have only focused on identifying movement patterns and left injury risk analysis for further research, it is a topic of uttermost importance for future extensions of this paper. The results of this paper are also suitable for further quantitative and qualitative analysis, as movement patterns allow ski resort management to improve organisation of the ski resort by analysing frequent skier trajectories, detecting bottlenecks, improving capacities of ski lifts; all resulting in increased level of security and end-user experience for skiers.

REFERENCES

Aalst, W. v. (2007). Business process mining: An industrial application. *Information sistems vol.32*, 713-732.

Aalst, W. v. (2012). Process Mining Manifesto. *Business Process Management Workshops* (pp. 169-194). Berlin: Springer.

Aalst, W. v., & Bose, R. (2009). Abstractions in process mining: A taxonomy of patterns. *Business Process Management, Lecture notes in computer science, vol.5701* (pp. 159-175). Springer.

Alst, W. v., Weijters, T., & Maruster, L. (September 2004). Workflow mining: Discovering process models from event logs. *IEEE TRANSACTIONS ON KNOWLEDGE AND DATA ENGINEERING Vol.16, No.9*.

Bose, R. P., & Aalst, W. M. (2009). Context Aware Trace Clustering: Towards Improving Process Mining Results. *Proceedings of the SIAM International Conference on Data Mining, SDM*, 401-412.

Chang, H., & Yeung, D.-Y. (2008). Robust path-based spectral clustering. *Pattern Recognition, 41(1)*, 191-203.

Delias, P., Doumpos, M., Manolitzas, P., Grigoroudis, E., & Matsatsinis, N. (May 2013). Supporting Management Decisions via Robust Clustering of Event Logs. *PROCEEDINGS OF THE EWG-DSS THESSALONIKI-2013 WORKSHOP - "EXPLORING NEW DIRECTIONS FOR DECISIONS IN THE INTERNET AGE ".* Thessaloniki, Greece.

D'Urso, P., & Massari, R. (2013). Fuzzy clustering of human activity patterns. *Fuzzy Set Syst*, 215: 29-54.

Jung, J.-Y., Bae, J., & Liu, L. (2009). Hierarchical clustering of business process models. *International Journal of Innovative Computing, Information and Control 5(12)*, 1349–4198.

Kisser, R., Goethals, B., & Wrobel, M. (1996). Epidemiology for marketing ski safety. *ASTM Spec Tech Publ*, 1266: 104-115.

Luengo, D., & & Sepúlveda, M. (2012). Applying Clustering in Process Mining to Find Different Versions of a Business Process That Changes over Time. *Business Process Management Workshops vol. 99*, 153-158.

Luxburg, U. v. (2007). A Tutorial on Spectral Clustering. *Statistics and Computing*.

Medeiros, A. d., Guzzo, A., Greco, G., M.P.Van der Aalst, W., Weijters, A., Dongen, B. F., & Sacca, D. (2008). Process Mining Based on Clustering: A Quest for Precision. *Business Process Management Workshops - Lecture Notes in Computer Science Vol.4928* (pp. 17-29). Springer.

Song, M., Günther, C., & Aalst, W. (2009). Trace Clustering in Process Mining. In D. Ardagna, M. Mecella, & J. Yang (Eds.),. *Business Process Management Workshops vol.17*, 109-120.

Veiga, G., & Ferreira, D. (2010). Understanding Spaghetti Models with Sequence Clustering for ProM. *Business Process Management Workshops vol. 43*, 92-103.

Xuan Vihn, N., Epps, J., & Bailey, J. (2010). Information Theoretic Measures for Clusterings Comparison: Variants, Properties, Normalization and Correction for Chance. *Journal of Machine Learning Research* , 2837-2854.

Fluxicon Disco process mining tool, http://fluxicon.com/disco/

DATA ANALYSIS AND SALES PREDICTION IN RETAIL BUSINESS

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Abstract: *Sales drive the business. Sales forecasting helps in setting right objectives and making crucial strategic decisions. It is of the vital significance for a business both in short- and long term strategy. It is an effective marketing and management tool used to put consumer behavior into a predictable pattern, thus reducing various cost categories by creating intuitive campaigns and incentives to stimulate the sales in periods of low season and boost the sales when sales peaks are expected.*

In this paper the goal was to make predictions on sales volumes for retail chain Walmart. The dataset was derived from the Kaggle competition which is active until 05.05.2014. We propose a model for sales forecasting with a weighted mean absolute error (WMAE) in range between 3.455 and 25.546 which makes this paper ranked between 186th and 399th on the competition among more than 500 competetors. The model was derived using SVM algorithm, which showed the best result with least WMAE, comparing to other algorithms we tested (linear regression, Neural Net, W-lBk, k-NN).

Keywords: *Sales forecasting, trends, seasonality, exponential smoothing, data analysis, RapidMiner, SVM*

1. INTRODUCTION

For this competition Kaggle presented several datasets from Walmart, with a challenge to create a prediction system of weekly sales in retail departments, according to given set of historical data, parameters and key indicators.

Thorough data analysis showed that it is extremely difficult to make a proper prediction for this model. We have noted the presence of seasonality and discovered trends which vary from department to department. In this case, it turns out to be beneficial to use a smoothing process to compensate for the sharp discontinuities that will inevitably occur (Ian H. Witten, 2005). Each department's behavior is often different from behavior of its own store, and factors that affect the sales in stores, not necessarily have the same impact to a single department sales, thus imposing the need to put one more step in prediction process – taking into account some factors not previously defined in problem setting.

In section 2 we have examined the basic setting of the problem, datasets and main factors, detected the presence of various trends and dependencies, and implemented multiple research methodologies, including SVM validation in RapidMiner, program capable of many data mining tasks (Matthew North, 2012), LES method (linear exponential smoothing) in Excel, as well as a new model we proposed which tracks the cross-functional dependencies between sales trends of several factors respectively.

First algorithm we applied in RapidMiner for this case was Linear regression, which commonly delivers excellent accuracy. However, it is not applicable in this problem due to seasonality & trend presence.

Section 3 presents the results we got with chosen approach, explained the complexity of the problem and defined next steps to take.

2. EXPERIMENTAL DESIGN

In this section we explained the formula of WMAE presented in Kaggle competition and analysed the importance of several parameters in Walmart datasets. Next we tried to discover some trends in data and, finally, we presented the project we created in RapidMiner in order to achieve the desired objective.

2.1. EVALUATION

The main data is divided in two main tables: training table, with dataset consisting of 421.570 rows of data, and test data sample with evaluation on a part of test sample which is unknown.

Accuracy is evaluated by a formula for weighted mean absolute error (WMAE). We did not pick this formula, it was imposed by Kaggle as such. The formula includes number of records in a recordset of a single department and defines weight so that the week in which some holiday occurs has 5 times bigger weight than the ordinary week:

- *wi* are weights.
  (w = 5 for a holiday week, 1 otherwise)
- n is the number of rows
- $\hat{y}_i$ is the predicted sales
- *yi* is the actual sales

$$\text{WMAE} = \frac{1}{\sum w_i} \sum_{i=1}^{n} w_i |y_i - \hat{y}_i| \quad (1)$$

2.2. DATA

Data is presented as weekly sales per department. There are 45 stores in total, counting 99 departments in each store. This gives the total number of approximately 4.445 departments (there are some departments without sales data) to create individual sales forecast for.

Parameter set includes: 4 big national holidays in USA (Super Bowl, Labor Day, Thanksgiving Day, Christmas), promotional markdowns for 5 different product categories, store size and store size categorization, unemployment ratio, consumer price index, fuel price and air temperature. Column [weekly_sales] is given for each department of the store for a period from 05.02.2010 to 26.10.2012, and the main task is to predict the weekly sales for each department of each store for a period starting from 05.11.2012 until 26.07.2013.

The importance of holidays should be observed with caution, since for some holidays there is evident sales peek, while for other holidays there is no significant change in sales.

Values in markdown columns, representing the amounts of promotional discounts per store (not per department), are the real challenge, since their appearance seems to be random, and the data seems incomplete.

Other factors (store size, CPI, unemployment, fuel price and air temperature), show slight but stable changes in time. Fuel price actually presents the selling price of fuel within Walmart stores. It is valuable to know that selling boost in these retail stores always starts with „Black Friday“, Friday that comes few weeks before Thanksgiving Day (beginning of November), and this high seson in sales usually ends after Christmas. Similar situation is with Super Bowl (usually 6th week of the year), in which case the sales jumps week or two before the final game. These informations may further relativize the true weight of holidays.

2.3. TREND DETECTION

The observed dataset is considered in light with time series with seasonality, which will further help in choosing the proper methodology and algorithms. All tables with raw data are imported in Microsoft Access. Trend analysis is conducted in Microsoft Excel. For that purpose several new attributes are created in a form of derrived date fields which are supposed to shape and support trend analysis: week, month, quartal, year. We have created a relational model, connected stores, departments, holidays and weeks by ID, and cross joined primary tables in Access, in order to get comparable time series, as shown in Table 1. As we can see, data is not consistent, since some sales data in starting weeks of 2010 are missing. One possible solution was to crop the missing weeks and put the dataset in a range between weeks 6 and 43. In table 2 we observed the sales fluctuations during holidays.

Table 1 - Weekly sales by department

Dept	Week	Total	2010	2011	2012
1	1	16,567.69			16,567.69
1	2	32,878.64		15,984.24	16,894.40
1	3	35,724.80		17,359.70	18,365.10
1	4	35,719.63		17,341.47	18,378.16
1	5	41,971.67		18,461.18	23,510.49
1	6	83,578.75	24,924.50	21,665.76	36,988.49
1	7	137,986.76	46,039.49	37,887.17	54,060.10
1	8	108,565.64	41,595.55	46,845.87	20,124.22
1	9	58,880.40	19,403.54	19,363.83	20,113.03

Table 2 - Cumulative sales during holidays by departments

holidayName	Dept	2010	2011	2012
Christmas	96	609,498.66	589,757.47	
Christmas	97	517,062.60	516,222.42	
Christmas	98	220,397.35	259,031.46	
Christmas	99		6,460.01	
Labor Day	1	679,750.43	685,912.02	700,311.48
Labor Day	2	1,991,188.88	2,037,339.92	2,076,768.16

holidayName	Dept	2010	2011	2012
Labor Day	3	753,846.33	885,746.06	1,024,883.43

Since each store consists of 99 departments, it was interesting to examine if there is a trend present in this particular view. Figure 1 shows remarkable pattern in sales by same departments. Apparently, same departments have similar revenue levels:

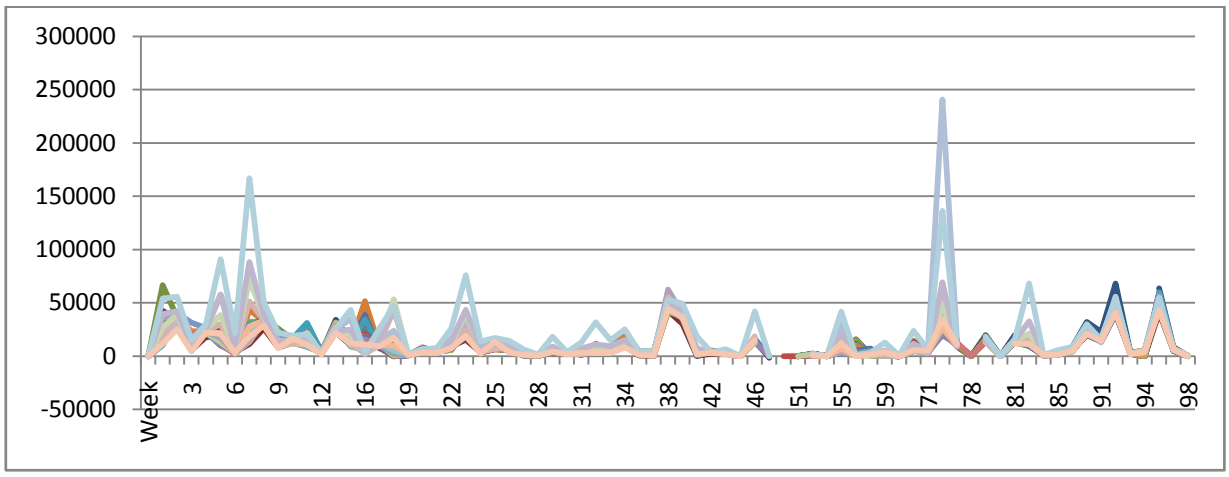


Figure 1 - Revenue trend for departments of all 45 stores

Table 3 shows annual changes in store revenues:

Table 3 - Cumulative sales in stores with % annual changes Y-2-Y

StoreID	2010	2011	2012	<> 2011	<> 2012
1	56,532,123	58,099,051	60,842,028	2.77%	4.85%
2	72,813,654	69,715,352	72,644,475	-4.26%	4.02%
3	14,218,013	14,715,512	16,118,525	3.50%	9.87%
4	72,380,275	78,634,279	82,674,554	8.64%	5.58%
5	11,315,820	11,649,619	12,647,859	2.95%	8.82%
6	58,946,026	57,201,270	59,437,292	-2.96%	3.79%

Figure 2 shows that there is no correlation in sales trends between departments of the same store whatsoever:

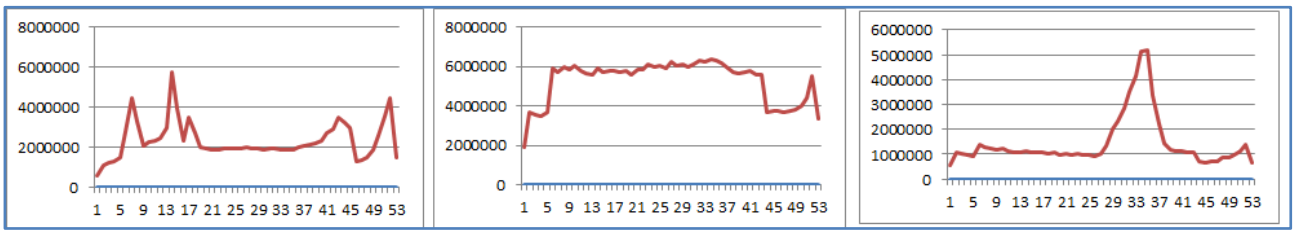


Figure 2 - Correlation existence analysis of sales in different departments within the same store

Figure 3 gives evidence of weekly sales correlation of same departments of different stores, and Figure 4 showes that this trend is being repeated in time, only with slight deviations.

Figure 5 brings the strongest evidence of trend existence. Each of 45 stores shows the same pattern in sales. Different behavior of store sales comparing to department sales adds to the complexity even more. To explain how complex problem really is, we managed to get prediction in RapidMiner only for a single store only (not for each department as originally required by Kaggle).

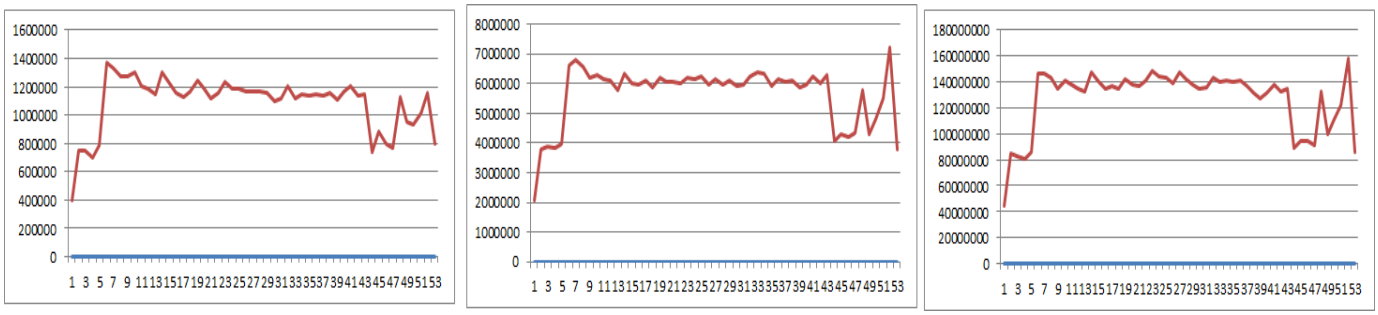


Figure 3 - Correlation existence analysis of weekly sales in stores 1, 2 and 3

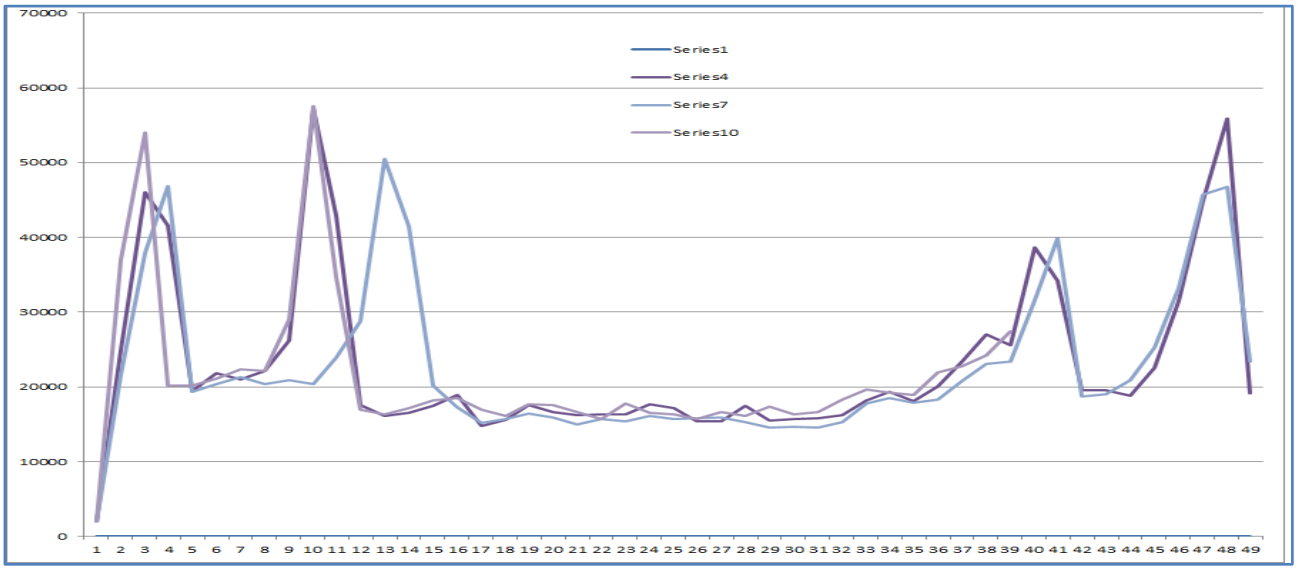


Figure 4 - Sales trend by weeks for a period 2010 - 2012 (weeks 6-43)

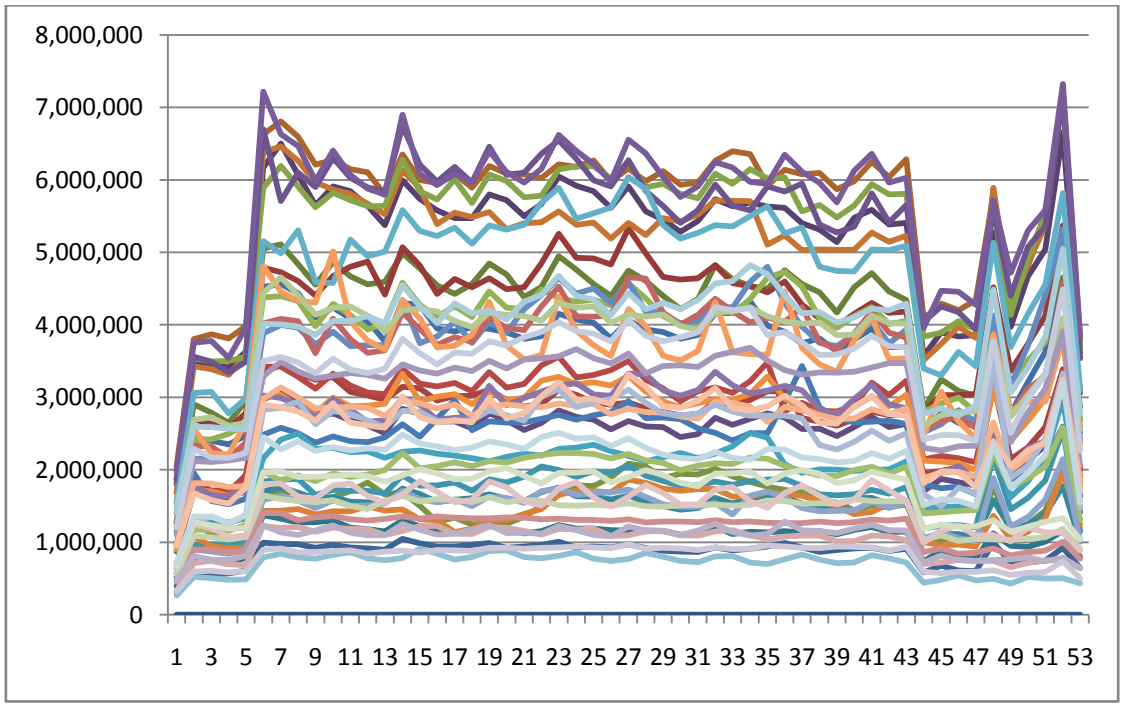


Figure 5 - General sales behavior in all stores

2.4. RESEARCH METHODOLOGY

Existence of time series with seasonallity combined with multifactor influence makes this problem complex in choosing a proper prediction methodology and algorithm. With regard to observations specified in previous chapter, we choose to test our work both in RapidMiner and in Excel. Unfortunately, due to the complexity of this problem, in Excel we did not include other factors except sales in time series.

2.4.1. MODELING IN RAPIDMINER

In modeling phase, we examined several methods to determine which model gives the best performance and least WMAE. Normalized data is processed in RapidMiner with following algorithms: SVM - support vector machine, linear regression, k-nn. In order to create a prediction model in RapidMiner, algorithm is trained with transformated data from file **TrainData.csv**, by implementing sigmoid kernel type.

Multiple error testing with SVM operator in RapidMiner showed the best results. Forecasting approach based on SVM model proves effective and feasible (Wu, Qi, 2009).

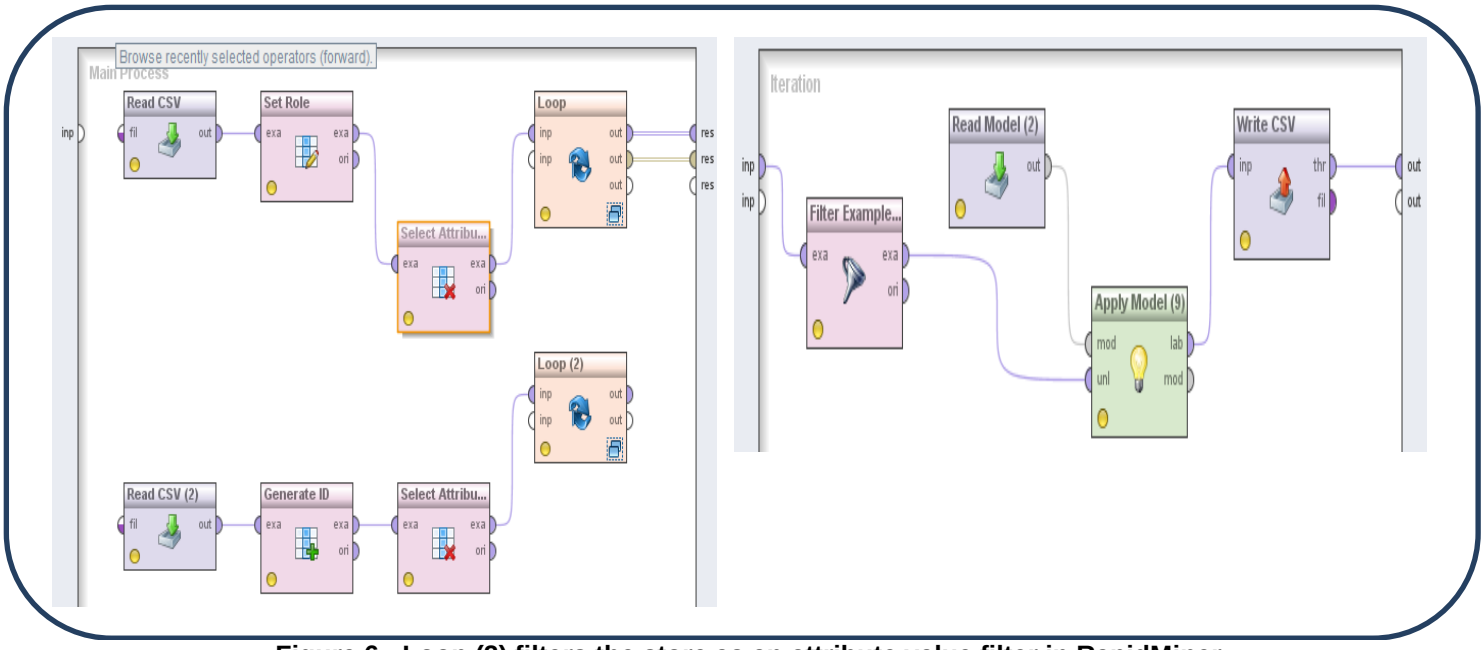


Figure 6 - Loop (2) filters the store as an attribute value filter in RapidMiner

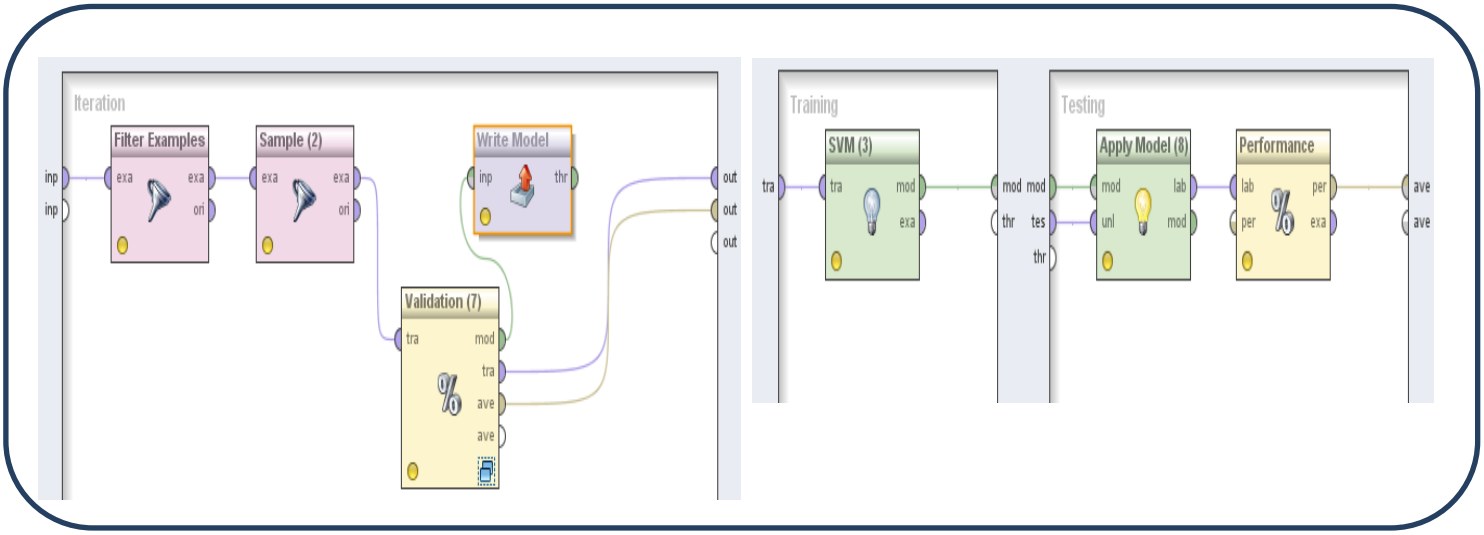


Figure 7 - Loop filters the store as an attribute value filter with 0.4 sample ratio, validated by SVM operator

As shown in figure 7, by using iteration macro, algorithm iterates 45 times, passes each store separately, and validates the model 10 times. To secure model to get through each store, we have put a filter example set by ID attribute value [store]. After each iteration, the model is saved at the store level. We have

tested the algorithm with data from file **TestData.csv**, by reading each model respectively. Finally, we saved the results of prediction in resulting **csv** file.

2.4.2. MODELING IN EXCEL

We have also examined various methods for implementation in Excel: moving average, linear approximation, least square regression, second degree approximation, flexible method, weighted moving average, linear smoothing, exponential smoothing, exponential smoothing with trend and seasonality.

Based on multiple testing and preliminary results, we decided to create several models: LES (linear exponential smoothing), seasonality moving averages, and multifactor dependency equation.

LES requires the number of periods best fit plus two years of sales data, and is useful for items that have both trend and seasonality in the forecast. You can enter the alpha and beta factor, or have the system calculate them. Alpha and beta factors are the smoothing constant that the system uses to calculate the smoothed average for the general level or magnitude of sales (alpha) and the trend component of the forecast (beta). (JD Edwards, 2013).

To get results with LES algorithm, we have ignored sales data for 2012 to create LES model based on two previous years only, 2010 and 2011. Then we compared results for 2012 proposed by LES, with actual sales. To implement LES, we have inserted moving average and divided it with sales value in order to get seasonality ratio for each week. Then by using denormalized and again normalized seasonality index we tried to make adjustment necessary to calculate LES formula which includes Alpha constant (Table 4).

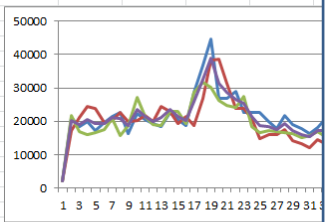
Table 4 - Linear exponential smoothing with seasonality adjustment and alpha constant

Week	Year	Sales	Trend Mov.avg	Seasonal. ratio	Seas.idx	Seas.adj.	Irregular	LES Forecast	LES Error	Reseason. forecast		Alpha	RMSE		Denorm. seas.index	Normaliz. seas.index
												0.471154				
5	2010	20,085	19,939	100.73%	103.5109%	19,404	97.31%	19,404	0	20,085		Auto(1)=	0.040		102.97%	103.51%
6	2010	21,084	19,795	106.51%	98.4362%	21,419	108.20%	19,404	2,015	19,100		Auto(2)=	-0.320		97.92%	98.44%
7	2010	18,310	18,633	98.27%	97.6442%	18,752	100.64%	21,303	-2,551	20,801		Auto(3)=	-0.138		97.13%	97.64%
8	2010	19,985	19,728	101.30%	100.4087%	19,904	100.89%	19,347	557	19,426		Auto(4)=	0.100		99.88%	100.41%
9	2010	17,224	19,262	89.42%	103.5109%	16,640	86.39%	19,753	-3,113	20,446		Auto(5)=	-0.082		397.89%	400.00%
10	2010	19,660	19,912	98.73%	98.4362%	19,972	100.30%	16,824	3,148	16,561						
11	2010	21,529	20,997	102.54%	97.6442%	22,049	105.01%	19,104	2,944	18,654		Ý(t) = 2Y(t-1) - Y(t-2) - 2(1-)e(t-1) + ((1-)^2)e(t-2)				
12	2010	22,712	21,222	107.02%	100.4087%	22,619	106.58%	21,891	728	21,981						
13	2010	16,254	18,506	87.83%	103.5109%	15,703	84.85%	23,243	-7,540	24,059						
14	2010	22,428	20,944	107.08%	98.4362%	22,784	108.78%	16,966	5,818	16,700		2010	2011	2012 P		
15	2010	20,517	20,356	100.79%	97.6442%	21,012	103.22%	21,602	-590	21,093						
16	2010	19,330	19,951	96.89%	100.4087%	19,252	96.49%	21,491	-2,240	21,579		21,084	17,240	21,619	20,085	
17	2010	18,534	19,593	94.60%	103.5109%	17,906	91.39%	19,695	-1,789	20,387		18,310	21,169	16,850	19,100	
18	2010	22,723	22,688	100.16%	98.4362%	23,084	101.75%	17,826	5,258	17,547		19,985	24,550	15,957	20,801	
19	2010	20,458	24,297	84.20%	97.6442%	20,951	86.23%	22,201	-1,250	21,678		17,224	23,811	16,474	19,426	
20	2010	18,771	27,753	67.64%	100.4087%	18,695	67.36%	21,611	-2,916	21,699		19,660	19,607	17,500	20,446	
21	2010	28,727	32,428	88.59%	103.5109%	27,752	85.58%	19,173	8,580	19,846		21,529	20,305	20,690	16,561	
22	2010	36,912	34,866	105.87%	98.4362%	37,498	107.55%	26,920	10,578	26,499		22,712	22,752	15,629	18,654	
23	2010	44,564	36,083	123.50%	97.6442%	45,630	126.48%	38,455	7,184	37,540		16,254	18,958	18,684	21,981	

Next model we examined is Moving average with seasonality adjustment. At first, we have calculated the seasonality factor by comparing each week sales with average sales for a given period between 2010 and 2012. Afterwards we implemented desasonality calculation for each repeating week in a period. Then we used Excel Forecast function which includes trend detection with prediction. Such result is finally used to take seasonality back in the model and to fine tune the prediction (Table 5).

Table 5 - Moving average with seasonality

Time	Week	Year	Sales	Week	1 Factor	2 Deseas	3 Forecast	4 Reseas		2010	2011	2012	2013	
1	6	2010	21,084.08	6	0.96	21,884	20,936	20,170	1	21,084	17,240	21,619	20,170	-6.70%
2	7	2010	18,310.31	7	0.91	20,224	20,960	18,976	2	18,310	21,169	16,850	18,976	12.62%
3	8	2010	19,985.20	8	0.97	20,555	20,983	20,401	3	19,985	24,550	15,957	20,401	27.85%
4	9	2010	17,224.22	9	0.92	18,634	21,007	19,418	4	17,224	23,811	16,474	19,418	17.87%
5	10	2010	19,659.70	10	0.91	21,547	21,031	19,189	5	19,660	19,607	17,500	19,189	9.65%
6	11	2010	21,529.14	11	1.00	21,424	21,055	21,159	6	21,529	20,305	20,690	21,159	2.26%
7	12	2010	22,711.59	12	0.98	23,130	21,079	20,697	7	22,712	22,752	15,629	20,697	32.43%
8	13	2010	16,254.21	13	0.88	18,422	21,103	18,619	8	16,254	19,958	18,684	18,619	-0.35%
9	14	2010	22,427.62	14	1.12	20,007	21,126	23,682	9	22,428	20,145	27,171	23,682	-12.84%
10	15	2010	20,516.64	15	1.02	20,122	21,150	21,565	10	20,517	21,618	21,302	21,565	1.23%
11	16	2010	19,330.26	16	0.94	20,614	21,174	19,855	11	19,330	19,955	19,057	19,855	4.19%
12	17	2010	18,534.40	17	0.99	18,646	21,198	21,071	12	18,534	24,606	18,705	21,071	12.65%
13	18	2010	22,723.48	18	1.10	20,605	21,222	23,404	13	22,723	22,934	22,957	23,404	1.95%
14	19	2010	20,457.62	19	1.01	20,239	21,246	21,475	14	20,458	19,394	23,037	21,475	-6.78%
15	20	2010	18,771.35	20	0.95	19,696	21,269	20,271	15	18,771	21,344	19,180	20,271	5.69%
16	21	2010	28,726.86	21	1.22	23,460	21,293	26,074	16	28,727	18,787	28,672	26,074	-9.06%
17	22	2010	36,911.59	22	1.53	24,119	21,317	32,624	17	36,912	26,737	31,569	32,624	3.34%
18	23	2010	44,563.68	23	1.82	24,522	21,341	38,782	18	44,564	38,450	30,053	38,782	29.05%
19	24	2010	26,910.46	24	1.47	18,253	21,365	31,499	19	26,910	38,569	26,249	31,499	20.00%
20	25	2010	26,984.25	25	1.34	20,179	21,389	28,602	20	26,984	31,439	24,777	28,602	15.44%
21	26	2010	28,912.18	26	1.23	23,428	21,412	26,425	21	28,912	23,792	24,077	26,425	9.75%



The final step in Excel prediction efforts is model we have created and named Multifactor Dependency equation. We have conducted the same methodology of cutting 2012 data to make prediction based on 2010 and 2011 sales and to eventually compare the results with actual 2012 sales.

We presumed that, in this particular case, sales has its various dimensions in time series. In other words, it can be viewed from different perspectives as percentage in sale change – by year, company, store, department, week, previous year, year before previous year, etc. Assuming that each dimension has its impact to the actual sales, we used some of them to create weights, namely importance factors as a

percentage of total sales factors (for example, we presumed that company sales trend has impact of 10% to the total department sales, store sales 20%, etc.), as shown in Table 6.

Table 6 - Multifactor dependency equation as a combination of single factor changes in time as weights in %

	2011	2012				2011					2012				
Walmart	-0.76%	2.57%	Store#	Dept#	Week#	Walmart	Store	Week	Dept	%	Walmart	Store	Week	Dept	%
						10%	20%	10%	60%		10%	20%	10%	60%	
Week	2011	2012													
6	-7.23%	8.36%	1	1	6	-0.76%	2.70%	-7.23%	-0.90%	-1.55%	2.57%	4.51%	8.36%	5.05%	3.18%
7	-2.07%	6.04%	1	2	6	-0.76%	2.70%	-7.23%	-0.75%		2.57%	4.03%	6.04%	2.01%	2.15%
8	0.91%	-6.04%	1	3	6	-0.76%	2.70%	-7.23%	-0.42%		2.57%	8.70%	-6.04%	2.93%	0.61%
9	0.36%	6.20%	1	4	6	-0.76%	2.70%	-7.23%	0.46%		2.57%	4.89%	6.20%	2.74%	2.89%
10	0.23%	1.06%	1	5	6	-0.76%	2.70%	-7.23%	-6.80%		2.57%	7.89%	1.06%	-3.26%	-0.96%
11	-2.83%	5.10%	1	6	6	-0.76%	2.70%	-7.23%	-21.50%		2.57%	3.76%	5.10%	-17.63%	-8.25%
12	-0.26%	0.27%	1	7	6	-0.76%	2.70%	-7.23%	-2.91%		2.57%	4.12%	0.27%	3.79%	0.64%
13	-2.85%	5.59%	1	8	6	-0.76%	2.70%	-7.23%	-1.05%		2.57%	3.29%	5.59%	3.11%	2.05%
14	-13.81%	23.11%	1	9	6	-0.76%	2.70%	-7.23%	-1.12%		2.57%	5.36%	23.11%	8.07%	8.17%
15	-3.12%	1.62%	1	10	6	-0.76%	2.70%	-7.23%	1.85%		2.57%	0.87%	1.62%	2.90%	1.13%
16	-0.47%	0.22%	1	11	6	-0.76%	2.70%	-7.23%	-3.46%		2.57%	3.32%	0.22%	1.69%	-0.24%
17	8.81%	-10.19%	1	12	6	-0.76%	2.70%	-7.23%	-5.20%		2.57%	3.93%	-10.19%	2.02%	-3.04%
18	-0.40%	8.26%	1	13	6	-0.76%	2.70%	-7.23%	-3.58%		2.57%	4.70%	8.26%	1.35%	2.00%
19	-3.38%	0.14%	1	14	6	-0.76%	2.70%	-7.23%	-5.25%		2.57%	-10.34%	0.14%	4.40%	-3.44%
20	0.26%	3.03%	1	15	6	-0.76%	2.70%	-7.23%	0.00%		2.57%	-1.53%	3.03%	0.00%	-0.31%

3. RESULTS

3.1 RAPIDMINER RESULTS

With lack of time to create the accurate prediction set for more than 4.400 individual data entities respectively (which is now more technical than methodological challenge), we have managed to get with SVM operator an error within range from 3.455 and 25.546, over a store, and not over departments.

Since the competition is still underway (ends on 5th May), with more than 500 teams competing at the moment, first team on the leaderboard scores 2.421. Our best projected WMAE score of 3.455 at the moment brings us at 186th place, with a note that this result has a big range deviation from 3.455 to 25.546.

3.2 EXCEL RESULTS

In Excel we have achieved results with different models based on week sales for a single department, as requested by Kaggle. However, we did not have enough time to process sufficient number of iterations before getting stable results, neither to check our prediction values with WMAE formulation.

By setting a different strategy, we made independent 2012 forecast and compared such 2012 sales prediction with real 2012 sales values. Results of weekly sales forecast by departments with three different methods showed following deviation from the real 2012 data:

- LES - 3.61%
- Multifactor dependency equation - 4.61%
- Moving average - 5.56%

4. CONCLUSION

After numerous attempts to get accurate predictions through RapidMiner and Excel with dozens of different algorithms, we concluded that RapidMiner provides best result with SVM algorithm, while in Excel models we have examined, we could only calculate deviations in prediction comparing to the actual data.

In both cases, data understanding is the key of picking the right implementation methodlogy. The complexity of this particular project has intensified the challenge we are facing. After carefully reviewing all aspects of data behavior, results we got upon various algorihms chosen are just the base for our future endeavours to make our predictive models even more accurate.

In general, plan is to divide data to smaller fractions at certain criteria (by departments, by seasonal periods, by holidays, etc.) and then to run numerous iterations to get the numbers in our sample stable enough to submit the final results to Kaggle.

Furthermore, since we started with a very small portion of a sample, and in this case only few iteration are processed respectively, we expect to get far more better results in days to come.

REFERENCES

Drucker, H., Burges, C. J., Kaufman, L., Smola, A., & Vapnik, V. (1997). Support vector regression machines. Advances in neural information processing systems, 9, 155-161.

Gardner, Everette S. "Exponential smoothing: The state of the art." Journal of forecasting 4.1 (1985): 1-28.

Harrison, P. J. "Exponential smoothing and short-term sales forecasting." Management Science 13.11 (1967): 821-842.

Holt, Charles C. "Forecasting seasonals and trends by exponentially weighted moving averages." International Journal of Forecasting 20.1 (2004): 5-10.

JD Edwards EnterpriseOne Applications Forecast Management Implementation Guide, Release 9.1.x, 2011 (http://docs.oracle.com/cd/E16582_01/doc.91/e15111/und_forecast_levels_methods.htm#g037ee99c9453fb39_ef90c_10a77f2c279__3d8b)

Ian H. Witten & Eibe Frank, Data Mining – Practical Machine Learning Tools and Teechniques, Morgan Kaufmann publishers, 2nd edition, 2005

JD Edwards EnterpriseOne Applications Forecast Management Implementation Guide, Release 9.1.x

Markus Hofmann, Ralf Klinkenberg, RapidMiner – Data Mining Use Cases and Business Analytics Applications, Chapman & Hall, 2013

Matthew North, Data Mining for the Masses , Global Text Project Book, 2012

Mierswa, I., Wurst, M., Klinkenberg, R., Scholz, M., & Euler, T. (2006, August). Yale: Rapid prototyping for complex data mining tasks. In Proceedings of the 12th ACM SIGKDD international conference on Knowledge discovery and data mining (pp. 935-940). ACM.

Roos, Dave. "How Sales Forecasting Works" 20 June 2008. HowStuffWorks.com. (http://money.howstuffworks.com/sales-forecasting.htm)

Thomas Kirn, Forecasting Revenue for the Long Term, 2007

Wu, Qi. "A hybrid-forecasting model based on Gaussian support vector machine and chaotic particle swarm optimization." Expert Systems with Applications 37.3 (2010): 2388-2394.

Wu, Qi. "The forecasting model based on wavelet v-support vector machine." Expert Systems with Applications 36.4 (2009): 7604-7610.

ACADEMIC DASHBOARD FOR TRACKING STUDENTS' EFFICIENCY

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Abstract:*The use of modern technological resources and teaching aids, as well as the adjustment of teaching content to students, in order to achieve better results in the adoption and application of knowledge, may represent a good basis for the development of contemporary concepts of education in the 21st century. In order to achieve this, it is necessary to detect, define and analyze existing patterns of behavior and students' learning. Today, there are a large number of software products for facilitating and improving the quality of learning. Computer applications in education system introduce unique technical, managerial and most importantly pedagogical issues. Using business discovery platform QlikView, application developed in this research, should be beneficial to both, students and professors at the university. Application allows academic staff to identify good students and students who need additional tutoring, analyze current study success and make strategy for further curriculum development.The relation database model is based on data collected from student admission service of Faculty of Organizational Science, University of Belgrade.*

Keywords*:knowledge-based application, educational data mining, higher education*

1. INTRODUCTION

Education, and in particular higher education, is at the heart of the Europe 2020 Strategy and of Europe's ambition to become a smart, sustainable and inclusive economy: it plays a crucial role in individual and social advancement; and, with its impact on innovation and research, it provides the highly skilled human capital that knowledge-based economies need to generate growth and prosperity.Globalization and technological development are radically changing the landscape of higher education. While world economies push for stronger competitiveness, creating and attracting top talent represent one of central objectives of world-renowned higher education institutions.

Higher educational institutions are important parts of our society and playing a vital role for growth and development of nation and prediction of student's performance in educational environments is also important as well. Student's academic performance is based upon various factors like personal, social, psychological etc. Educational data mining concerns with developing methods for discovering knowledge from data, that comes from educational domain. The Data Mining tool has accepted as a decision making tool which is able to facilitate better resource utilization in terms of students performance.Many higher education institutions are committed to increase the quality of their courses to attract and retain the very best students. For propose of this paper a student data from Faculty of Organizational Sciences, University of Belgrade has been taken and some of educational data mining methods have been performed, in order to extract useful information from available data set and providing analytical tool to view. The result of study is aimed to develop an interactive data mining so that present education system may adopt this as a strategic management tool.

In this paper, the introductory part will present related works and background of the methodology in area of educational data mining software. The basic concepts of QlikView software platform and developed Academic Dashboard for Faculty of Organizational Sciences will be presented in the central part of the paper. The final part of the paper defines the guidelines for further development and adaptation of higher education system to the necessities of a student.

2. METHODOLGY AND TECHNOLOGY BACKROUND

Data mining in the field of education (Educational Data Mining - EDM), as a new field of research, has developed in the last decade as a special area of application techniques and tools for detecting regularities and correlations in the data (data mining), with the aim of analyzing the unique data types that appear in educational system for solving various problems of educational and instructional improvement process

(Romero & Ventura, 2007; Romero & Ventura, 2011). Educational data mining (EDM) is an interesting research area which extracts useful, previously unknown patterns from educational database for better understanding, improved educational performance and assessment of the student learning process (Moucary, 2011). EDM is engaged in development, research and application of methods to detect regularities in the data in the database in the field of education, which would otherwise be difficult or almost impossible to analyze and determine the dependency patterns of behavior and learning among students, primarily because of the large amount of data (Romero et al., 2006). Reasons of good or bad students' performances belong to the main interests of teachers and professors, because they can plan and customize their teaching program, based on the feedback. EDM could be used to improve business intelligence process including education system to enhance the efficacy and overall efficiency by optimally utilizing the resources available. The performance, success of students in the examination as well as their overall personality development could be exponentially accelerated by thoroughly utilizing data mining technique to evaluate their admission academic performance and finally the placement (Agarwal et al., 2012).

Data mining has several tasks such as association rule mining, classification and prediction, and clustering. Classification is one of the most useful techniques in data mining to build classification models from an input data set. The used classification techniques commonly build models that are used to predict future data trends. EDM consists of a set of techniques that can be used to extract relevant and interesting knowledge from data. Traditionally, academic researchers have used statistic models and methods in order to predict the success of the students. Today, there are many different approaches about classifying the students and predicting their success, such as linear regression, cluster algorithms, decision trees artificial neural networks, (Wook et al., 2009; Guo, 2010; Stathacopoulou et al., 2007; Wu et al., 2008; Isljamovic et al., 2012). For development of all mentioned data mining methods and model is need adequate software support, in whole process form collecting data to result visualization.

Technological development has provided base for developing software with new functionality. Teaching process records constant improvements through the use of ICT (Arenas-Marquez et al, 2012). Nowadays, providing students with services they expect is more challenging than ever before. Some of those services are ability to track current students' achievements and results, planning next semester, conducting optimal selection of exams based on preferences and results, operational planning, like attending colloquia, exams, participations in projects and practices etc. Also, that kind of software is attended for professors in order to track effectiveness of students (individually, by teams or by generation) and for planning and adapting curriculums in order to meet future interest of students, (Coll et al., 2008). Software scope and architecture may vary and below is an overview of the most significant solutions.

The first group of software represents large commercial software solutions which integrate data collection, ETL process and results representation. IBM company provides personalized software package SPSS for students and teachers. This software integrates different types of data analysis, data mining trend research and quantitative methods for measuring efficiency. As well, IBM developed SPSS Clementine (Clementine, 2014)which represents specialized software for data mining. SAP offers solution to support the work of students and teachers. Integral parts of this software are: Student Lifecycle Management, Teaching and Learning, Learner achievement Measurement and Tracking and Educational Performance Analytics (SAP). This software is a feature-rich, both for the students' and teachers' work. Student can plan and monitor present liabilities in the current semester, but also software allows professors to plan classes and the necessary resources (personnel, classrooms, technical resources), to monitor the presence of students (status of their obligations, progress, rating), to define grade scale, to evaluate test in-time and to send test results to students, to propose future courses based on interest of students, to optimize study process and to carry out large number of statistical analyzes.Microsoft offers multiple solutions to support students and teachers by personalizing product from the Dynamics family or using dedicated software like: Communication and Collaboration, Device Management, Web Portals, E-learning and Tracking Institutional effectiveness for Higher Education. These software solutions allow quick and easy connection and communication between students and teachers through various types of devices, easy scheduling obligations both students and teachers in accordance with number of registered students, retention of various records. Using this software, teachers can easily perform different analysis, support online teaching, testing and decision-making.

In the second group, of public domain data mining tools exist variety solutions such asWeka(Weka, 2014) andRapidMiner (RapidMiner, 2014). All these tools are not specifically designed for pedagogical/educational purposes and it is cumbersome for an educator to use these tools which are normally designed more for power and flexibility than for simplicity. However, there are also an increasing number of mining tools specifically oriented to educational data such as: Mining tool (Zaïane and Luo, 2001) for association and pattern mining, MultiStar (Silva and Vieira, 2002) for association and classification, KAON (Tane et al., 2004) for clustering and text mining, Synergo/ColAT (Avouris et al., 2005) for statistics and visualization, Listen tool

(Mostow et al., 2005) for visualization and browsing, Sequential Mining tool (Romero et al., 2006) for pattern mining, Simulog(Bravo and Ortigosa, 2006) for looking for unexpected behavioral pattern. All these tools are oriented to be used by a single instructor or course administrator in order to discover useful knowledge from their own courses. So, they don't allow a collaborative usage in order to share all the discovered information between other instructors of similar courses (contents, subjects, marks). In this way, the information discovered locally by teachers could be joined and stored in a common repository of knowledge available for all instructors for solving similar detected problems.

In this paper, we describe an educational data mining tool based on association rule mining and collaborative filtering for the continuous improvement curriculums and it directed to teachers non experts in data mining. The main objective is to make a mining tool in which the information discovered can be shared and scored between different instructors and experts in education. This paper will present custom developed applications based on both existing data, collected from student admission service of Faculty of Organizational Science (University of Belgrade) and the required functionality. Technology used for this solution is QlikView.

3. QLIKVIEW TECHNOLOGY STRUCTURE OF DATA MODEL

QlikView represents new patented software engine, which compresses data and holds it in memory, where it is available for immediate exploration by multiple users. QlikView delivers an associative experience across all the data used for analysis, regardless of where it is stored, (Harmsen, 2012). For datasets too large to fit in memory, QlikView connects directly to the data source and generates new views of data on the fly. QlikView's patented core technology, associative experience, and collaboration and mobile capabilities, make able to work with a lot of questions, passing by traditional hierarchical models, with created an associative network which works similar to human brain. Empowering the information workforce to derive insights from data helps organizations streamline, simplify, and optimize decision making, (Harmsen, 2012).

In primary frontend-backend architecture, on which is based QlikView solution, as data layer (Infrastructure resource) will be used relational database to record data on students of the Faculty of Organizational Sciences. Using OLDB connections, QlikView server will establish communication with the database with students data within specific time intervals (monthly level or after completion of the exam period). Once the connection between QlikView and elementary student database is established, the application will use the Associative Query Language (AQL) to download data from the relevant tables, necessary for the operating and usage, and after that it will be stored in its own memory. In addition to downloading data, backend part of application will be provided with ability to define application logic, rules for establishing a link between the data (in accordance with already defined relational model), as well as methods and privileges for using the application. Within the frontend, according to the rights they have, each user will be able to access the application and review it available reports and data.

Similar to QlikView usage in public or private sector, we developed QlikView Academic Dashboard for Faculty of Organizational Sciences, University of Belgrade, in order to help educational professionals and students to maximize data governance and optimize their intellectual investments by discovering how QlikView is used at a granular level in educational sector. With this application and resulting knowledge, professors and students can introduce more manageable and repeatable educational processes, as well as address data lineage and impact analysis questions on more efficient way. Approach of developing an integrated system for students and teachers has considerable benefits for improved data quality, mainly due to the fact that integration obviates the need for complex interfaces (Berkhoff et al., 2012).

The data contained within this application represents student personal, demographic and academic data, collected from student admission service of Faculty of Organizational Science, University of Belgrade. Using this data we can analyze the demographic and socio-economic student structure and success at the University.Developed relation data base model consists of 15 objects and more than 50 attributes.

Using the student data, professors will be able to monitor students' achiness and success by each study program, student gender, finished high school, exam, semester or science filed. Application allow professors to analyze current study success, but also to predict future success performance based on average exam performance from other students whit same background. Professors in addition can use developed application as an advisor system, in order to define new curriculum or in planning of faculty promotion activities. This application, also, takes advantage of security level setup using section access to show different views of the data, including two basic views: a professor view and a vice dean view.

4. RESULTS - ACADEMIC DASHBOARD FOR FACULTY OF ORGANIZATIONAL SCIENCES

Academic Dashboard for Faculty of Organizational Sciences allows professor and administrative staff to view and monitor student performance at undergraduate level, with ability of breakdown pass through demographic data such as gender, ethnicity, class standing and province of residence. Using these data fields they can identify trends and also can get an overall picture of the demographic breakdown of the faculty and students.

Teaching staff will be able to monitor success of students in each of the courses for which they are responsible. Data for each subject will be available in different time units: specific examination period, semester, school year, calendar year etc. Teachers will be able tofollow up students' success on multiple courses, for example group of courses for which a particular teacher is in charge. As it shown in Figure 1, professors can keep an eye on data such as GPA, average study length, entrance exam points by country, region and high school type for each generation of students.

Figure 1. Students' success by Region

In order to identify, for example correlation betweenstudy program and study success by different success criteria, on both global (GPA, average study length, average entrance exam points) and individual (exam, semester, specific examination period) level, it is allowed just by selecting adequate view, time period and desired variable, as it shown on Figure 2. Professor can switch to a chart view of GPA and see the disbursement of current GPAs on student, course or exam level, and with that like organized data, professors can look for trends in GPAs and get a high-level view of how students are performing. Selecting from the list boxes on the left side of dashboard, they can filter the data down to a single student or to results on particular course in one examination period.

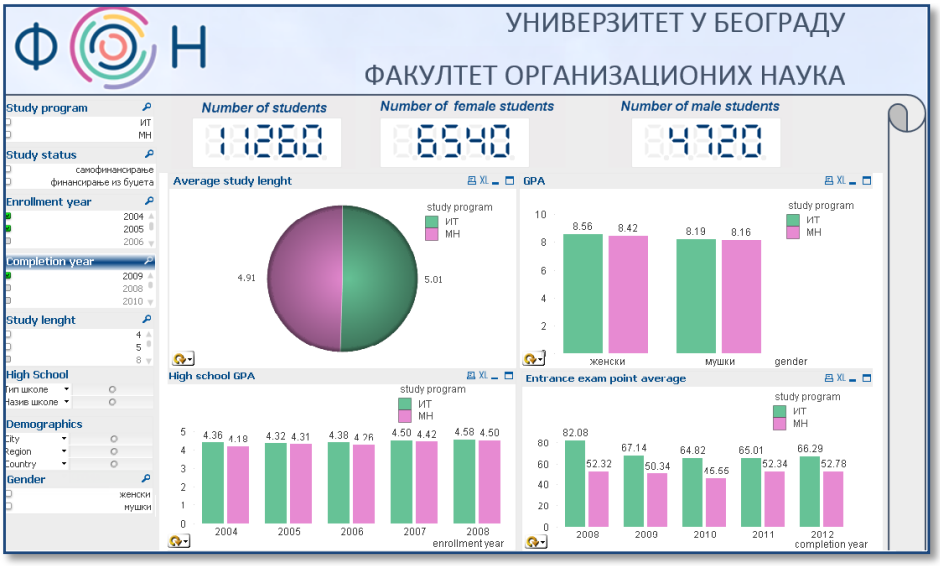

Figure 2. Detailed success statistic by study program

Observing student profile a professor or educational office stuff, as administrator, can see the academic data for any of the students enrolled in the faculty. Once the administrator identifies a single student, he/she can then get a look into that student's current academic state on more detailed level. Data such as cumulative GPA, declared major and minor, courses taken, remaining courses needed to fulfillment major requirement, and address information. As an advisor, this data is useful in helping the student plan for the upcoming semesters and also to be able answer any questions that the student may have regarding his/her academic standing. Through continuous monitoring of students during their studies, at an early stage, teachers can perceive students with good potential and students who need extra help in order to improve their results. The best students can be offered extra activities, for example additional courses, participation in scientific research and projects.

Academic Dashboard for Faculty of Organizational Sciences allows special functionalities and views for vice deans, which will have access to all student data, such as:

- Review the success of all students,
- Review the results of the each exam and examination periods,
- Summary and analytical review of students success by study program,
- Summary and analytical review of examination performance for all students by funding student status,
- Performance summary of students by student gender,
- Students performance summary by region and district from which the student came to study,
- Study performance by type of secondary high school and the particular high school that the student has completed,
- Parallel comparison of student success from one high school to success of students from other high school of same high school type or from same region (Figure 3),
- Parallel comparison of one student success with all student in study generation or with group of student with similar characteristic,
- Parallel comparison of the two sets of data according to the selected data criteria,
- Identification of enrollment trends by region or district, high school type or high school success, gender or study program.

That kind of observing students' success can be of great significance in determining trends in faculty performance and curriculum overview success.

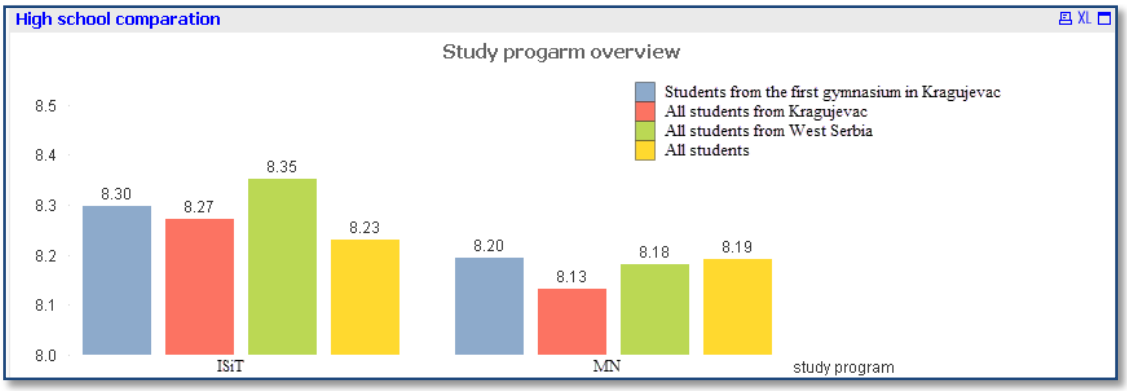

Figure 3. Comparison of GPA by specific high school students and other students

Another important benefit of this software represent fact that it is provided as SaaS(Software-as-a-Service), which is defacto increasingly important paradigm in information technology and also provides education systems as a service for enhancing processes in higher education (Masud& Huang, 2013). This functionality enables professors with an easy-to-use application, for which utilization they only need web browser and permitted access to application.

5. CONCLUSION

The main goal of this work was present developed application with ability to automatically discover useful, complex features in the context of educational data mining at faculty level. These features would at once elucidate the underlying structure of the raw data to the researcher, while at the same time hiding the complexity of this structure from the model so that the whole application could be fed into even simple model without introducing intractable complexity. In addition, developed Academic Dashboard is sustainable, easy to use and with automatically reloaded data always up to date, giving opportunity to academic personal with no expert knowledge to used it on every day basis.

Presented system model for analyzing and monitoring study performance in this paper, can represent a good basis for improving the process of higher education. The developed system aims to provide professors with tracking functionality in order for continuously monitor students' achievements. Also, application allows them to compare students' success categorized by courses, science-education groups or exams periods. Based on these information professors can determine the patterns of students' aspirations and needs, which can directly improve the process of education.

In addition to relations that indicate dependency between of students and their success, the developed system (based on QlikView in- memory solution) allows as well identification of relationships that are not directly related to the success in studies. Example for previous would be possibility for linking student with list of elective courses and optional seminaries, that they have chosen. This possibility provides students with advisory tool for choosing courses in the following semesters, gives guidelines for further scientific and professional development of each individual and also contributes to the prediction of the expected popularity of the elective subjects in the future.

Directions for future research are further improvement of the system in terms of development of modules for prediction students' success and implementing QlikView application Academic Dashboard on higher study level, such as master, specialist or doctoral studies. There is no one-size-fits-all approach, that will allow complete data analysis on all faculties, but at start level, developed application can present very good basis and point of start for further development of integrated application for whole university.

REFERENCES

Agarwal, S., Pandey, G.N.,Tiwari, M.D. (2012). Data Mining in Education: Data classification and Decision tree approach, International journal of e-education, e-business, e-management and e-learning, vol 2 no. 2.

Arenas-Marquez, F.J., &Machuca, J.A.D., & Medina-Lopez, C. (2012). Interactive learning in operations management higher education Software design and experimental evaluation, International Journal Of Operations & Production Management, 32(12), 1395-1426.

Avouris, N., Komis, V., Fiotakis, G., Margaritis, M., Voyiatzaki, E. Why logging of fingertip actions is not enough for analysis of learning activities. In Workshop on Usage analysis in learning systems at the 12th International Conference on Artificial Intelligence in Education, 2005. Amsterdam, Netherland, pp. 1-8.

Berkhoff, K., &Ebeling, B., &Lubbe, S. (2012). Integrating research information into a software for higher education administration - benefits for data quality and accessibility, E-Infrastructures For Research And Innovation: Linking Information Systems To Improve Scientific Knowledge Production, 167-176.

Bravo, J., Ortigosa, A. Validating the Evaluation of Adaptive Systems by User Profile Simulation. In Proc. Workshop on User-Centred Design and Evaluation of Adaptive Systems, 2006, Dublin, Germany, pp. 52-56.

Clementine.Available at http://www.spss.com/clementine/.last accessed: april 2014.

Coll, H., &Bri, D., & Garcia, M., &Lloret, J. (2008). Free software and open source applications in higher education. New Aspects Of Engineering Education, 325-330.

Guo, W.W. (2010). "Incorporating statistical and neural network approaches for student course satisfaction analysis and prediction", Expert Systems with Applications, 37(4), pp. 3358-3365, 2010.

Harmsen, B. (2012). QlikView 11 for Developers, Packt Publishing.

IBM. (2014). Institutional SPSS software, link: http://www-03.ibm.com/software/products/en/spss-stats-gradpack, last accessed: april 2014.

Išljamović, S., Vukićević, M. Suknović, M. (2012)."Demographic influence on students' performance - case study of University of Belgrade", TTEM -Technics Technologies Education Management, 7 (2), pp. 645-666, ISSN 1840-1503.

Masud, M.A.H., & Huang, X.D. (2013).ESaaS: A New Software Paradigm for Supporting Higher Education in Cloud Environment. Proceedings Of The 2013 Ieee 17th International Conference On Computer Supported Cooperative Work In Design (Cscwd), 196-201.

Microsoft. (2014). Institutional Effectiveness For Higher Education, link: http://www.microsoft.com/education/ww/solutions/Pages/institutional-effectiveness.aspx, last accessed: april 2014.

Mostow, J., Beck, J., Cen, H., Cuneo, A., Gouvea, E., Heiner, C. An educational data mining tool to browse tutor-student interactions: Time will tell! In Proceedings of the Workshop on Educational Data Mining, 2005. Pittsburgh, USA, pp. 15–22.

Moucary, Khair, M., Zakhem.,W. (2011).Improving student performance using data clustering and neural networks in foreign language based higher education, The Research Bulletin of Jordan ACM, vol II (III).

RapidMiner.Available at http://rapid-i.com/.last accessed: april 2014.

Romero, C. Ventura, S, (2007).“Educational data mining: A survey from 1995 to 2005”, Expert Systems with Applications, 33(1), pp. 135-146.

Romero, C., Porras, A.R., Ventura, S., Hervás, C., Zafra, A. Using sequential pattern mining for links recommendation in adaptive hipermedia educational systems. In International Conference Current Developments in Technology-Assisted Education, 2006.Sevilla, Spain, pp.1016-1020.

Romero, C., Ventura, S. (2011).“Educational data mining: a review of the state-of-the-art”, IEEE Trans. Syst. Man Cybernet. C Appl. Rev., 40(6), pp. 601–618.

SAP.(2014). Executive Overview Higher Education and Research, SAP AG.

Seghedin, N.E., &Chitariu, D. (2013). Software Application For The Development Of Quality Culture In Higher Education, eLearning & Software for Education, 3, 338-343.

Silva, D., Vieira, M., 2002.Using data warehouse and data mining resources for ongoing assessment in distance learning.In IEEE International Conference on Advanced Learning Technologies, 2002. Kazan, Russia, pp. 40–45.

Stathacopoulou, R., Grigoriadou, M. Samarakou, M. Mitropoulos, D. (2007). “Monitoring students’ actions and using teachers’ expertise in implementing and evaluating the neural network-based fuzzy diagnostic model”, Expert Systems with Applications, 32(4), pp. 955-975.

Tane, J., Schmitz, C., Stumme, G. Semantic resource management for the web: An elearning application. In Proceedings of the WWW Conference, 2004 New York, USA, pp. 1–10.

Weka.Available at http://www.cs.waikato.ac.nz/ml/weka/.last accessed: april 2014.

Wook, M., Yahaya, Y.H., Wahab, N., Isa, M.R.M., Awang, N.F., Seong, H.Y. (2009)."Predicting NDUM Student's Academic Performance Using Data Mining Techniques", The Second International Conference on Computer and Electrical Engineering, pp. 357-361.

Wu, T.K., Huang, S.C., Meng, Y.R. . (2008).“Evaluation of ANN and SVM classifiers as predictors to the diagnosis of students with learning disabilities”, Expert Systems with Applications, 34(3), pp. 1846-1856.

Zaïane, O., Luo, J. Web usage mining for a better web-based learning environment. In Proceedings of conference on advanced technology for education, 2001. Banff, Alberta , pp. 60–64.

ANALYSIS OF RUNTIME DIFFERENCE BETWEEN RAPIDMINER AND CUSTOM IMPLEMENTATION OF SIMPLE COLLABORATIVE FILTER BASED RECOMMENDER SYSTEM

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Abstract: *This paper demonstrates creation of simple recommendation engine in Rapidminer and implementing it in C# programming language – as well as their strengths and weaknesses, through analysing time performance. Data used in this paper is a subset of Netflix Prize (Bennett & Lanning, 2007), comprising of roughly 1.27 million ratings made by around 4000 users for near 3000 movies. Recommendation quality was average, with AUC of 0.85 for both implementations. Time measurements showed drastic difference between tools used, with more than 60% runtime decrease when comparing C# to Rapidminer.*

Keywords*: Recommender systems, Rapidminer, C# recommender system implementation, Recommender system performance,*

1. INTRODUCTION

The idea for this paper came after observing the ease with which people with only basic computer training can make data mining models using pre-made software solutions. With some data science background, it was possible for a non-programmer to create a system which gave back somewhat accurate results. However, the question arose – are there any drawbacks to creating models using these tools? Several parameters were considered to possibly show differences, but they were all discarded. Prediction performance measures (accuracy, precision and recall, ROC curve) depend on the quality of the model chosen, and should be the same regardless of which type of implementation is used. On the other hand, CPU, memory and disk usage, as well as overall runtime appear to be most adequate performance measures for this case.

Interest in performance analysis of data mining systems is usually focused on the system's content – on accuracy, recall, and similar. There are almost no scientific papers that are concerned with system performance from the aspect of the runtime, and no side-by-side comparison of such performances for tool-based systems.

For this paper, the test is comprised of a simple recommender system implemented as similarly as possible in Rapidminer and in C#, and measuring the times required for implementation and average runtime. Prediction performance, as well as CPU, memory and disk usage are skipped in this paper.

The expected results are that the runtime of recommender system custom-built for single purpose should be less than the runtime of a tool-based recommender system. However, the implementation time for the tool-based recommender system should be drastically lower than for custom-build system.

2. IMPLEMENTATION ENVRIONMENTS

Rapidminer is an open-source platform which can be traced back to the year 2001, when it was still known as YALE ("Yet Another Learning Environment", developed at the Technical University of Dortmund) (Mierswa et al, 2006). In the thirteen years since its beginnings, Rapidminer has become number one of the foremost software packages for data analysis (Piatetsky, 2013). Some of the reasons for this surely lie in its affordable pricing and high availability to students, but also in the high level of generic approach adopted by the creators. This allows for a wide variety of combinations and easy extensibility, making experimentation, modification and upgrades of existing systems a painless and quick process.

On the other hand, this generic approach comes with a cost, in the form of a large overhead that occurs during runtime.

C# is an object-oriented programming language developed by Microsoft, and is an integral part of the .NET framework. With the first appearance during the July of 2000, it predates Rapidminer by a year. It is one of the top programming languages used in the world (currently ranked in the 5th place according to TIOBE Index for April 2014 (TIOBE Software B.V., 2014)). The recommender engine presented in this paper is built from the scratch, and can be made to fit perfectly to all aspects of the data model.

Both implementations were run on the same hardware specification[1], with Windows 8.1 Pro as the operating system.

[1] AMD Athlon™ II X2 260 processor @3.20 GHz, 2 x 4GB DDRAM3 @1600MHz CL10 latency, SSD Sata3 storage

3. DATA AND ALGORITHM SPECIFICATION

The problem considered is a textbook example of recommender engine implementations – the one of recommending movies to users, based on their previous ratings, and ratings of other users. The data used in this paper is a subset of the Netflix challenge (http://www.netflixprize.com/), no longer freely available due to privacy issues. Dataset contains around 3000 movies, as well as around 1.2 million of user ratings. The ratings are given in the `[MovieID, UserID, Rating]` format. The data for users is not explicitly given – we only have their IDs and ratings, but there are around 4000 distinct user IDs.

Algorithm chosen for recommender engine is k-nearest neighbors. The algorithm is based on learning by analogy, that is, by comparing a given test example with training examples that are similar to it. The training examples are described by n attributes. Each example represents a point in an n-dimensional space. In this way, all of the training examples are stored in an n-dimensional pattern space. When given an unknown example, a k-nearest neighbor algorithm searches the pattern space for the k training examples that are closest to the unknown example. These k training examples are the k "nearest neighbors" of the unknown example. "Closeness" is defined in terms of a distance metric. For this paper, the distance metric chosen is the Euclidean distance.

Recommender system that is considered in this paper is a user-based collaborative recommender. Collaborative recommenders try to predict the value of items for a particular user based on the items previously rated by *other* users, based on the "similarity" to the user (Adomavicius & Tuzhilin, 2005). For this dataset, the recommendation application tries to find the "neighbours" of user - other users that have similar tastes in movies (shown by rating the same movies similarly). Then, only the movies that are most liked by those neighbours would be recommended.

4. IMPLEMENTATION

Recommender engines are not the part of the default Rapidminer 5 installation, but they are freely available as an extension. After the installation, we have to choose among 20 options for recommender system that suits our needs. Since the recommender that will be implemented in C# is the simple K-NN collaborative filter, based on the similarity of users, that option is chosen. The implementation process for Rapidminer is straightforward and takes a short while – the entire process is done in less than five minutes. The Rapidminer recommender system process is shown on Figure 1.

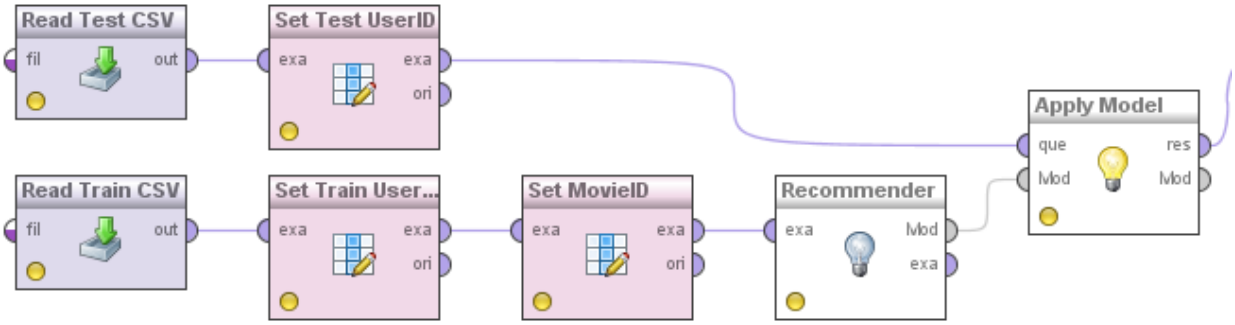

Figure 1 – Rapidminer recommender system process

After the configuration, we are able to run the process, and get the recommendations for our test User. Runtime for Rapidminer process is on average between 9 and 10 minutes, after which the recommender system gives recommendations for all supplied User examples.

Implementation of the recommender engine in C# is more open to choices, but for this paper, the choice is a simple WPF (Windows Presentation Foundation) user interface, together with filesystem access to data. Domain classes are shown in Figure 2.

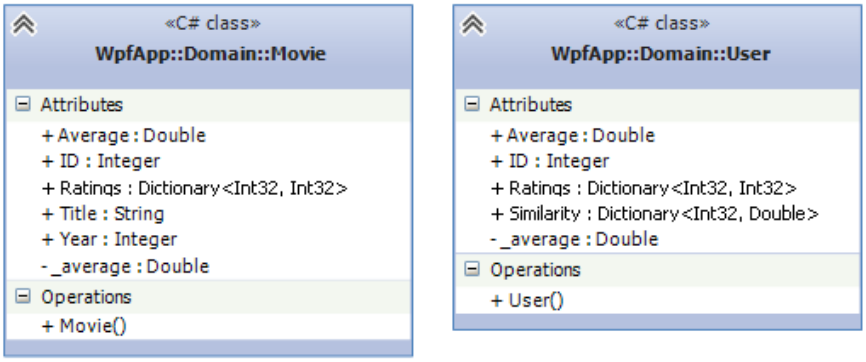

Figure 2 - C# domain classes

For computation of K-NN the distance chosen was Euclidian, based on the following equation (1)

$$d = \sqrt{\sum_{i=0}^{n}(x_i - y_i)} \tag{1}$$

With d being the distance between users, x_i first user rating for movie with `MovieID` i, and y_i second user's rating for movie with the `MovieID` i. Computations were done only for movies for which both users have given ratings.

The implementation time for C# was considerably longer, taking around 8 hours of work. But unlike the Rapidminer process, custom implementation allows us finer control over the dynamic program execution.

Runtime for reading the data and learning the model averages on around 3.5 minutes, a drastic improvement compared to Rapidminer results. This is probably the result of custom-made domain classes which do not have the requirement to conform to generic data model, eliminating some of the overhead.

Also, while Rapidminer solution allows only for batch processing, with the renewed learning process for every new batch, the C# solution allows for continual iterative process in which the model is learned only once at the application startup, and all further changes and queries are handled dynamically at runtime, creating new possibilities for further time savings.

For easier comparison, some of the noted aspects of this study are shown in Table 1.

Table 1 - Comparison of C# and Rapidminer implementations

	C#	Rapidminer
Initial implementation time	≈ 480 minutes	≈ 5 minutes
Initial implementation knowledge	Data-mining, basic programming	Data-mining
Runtime (data load and model learning)	≈ 3.5 minutes	≈ 9.5 minutes

5. CONCLUSION

Rapidminer's fast initial implementation makes it a good choice for models that are not yet fully defined. The ability to change the model without a significant investment in time is one of the key advantages when initially building a model. Also, the knowledge necessary for creating a recommender engine in Rapidminer is strictly tied to Data sciences, making it possible to non-programmers to use. The ability to implement Rapidminer models in Java programs adds to their usability by removing the batch-only limitation. However, even with that limitation removed, overhead caused by generic approach to data is not removed, and runtime should remain unchanged.

On the other side, that overhead makes implementation of the recommender engine in C# (or a similar programming language) possibly worth the cost. Taking only time into consideration (initial implementation time and runtime per batch), it is possible to see a point in time where C# solution will be more time effective compared to the Rapidminer.

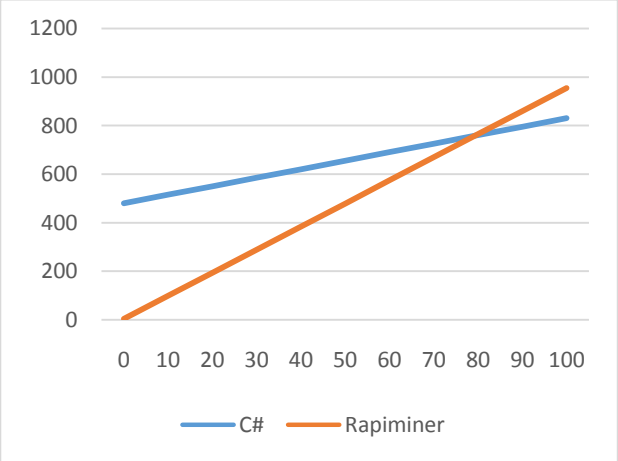

Figure 3 - time spent per number of batches

This paper does not suggest one approach to the other. It is imperative to understand the complex nature of data analysis, and realize there can be no one simple approach to all the problems. However, deeper understanding of options will hopefully allow for better decision making concerning choices of implementations of small-scale recommender engines.

REFERENCES

Adomavicius, G., & Tuzhilin, A. (2005). Toward the Next Generation of Recommender Systems : A Survey of the State-of-the-Art and Possible Extensions. *IEEE Transactions on Knowledge and Data Engineering, Vol. 17, No6*, 734-749.

Bennett, J., & Lanning, S. (2007). The netflix prize. *Proceedings of KDD cup and workshop*, 35.

Mierswa et al. (2006). Yale: Rapid prototyping for complex data mining tasks. *Proceedings of the 12th ACM SIGKDD international conference on Knowledge discovery and data mining*, 935-940.

North, D. M. (2012). *Data Mining for the Masses.* Amazon.com. Retrieved from http://1xltkxylmzx3z8gd647akcdvov.wpengine.netdna-cdn.com/wp-content/uploads/2013/10/DataMiningForTheMasses.pdf

Piatetsky, G. (2013, June 3). *KDnuggets Annual Software Poll:RapidMiner and R vie for first place*. Retrieved from KD: http://www.kdnuggets.com/2013/06/kdnuggets-annual-software-poll-rapidminer-r-vie-for-first-place.html

TIOBE Software B.V. (2014, April). *TIOBE Software: Tiobe Index*. Retrieved from Tiobe: http://www.tiobe.com/index.php/content/paperinfo/tpci/index.html

A DATA MINING MODEL FOR DRIVER ALERTNESS

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Abstract:*This article proposes a classification model for a challenge that Ford has provided on Kaggle site. The goal of the research was to design a binary classifier to detect whether a driver is alert or not. Using a different algorithms (Decision tree, k-NN, Neural Network and Naïve Bayes) on a sample of the dataset thatis consist of about 600.000 data points we made a model, and for evaluation we used Rapid Miner (accuracy and Area Under the Curve). The best performance gave k-NN algorithm (for k=7) with the value for AUC=0.920 on training set. Also we have concluded that the biggest positive influence on the results of the process had adding weights to each attribute, and the most important group of attributes is environmental attributes (E1-E11).*

Keywords*:Ford Kaggle competition, Driver Alertness model, Rapid Miner, AUC, Neural Network, k-NN*

1. INTRODUCTION

There are activities that disturb the driver's attention while he is driving and can lead to accidents. These activities can be making or receiving phone calls, sending or receiving text messages, engaging in a conversation with other passengers in the car, eating while driving, also fatigue and drowsiness can be dangerous for all road users. (https://www.kaggle.com/c/stayalert) Our goal was to design a detector/classifier that will detect whether the driver is alert or not alert, employing any combination of vehicular, environmental and driver physiological data that are acquired while driving.
We have decided to work on this project because drivers who are not alert are threat, and there are a lot of accidence caused by them.

During our research, we monitored the results and the selected algorithms in two works that we found. Authors of the first paper are Louis Fourrier, Fabien Gaia and Thomas Rolf from Stanford University. In order to assess algorithms they mainly used two types of evaluation criteria: The accuracy of our algorithm and The Area Under the Curve (AUC). Their first step was to run their three algorithms (Naive Bayes, Logistic Regression, SVM) on the initial data set of 30 features. Out of the algorithm their implemented, the Naive Bayes with Gaussian Distribution fitting is clearly the most accurate one (Accuracy 90% AUC0.844)

In second research work Tayyab bin Tariq and Allen Chen have used Logistic regression, SVM, Naive Bayes, Neural Network, Random Forest, Logistic regression with feature selection. In the end, their simple logistic regression using 2 or 3 features selected via forward search presented the best results, with AUC around 81 percent and putting them in the top 15 on the Kaggle leaderboard.

Our project has three sections. First, we have done data processing (normalization, generating attributes, and attributes weights), then we chose algorithms (Decision tree, k-NN, Naive Bayes and Neural Net), and in the third phase we have done elevation of results (accuracy and AUC).

2. EXPERIMENTAL SETTING

The dataset that Ford has provided consists of about 600.000 data points. As we have already said, there are three types of attributes – physiological (P1-P8), environmental (E1-E11) and vehicular (V1-V11) (https://www.kaggle.com/c/stayalert/data). The problem was that we did not have the information about the names of attributes, and what they actually represent.

Because of the large number of data points we decided to use sample of whole dataset, and we used 10% of it to learn algorithm behavior.

The algorithms that we have used are:

1. **Decision tree** – It is an algorithm that is used for classification on both nominal and numerical data and to create a classification model that predicts the value of a *target attribute* (often called *class* or *label*). (Quinlan, 1986)
2. **Naive Bayes** classifier is a simple probabilistic classifier based on applying Bayes' theorem (from Bayesian statistics) with strong (naive) independence assumptions.
3. **K Nearest Neighbor**(k-NN from now on)is one of those algorithms that are very simple to understand but works incredibly well in practice. Also it is surprisingly versatile and its applications range from vision to proteins to computational geometry to graphs and so on. In pattern recognition, the k-Nearest Neighbors algorithm (or k-NN for short) is a non-parametric method used for classification and regression. In k-NN classification, the output is a class membership. An object is classified by a majority vote of its neighbors, with the object being assigned to the class most common among its k nearest neighbors. In k-NN regression, the output is the property value for the object. This value is the average of the values of its nearest neighbors. Both for classification and regression, it can be useful to weight the contributions of the neighbors, so that the nearer neighbors contribute more to the average than the more distant ones. K-NN is a type of instance-based learning, or lazy learning, where the function is only approximated locally and all computation is deferred until classification. The k-NN algorithm is among the simplest of all machine learning algorithms. The basic k-Nearest Neighbor algorithm is composed of two steps: Find the k training examples that are closest to the unseen example. Take the most commonly occurring classification for these k examples (or, in the case of regression, take the average of these k label values).A shortcoming of the k-NN algorithm is that it is sensitive to the local structure of the data.(Cover & Hart, 1967)
4. **Neural networks** try to mimic the human brain by using artificial ‘neurons’ to compare attributes to one another and look for strong connections. An artificial neural network (ANN), usually called neural network (NN), is a mathematical model or computational model that is inspired by the structure and functional aspects of biological neural networks. In most cases an ANN is an adaptive system that changes its structure based on external or internal information that flows through the network during the learning phase. Neural networks are usually used to model complex relationships between inputs and outputs or to find patterns in data. In this network, the information moves in only one direction, forward, from the input nodes, through the hidden nodes (if any) to the output nodes.(Haykin, 1994)

We decided to use this algorithm because we have already found some results of this Ford’s competition obtained with some others algorithms (Logistic Regression, SVM, etc.)

For the evaluation we have used two types of evaluation criteria:
The **accuracy** of our algorithm, which is calculated as in formula below:

$$\text{Accurecy} = \frac{(TP + TN)}{N} \qquad (1)$$

TP - True Positive
TN - True Negative
N – Number of data points in sample

The **Area Under the Curve (AUC)** – it presents a measure of discriminatory power of classifiers. It is very good for measuring performances of binary classifiers and it takes values from zero to one. When value is above 0.5 it is a positive class prediction, and when is between 0.7 and 0.8 it is a good classifier, between 0.8 and 0.9 very good, and above 0.9, it is excellent.

Validation of model, which is used to prevent over fitting, was done using 10-fold cross validation. This means that original dataset was divided to 10 disjunctive parts, from which 9 subsets were used for training of model and remaining one for test. This process is iterated 10 times, each having different subset for testing the model. (Kohavi, 1995)

3. RESULTS

In Table 1 results that were obtained using mentioned algorithms on theAlert dataset are shown.

Table 1: Performance of algorithms on Alert dataset

Algorithms	Accuracy	AUC
Decision Tree	66.56% ± 0.28%	0.603 ± 0.003
K-nn	69.17% ± 1.9%	0.500 ± 0.000
Neural Net	**82.94% ± 1.09%**	**0.880 ± 0.007**
Naive Bayes	64.31% ± 0.56%	0.812 ± 0.006

After the first section, where we used sample of original dataset, without any data processing, we can conclude that the best performance was obtained by the Neural Net algorithm. Other three algorithms had approximately same accuracy, but the values for AUC were different. For k-NN algorithm AUC was 0.500, and that means that it is on the border between positive and negative class prediction. Also, we must emphasize that in k-NN algorithm, k was 1.

We continued our research, and the next step was adding operator Attribute Weight in our validation. The operator Attribute Weight by Information Gain calculates the weight of attributes with respect to the class attribute and the higher the weight of an attribute, the more relevant it is considered.

In Table 2 are shown weights of each attribute and in the Table 3 new results for each algorithm.

Table 2: Attribute Weights

Attribute	Weight	Attribute	Weight	Attribute	Weight
P1	0.0738	E3	0.2286	V2	0.0516
P2	0.0151	E4	0.1689	V3	0.0298
P3	0.0070	E5	0.1118	V4	0.2511
P4	0.0070	E6	0.2955	V5	0.0150
P5	0.4457	E7	0.8297	V6	0.4782
P6	0.4548	E8	0.6597	V7	0.0000
P7	0.4548	E9	1.0000	V8	0.3515
P8	0.0000	E10	0.9658	V9	0.0000
E1	0.1883	E11	0.0384	V10	0.5038
E2	0.1064	V1	0.5120	V11	0.7725

After obtained attribute weights, we concluded that physiological (P) and vehicular (V) attributes were generally less important (except V1 = 0.5120 and V11 = 0.7725). And the most important attributes in the process of discovering whether the driver is alert or not alert, are environmental attributes (especially E9= 1).

Environmental attributes are more important and that means that should pay attention on environment more than physiological and vehicular factors on driver's attention. Otherwise, in environmental excited much more things that will distract attention of driver (human commercial or natural weather conditions, but this can be explained in more details in another project).

Table 3: Performance of algorithms with attribute weight

Algorithms	Accuracy	AUC
Decision Tree	66.56% ± 0.28%	0.603 ± 0.003
K-nn	87.43% ± 1.9%	0.500 ± 0.000
Neural Net	**82.94% ± 1.09%**	**0.922 ± 0.007**
Naive Bayes	64.31% ± 0.56%	0.802 ± 0.006

When we put attribute weights, we got some new results. Neural Net algorithm, again, gave the best results, and with accuracy of 82.94%, and value for AUC = 0.922 we can say that is an excellent classifier. Also, we

would like to point out that giving weight to each attribute had a positive influence on the results, and it is something that is really important for this problem.

The next that we wanted to examine is how the relationship between the attributes effect on the results, so we generated some new attributes. To be able to generate new attributes, we needed to normalize our data and to define what we want to present. To achieve the relevancy of new attributes we used relation between average size of the same group of attributes (physiological, environmental and vehicular). After the normalization of the data we have generated following attributes:

1. **E/P** = ((E1+E10+E11+E2+E3+E4+E5+E6+E7+E8+E9)/11)/((P1+P2+P3+P4+P5+P6+P7+P8)/8)
2. **E/V** = ((E1+E10+E11+E2+E3+E4+E5+E6+E7+E8+E9)/11)/((V1+V10+V11+V2+V3+V4+V5+V6+V7+V8+V9)/11)
3. **P/V** = ((P1+P2+P3+P4+P5+P6+P7+P8)/8)/((V1+V10+V11+V2+V3+V4+V5+V6+V7+V8+V9)/11)

Result of this fasa of research are shown in Table 4:

Table 4: Performance of algorithms with attribute weight and three new attributes

Algorithms	Accuracy	AUC
Decision Tree	66.56% ± 0.27%	0.603 ± 0.003
k-NN	91% ± 0.17%	0.500 ± 0.000
Neural Net	**86.25% ± 0.56%**	**0.920 ± 0.003**
Naive Bayes	64.16% ± 1.12%	0.809 ± 0.006

From the table above (Table 4) we can conclude that new attributes had not an influence on the results of process. As we can see there are not any relevant changes. The best results are still got from the Neural Net algorithm.
Also, we have noticed that accuracy for k-NN algorithm was good, bud the value for AUC was constantly on the border, so it was something that we wanted to examine. So we have tried with other valesfor k. The results that we have god were great, and the best were for k=7.

Table 5: Performance of k-NN algorithm for k=7

Algorithm	**Accuracy**	**AUC**
k-NN (k=7)	**90.38% ± 0.17%**	**0.958 ± 0.006**

To summarize everything above we have used a chart which is presented on Figure 1:

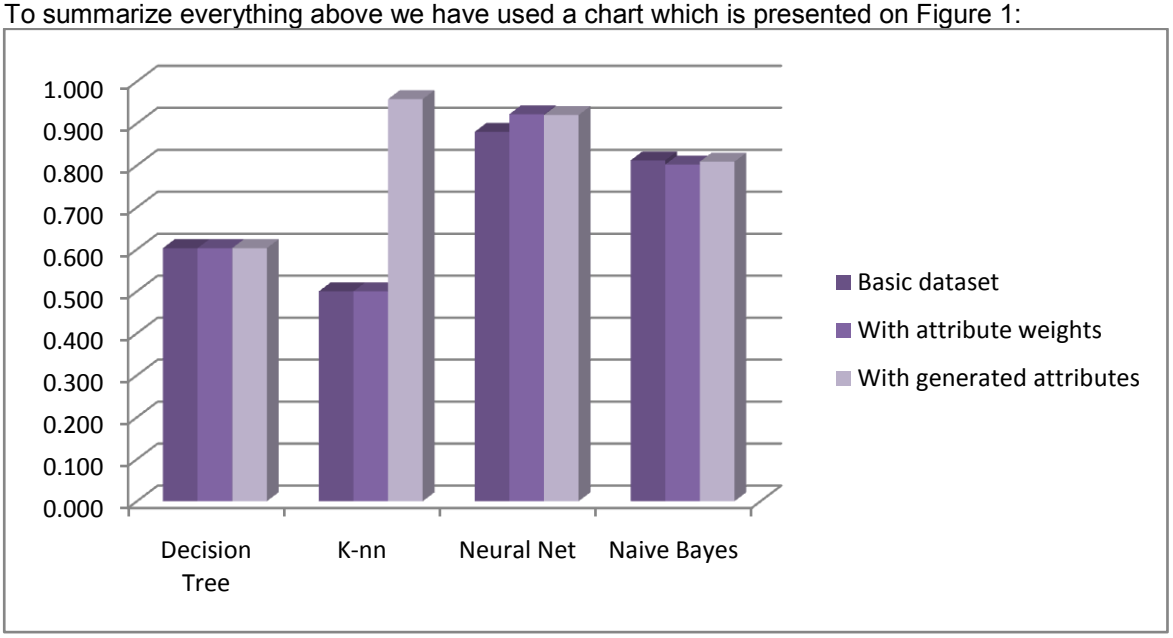

Figure 1: Chart with all values of **AUC** for all algorithms that has been used

From Figure 1 it can be noticed that best results gave **k-NN** algorithm for k=7, with accuracy about 90% and value for AUC= 0.958. We must not forget about results obtained with Neural Net algorithm – accuracy 86.25% and AUC=0.920 who also were excellent.

As we it was already mentioned, we used Rapid Miner for evaluation. Our process in Rapid Miner is presented on Figure 2.

The first thing that we needed to do was to take a sample of dataset. All attributes had a different values and different range, and because we wanted to make some new attributes the normalization was the first thing to do. After that, in the validation operator we put an operator for attribute weights, and k-NN algorithm. We also specified the value for k, an as it was mentioned the best results were with k=7,and the distance between vector was calculated with Mixed Eucledian Distance (Figure 3). At the performance operator we specified that we want our results to be shown by the accuracy and the value of AUC.

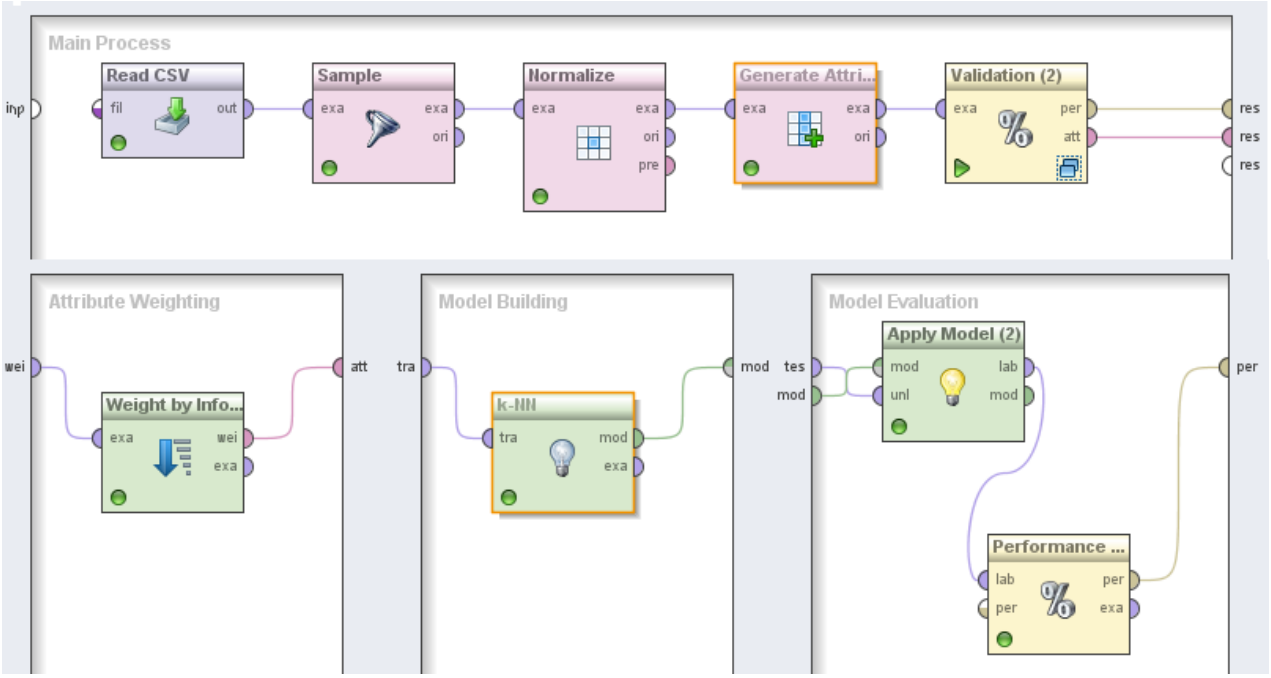

Figure 2: Process in Rapid Miner

4. CONCLUSION

There are lots of accidents and driving while not alert can be deadly. Using the program Rapid Miner we wanted to find out the best solution of Ford challenge. In our project we have worked with many algorithms - Decision tree, k-NN, Naive Bayes and Neural Networks. After our analysis the best experimental results are obtained from k-NN algorithm. k-NN gave us two moments which is able to predict values of numeric attributes, accuracy (90%) and AUC (95%). Also, Neural Net obtained good results, accuracy (86%) and AUC (92%)

We, also, conclude that the biggest positive influence on the results of the process was adding weights to each attribute, and the most important group of attributes is environmental attributes (E1-E11).
We were expecting the new attributes to have some positive influence on the model, but it was not the case. It turns out that relation between the averages of a same group of attributes has no influence for this research.

At the end we would just wanted to remind you – STAY ALERT!

REFERENCES

Cover, T., & Hart, P. (1967). Nearest neighbour pattern classification. Information Theory, IEEE Transactions on, 13(1), 21-27. doi:10.1109/TIT.1967.1053964

Haykin, S. (1994). Neural networks: a comprehensive foundation. Prentice Hall PTR.

Kohavi, R. (1995, August). A study of cross-validation and bootstrap for accuracy estimation and model selection. In IJCAI (Vol. 14, No. 2, pp. 1137-1145).

Mierswa, I., Wurst, M., Klinkenberg, R., Scholz, M., & Euler, T. (2006, August). Yale: Rapid prototyping for complex data mining tasks. In Proceedings of the 12th ACM SIGKDD international conference on Knowledge discovery and data mining (pp. 935-940). ACM.

Quinlan, J. R. (1986). Induction of decision trees. Machine learning, 1(1), 81-106. doi:10.1023/A:1022643204877

Louis Fourrier, Fabien Gaia and Thomas Rolf. (2012.). Stay Alert! The Ford Challenge Retrieved from http://cs229.stanford.edu/proj2012/FourrierGaieRolf-StayAlert!TheFordChallenge.pdf

Tayyab bin Tariq, Allen Chen. (2012.)Stay Alert! The Ford ChallengeRetrieved from http://cs229.stanford.edu/proj2012/ChenTariq-StayAlert.pdf

Stay Alert! The Ford Challenge.(2012.)Retrieved fromhttps://www.kaggle.com/c/stayalert

RISK PREDICTION OF CUSTOMER CREDIT DEFAULT

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Abstract: *Credit risk is the primary risk facing financial institutions. In this paper, the focus is on the individuals whom are in the need of a loan, rather than on corporations and other institutions. In this project, we had 10 attributes and 250.000 examples on which we managed to predict whether or not the client defaulted the loan in the next two years. The data set was provided by www.kaggle.com, as part of the contest 'Give me some credit'[1]. Using several different algorithms we were able to get the best AUC score of 0.813.*

Keywords*: Forecasting, RapidMiner, data analysis, loan prediction, feature weighting.*

1. INTRODUCTION

Historically, credit scoring systems were built to answer the question of how likely is it for credit applicant to default by a given time in the future. Different modelling techniques can be used to build such systems-discriminant analysis, logistic regression, partitioning trees, mathematical programming, neural networks, expert systems and generic algorithms[2]. The methodology is to take a sample of previous customers and classify them into a certain category, depending on their features, for instance, number of open credit lines and loans, debt ratio, and belated payments, supported by certain personal information such as age, number of dependants, and monthly income. The tool utilised for the purpose of the project is RapidMiner.

Credit scoring problem is often tackled with different data mining techniques and algorithms. (Huang et al., 2007) proposed hybrid GA-SVM algorithm that can simultaneously perform feature selection task and model parameters optimization by combining genetic algorithms with SVM classifier. Experimental results showed that SVM is a promising addition to the existing data mining methods.
(Vukovic et al., 2012) proposed a case-based reasoning (CBR) model that uses preference theory functions for similarity measurements between cases. Additionally, they used a genetic algorithm in order to select the right preference function for every feature and set the appropriate parameters. The proposed model is compared to the well-known k-nearest neighbour (k-NN) model based on the Euclidean distance measure on three different benchmark datasets. They showed that, in some cases, newly proposed algorithm outperforms the traditional k-NN classifier.

(Hsieg, 2004) proposed an integrated data mining and behavioral scoring model to manage existing credit card customers in a bank. A self-organizing map neural network was used to identify groups of customers based on repayment behavior and recency, frequency, monetary behavioral scoring predicators. It also classified bank customers into three major profitable groups of customers. The resulting groups of customers were then profiled by customer's feature attributes determined using an Apriori association rule inducer.
(Lee et al. 2002) proposed a study in which they explored the performance of credit scoring by integrating the back-propagation neural networks with traditional discriminant analysis approach. As the results reveal, the proposed hybrid approach converges much faster than the conventional neural networks model. They have reached the conclusion that the credit scoring accuracies increase in terms of the proposed methodology and outperform traditional discriminant analysis and logistic regression approaches.
(Martens et al., 2007) provided an overview of the rule extraction techniques for SVMs and introduced two others taken from the artificial neural networks domain, Trepan and G-REX. Their experiments show that the SVM rule extraction techniques lose only a small percentage in performance compared to SVMs and therefore rank at the top of comprehensible classification techniques.

(Huang et al., 2006) understood that the problem of imbalanced class distributions can lead the algorithms to learn overly complex models that overfit the data and have little relevance. Their study analyzes different classification algorithms that were employed to predict the creditworthiness of a bank's customers based on checking account information.

In this study we evaluate different classification algorithms on the real world credit scoring dataset that is recently used on Kaggle's "Give me some credit" competition[3]. We compared the performances of seven single and ensemble algorithms. Additionally, we used Evolutionary and Particle Swarm Optimization (PSO) algorithm for feature weighting in order to identify the most influential attributes and hopefully improve model performance.

2. PREDICTION OF CUSTOMER CREDIT DEFAULT – „GIVE ME SOME CREDIT"

In this section we propose a method for prediction of customer credit default. The data is collected from Kaggle competition and contains real world credit scoring examples from www.kaggle.com. Example set contains 250.000 examples, among those 150.000 is training set, and another 100.000 is testing data set. The basic description is given in Table 1.

Table 1: Basic description of variables

Variable Name	Description
SeriousDlqin2yrs	Person experienced 90 days past due delinquency or worse
RevolvingUtilizationOfUnsecuredLines	Total balance on credit cards and personal lines of credit except real estate and no installment debt like car loans divided by the sum of credit limits
Age	Age of borrower in years
NumberOfTime30-59DaysPastDueNotWorse	Number of times borrower has been 30-59 days past due but no worse in the last 2 years.
DebtRatio	Monthly debt payments, alimony, living costs divided by monthly gross income
MonthlyIncome	Monthly income
NumberOfOpenCreditLinesAndLoans	Number of Open loans (installment like car loan or mortgage) and Lines of credit (e.g. credit cards)
NumberOfTimes90DaysLate	Number of times borrower has been 90 days or more past due.
NumberRealEstateLoansOrLines	Number of mortgage and real estate loans including home equity lines of credit
NumberOfTime60-89DaysPastDueNotWorse	Number of times borrower has been 60-89 days past due but no worse in the last 2 years.
NumberOfDependents	Number of dependents in family excluding themselves (spouse, children etc.)

It can be seen from Figure 1 that cases are highly imbalanced 1:14. This is important to notice because algorithms and evaluation techniques for this kind of data are specific. This will be more thoroughly explained later. Figure 1 shows the data set summary:

Role	Name	Type	Statistics	Range	Missings
id	att1	integer	avg = 75000.500 +/- 43301.415	[1.000 ; 150000.000]	0
label	SeriousDlqin2yrs	binominal	mode = 0 (139974), least = 1 (10026)	1 (10026), 0 (139974)	0
regular	RevolvingUtilizationOfUnsecuredLines	real	avg = 6.048 +/- 249.755	[0.000 ; 50708.000]	0
regular	age	integer	avg = 52.295 +/- 14.772	[0.000 ; 109.000]	0
regular	NumberOfTime30-59DaysPastDueNotWorse	integer	avg = 0.421 +/- 4.193	[0.000 ; 98.000]	0
regular	DebtRatio	real	avg = 353.005 +/- 2037.819	[0.000 ; 329664.000]	0
regular	MonthlyIncome	real	avg = 6670.221 +/- 14384.674	[0.000 ; 3008750.000]	29731
regular	NumberOfOpenCreditLinesAndLoans	integer	avg = 8.453 +/- 5.146	[0.000 ; 58.000]	0
regular	NumberOfTimes90DaysLate	integer	avg = 0.266 +/- 4.169	[0.000 ; 98.000]	0
regular	NumberRealEstateLoansOrLines	integer	avg = 1.018 +/- 1.130	[0.000 ; 54.000]	0
regular	NumberOfTime60-89DaysPastDueNotWorse	integer	avg = 0.240 +/- 4.155	[0.000 ; 98.000]	0
regular	NumberOfDependents	integer	avg = 0.757 +/- 1.115	[0.000 ; 20.000]	3924

Figure 1: Example set descriptive statistics

It can be noticed that there are 29.731 missing values under the attribute *MonthlyIncome*, and 3.924 under the attribute *NumberOfDependants.* The solution for the first issue was removal of the instances with missing

values, and as for the second, we used an operator Replace Missing Values which had replaced the missing instances with average value. After the completion of these steps, we got the final data set that has 120.269 instances with no missing values.

From the original attributes showed in Table 1 we derived several new attributes in order to inspect if some aggregated attributes can provide more information to the algorithms, compared to original ones. These are:

Table 2: Derived attributes

Variable name	Description
Debt	MonthlyIncome*DebtRatio
CumulativeLateness	Sum of all lateness
WagesPerCapita	MonthlyIncome/NumberOfDependents
AgeDiscretized	Age is discretized in three categories: Young (under 35), Middle age (between 35 and 60), Old (above 60 years of age).

2.2. Algorithms

Because of the imbalanced nature of dataset we evaluated several ensemble algorithms, since they often showed good performance on this kind of data[4]. Additionally, we compared algorithm performances with single algorithms. Brief descriptions of algorithms used in this study is given in Table 3.

Table 3: Types of used algorithms

Type	Algorithm	Description
Ensemble	Random Forest	Learns a set of random trees, i.e. for each split only a random subset of attributes is available. The resulting model is a voting model of all trees.
Ensemble	Bayesian Boosting	This operator trains an ensemble of classifiers for boolean target attributes. In each iteration the training set is reweighted, so that previously discovered patterns and other kinds of prior knowledge are "sampled out".
Ensemble	Meta Cost	This operator uses a given cost matrix to compute label predictions according to classification costs.
Ensemble	Bagging	Bagging operator allowing all learners.
Single	Naive Bayes	Returns classification model using estimated normal distributions.
Single	Decision Tree	Generates decision trees to classify nominal data.
Single	Perceptron	Single Perceptron finding separating hyperplane if one exists.

2.3. Evaluation

Because of high class imbalance and binary class type, classification accuracy is not suitable for measuring performance of algorithms, since it gives misleading results, on this type of data. In our case, classification accuracy would give the accuracy of 93.05% forth majority algorithm, i.e. if algorithm predict always negative case (person will return credit). Even though this accuracy is high, it doesn't reflect the success of the model, since in this case is more important to predict positive cases (identify persons that will not return the credit). This is the reason we used Area under curve (AUC measure) for algorithm evaluation. It represents the area under Receiver Operating Characteristic (ROC) curve - graphical plot which illustrates the performance of a binary classifier system as its discrimination threshold is varied. ROC curve is created by plotting the fraction of true positives out of the total actual positives (TPR = true positive rate) divided by the fraction of false positives out of the total actual negatives (FPR = false positive rate), at various threshold settings[5]. The true positive rate, or recall, is calculated as the number of true positives divided by the total number of positives. The false positive rate is calculated as the number of false positives divided by the total number of negatives.

2.4. Experiments and results

In the first process, we evaluated performances of all algorithms on all available attributes. AUC is measured based on 10 fold cross validation with the stratified sampling. It builds random subsets and ensures that the class distribution in the subsets is the same as in the whole dataset. In our case of a binominal classification, stratified sampling builds random subsets in which each subset contains roughly the same proportions of the two values of class labels. Stratification is the process of dividing members of the population into

homogeneous subgroups before sampling. Afterwards, simple random sampling or systematic sampling is applied within each stratum. This often improves the representativeness of the sample by reducing sampling error. This enables correct interpretation of AUC values. Imbalanced class distributions can lead the algorithms to learn overly complex models that overfit the data and have little relevance. It is known that class imbalance problem can be successfully solved with under-sampling techniques[6]. In this experiment we evaluated every algorithm on different sub-samples:

Table 4: Evaluation of algorithms on basic data set

Algorithm/Sample (class 0/ class 1)	**111911/8357**	**50000/8357**	**30000/8357**	**8357/8357**	**5000/8357**	**2000/8357**
Random Forest	0.5	0.500	0.575	0.792 (0,667)	0.642	0.0
Bayesian Boosting- Decision stump	0.5	0.570	0.570	0.771	0.715	0.5
Meta Cost - Decision stump	0.511	0.571	0.646	0.668	0.775	0.697
Bagging - Decision stump	0.505	0.570	0.615 (0.773 DT, 0.748)	0.644	0.739	0.626
Naive Bayes	0.801	0.797	0.797	0.795	0.797	0.789
Decision Tree	0.719	0.500	0.500	0.773	0.715	0.701
Perceptron	**0.775**	**0.812**	**0.813**	0.814	**0.812**	**0.737**

After the conducted experiment with basic attributes, we started another analysis, but this time we utilized derived attributes, hoping to get better results. Those results are presented in Table 5:

Table 5: Evaluation of algorithms on data set that contained derived attributes

Algorithm/Sample (class 0/ class 1)	**111911/8357**	**50000/8357**	**30000/8357**	**8357/8357**	**5000/8357**	**2000/8357**
Random Forest	0.5	0.5	0.593	0.803 (0,737, 810)	0.794	0.5
Bayesian Boosting	0.502	0.631	0.664	0.789(0,708)	0.737	0.5
Meta Cost	0.54	0.587	0.657	0.758	0.757	0.776
Bagging	0.513	0.579	0.625	0.692	0.743	0.579
Naive Bayes	0.79	0.789	0.782	0.782 (0,68)	0.784	0.789
Decision Tree	0.5	0.5	0.546	0.753	0.753	0.753
Perceptron	**0.809**	**0.809**	**0.809**	**0.807 (0,756, 803)**	**0.811**	**0.81**

It can be seen from Table 4 that different samples influence on algorithm performance and that Perceptron in all cases gives the best results (around 0.81). Perceptron is a type of artificial neural network. It can be seen as the simplest kind of feed-forward neural network: a linear classifier. From this we can conclude that Perceptron successfully solves imbalance data problem on all sub-samples. This indicates that Perceptron could be trained on smaller sub-samples (in order to reduce time cost) without worsening the performance.

It can be also be noticed from Table 5 that ensemble algorithms showed the best performance when data is completely balanced (8.357 negative and 8.357 positive cases). As expected, Decision Tree algorithm showed the worst results especially when the data is imbalanced (111.911 positive and 8.357 negative cases).

In the second experiment we used feature weighting techniques (Evolutionary and PSO) in order to identify the most influential attributes, and hopefully, to improve model's performance. In order to prevent overtraining of models (because of optimization of attribute selection) we used Wrapper X-Validation operator that divides data on training and test samples. Training sample is used for estimating performance of different classifiers on different feature subsets. Models built on features with best estimated performance are returned to Wrapper X validation and evaluated on unseen data.

In Table 6 the results for evolutionary feature weighting are showed.

Table 6: Evolutionary feature weighting

Attributes	*Random Forest*	*Bayesian Boosting*	*Meta Cost*	*Bagging*	*Naive Bayes*	*Decision Tree*	*Perceptron*
RevolvingUtilizationOfUnsecuredLines	1	1	0.2	1	1	1	0.4
AgeDiscretized	0	0	0	0.4	0.4	0	0
DebtRatio	0	0	0.6	0	0	0	0.8
MonthlyIncome	1	1	0.6	1	1	1	0.6
Debt	0	0.6	0.4	0.4	0.4	0	0.4
NumberOfOpenCreditLinesAndLoans	1	0.8	0	0.6	0.6	1	0.2
NumberRealEstateLoansOrLines	0	0.8	1	0.2	0.2	0	1
WagesPerCapita	1	0.6	0.2	0.8	0.8	1	0.4
CumulativeLateness	0.4	1	1	0	0	0.8	1
AUC	**0.744**	**0.788**	**0.744**	**0.716**	**0.779**	**0.771**	**0.757**

It can be seen from Evolutionary feature weighting that Bayesian Boosting gave the best performance by the means of AUC (0.788) and the most important features were *RevolvingUtilizationOfUnsecuredLines*, *MonthlyIncome*, *CumulativeLateness*. It is interesting to notice that *RevolvingUtilizationOfUnsecuredLines* and *MonthlyIncome* had the highest relative importance in 5 out of 7 algorithms, and this indicates that these attributes are generally important for this problem. In Table 7 the results for PSO feature weighting are showed.

It can be seen from PSO feature weighting that Perceptron gave the best result (around 0.8). PSO gave the highest weights for *Debt and WagesPerCapita*, while the attributes with lowest importance were *MonthlyIncome* and *NumberRealEstateLoansOrLines* (below 0.2). Similar performance (0.796) was obtained by Random Forest (0.796), but the most important attributes were *CumulativeLatence* and *RevolvingUtilizationOfUnsecuredLines*, while the lowest weight was *RevolvingUtilizationOfUnsecuredLines*. Still, general conclusions about most important features cannot be made since other features were often identified as important in the other algorithms (e.g. *AgeDiscretized* was the most important feature in Bayesian Boosting and Bagging, while *Debt* was most important feature for Naive Bayes and Perceptron).

From previous results and discussion we can conclude that *RevolvingUtilizationOfUnsecuredLines* has the biggest influence on the problem (by both PSO and Evolutionary algorithms). *MonthlyIncome* also showed high relative importance in Evolutionary, but very low with PSO. In contrast to Evolutionary algorithm PSO gave higher importance to *Debt*, instead of *MonthlyIncome*.

3. CONCLUSION AND FUTURE WORK

In this research, we evaluated several classification algorithms and feature optimization techniques for client loan default in the next two years. The best performing algorithm was Multilayer Perceptron that showed AUC score of 0.813 in combination with evolutionary feature selection technique. As a part of our future work, we plan to evaluate different algorithms and other sampling techniques (such as random sampling, systematic sampling, cluster sampling). Additionally, we plan to improve performance of classification algorithms by using different techniques for imputation of missing values.

REFERENCES

Banasik, J., Crook, J. N., & Thomas, L. C. (1999). Not if but when will borrowers default. *Journal of the Operational Research Society*, 1185-1190.

Guo, H., & Viktor, H. L. (2004). Learning from imbalanced data sets with boosting and data generation: the DataBoost-IM approach. *ACM SIGKDD Explorations Newsletter*, *6*(1), 30-39.

Hsieh, N. C. (2004). An integrated data mining and behavioral scoring model for analyzing bank customers. *Expert systems with applications*, *27*(4), 623-633.

Huang, C. L., Chen, M. C., & Wang, C. J. (2007). Credit scoring with a data mining approach based on support vector machines. *Expert Systems with Applications*, *33*(4), 847-856.

Huang, Y. M., Hung, C. M., &Jiau, H. C. (2006). Evaluation of neural networks and data mining methods on a credit assessment task for class imbalance problem. *Nonlinear Analysis: Real World Applications*, *7*(4), 720-747.

Lee, T. S., Chiu, C. C., Lu, C. J., & Chen, I. F. (2002). Credit scoring using the hybrid neural discriminant technique. *Expert Systems with applications*, *23*(3), 245-254.

Liu, X. Y., Wu, J., & Zhou, Z. H. (2009). Exploratory undersampling for class-imbalance learning. *Systems, Man, and Cybernetics, Part B: Cybernetics, IEEE Transactions on*, *39*(2), 539-550.

Martens, D., Baesens, B., Van Gestel, T., &Vanthienen, J. (2007). Comprehensible credit scoring models using rule extraction from support vector machines. *European journal of operational research*, *183*(3), 1466-1476.

Mierswa, I., Wurst, M., Klinkenberg, R., Scholz, M., & Euler, T. (2006, August). Yale: Rapid prototyping for complex data mining tasks. In *Proceedings of the 12th ACM SIGKDD international conference on Knowledge discovery and data mining* (pp. 935-940). ACM.

Swets, John A.; *Signal detection theory and ROC analysis in psychology and diagnostics: collected papers*, Lawrence Erlbaum Associates, Mahwah, NJ, 1996

Vukovic, S., Delibasic, B., Uzelac, A., & Suknovic, M. (2012). A case-based reasoning model that uses preference theory functions for credit scoring. *Expert Systems with Applications*, *39*(9), 8389-8395.

APPLICATION OF ANP METHOD BASED ON A BOCR MODEL FOR DECISION-MAKING IN BANKING

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Abstract: *This paper describes the application of the ANP multicriteria method in modeling and quantitative analysis of major determinants and their relative weights in regard to benefits, opportunities, costs and risks (BOCR). In this way we estimate all the effects of the choice of appropriate strategies for the successful introduction of the concept of open innovation in the banking sector of Serbia. Based on the obtained results, the paper demonstrates the possibility of using ANP method to support effective decision-making in a complex business environment, as it provides a comprehensive, quantitative, and objective approach to all relevant, tangible and intangible factors in a decision-making process.*

Keywords*: Multi-criteria ANP method, BOCR, Serbian banking sector, concept of open innovation, effective decision-making.*

1. INTRODUCTION

Management of an organization is profoundly based on a decision-making process. Adoption of appropriate business decisions in a dynamic business environment is vital at all managerial levels, bearing in mind that each decision makes a significant impact on a company's business. Due to pronounced changes in business environments, functioning and survival of companies is becoming increasingly more complex, and the responsibility for decisions much greater. A wrong decision can have irreparable loss to an organization (Čupić & Suknović, 2010; Lawrence & Pasternack, 2002). Therefore, effective decision-making in complex conditions is a cognitive process that involves developing a logical, systematic and comprehensive approach, which requires the incorporation of multiple available data and alternatives, as well as qualitative and quantitative factors into a decision-making process itself, using appropriate tools and decision support systems (Drucker, 1967; Čupić & Suknović, 2010; Wood & Bandura, 1989; Heizer & Render, 2010).

In recent years the financial sector has been in the process of revolutionary transformation caused by a number of phenomena such as: global economic integration and regionalization of markets, development of knowledge-based economy, intense competition, regulatory pressures, a growth of sophisticated consumer requirements, technological innovations, political and demographic changes, volatile and turbulent business environments. The selection of effective strategies for sustainable competitiveness, growth and development of the organization, as well as creating superior values for customers and shareholders, have always represented a challenge for the banking sector. However, in the modern business environment the choice becomes increasingly complex. In order to respond adequately to the challenges of the external environment and to find appropriate strategies for sustainable competitiveness, growth and development of organizations, as well as timely response to a short-term phenomenon in the everyday pressures of business, the banking sector needs to develop the capacity to adapt to all the changes and to redefine existing business strategies without any delay (Fasnacht, 2009; Huo & Hong, 2013).

One of the competitive strengths of organizations and a key driver to maintain high profitability is an innovation (Drucker, 1988; Christensen, 1997). According to Löfsten (2014), organizations with a strategy of innovation gain a platform for better business performance. Due to pronounced pressures from the environment, the success of innovation has become very uncertain, and the question is whether the innovation and innovative processes in closed business environments are sufficient for sustainable competitiveness, growth and development of organizations in the 21st century? Chesbrough (2003) argues that companies from different business areas significantly changed the approach to innovation, so that the recently proposed concept of innovation management, the concept of open innovation, has become a key strategic element for the commercialization of innovation, the basis for the reduction of operating costs and increase of profitability in the conditions of the new era. Moreover, the model of open innovation has been recognized as an important driver of sustainable growth and development of organizations in all industries (Gassmann & Enkel, 2004).

As a new business paradigm, this concept represents a fundamental change in generating and managing intellectual property; it is based on a holistic approach to innovation management that involves

"systematically encouraging and exploring a wide range of internal and external resources as new innovation opportunities, consciously integrating the research possibilities and resources of a company and a wide exploitation of these opportunities through multiple channels of distribution" (West & Gallagher, 2006).

Introducing the concept of open innovation in the banking sector in Serbia is a very challenging and complex task, given that banks are traditionally closed systems, and the fact that the concept of open innovation, in addition to its benefits and opportunities, is correlated with costs and risks as important indicators for the assessment of important determinants based on which a final decision on the strategy implementation model of open innovation in the banking sector of Serbia is to be made. To this end this paper presents Analytical Network Process (ANP) based on the BOCR (Benefits, Opportunities, Costs and Risk) model as a method for decision support in a complex business environment that provides a comprehensive, quantitative, and objective approach to all relevant, tangible and intangible factors in the decision-making process.

2. DECISION MAKING IN BANKING

In today's business environment characterized by complexity and dynamism of the business environment, banks are facing different decision-making problems at every managerial level, and it is a particular challenge for strategic management in making appropriate strategic decisions on which the survival, growth, and development of banks depend. This problem is even more noticeable due to uncertainties and risks, as well as the strong influence of political-economic, social, technical, institutional and cultural factors.

Business environment of the banking sector has drastically changed over the last 20 years, which has led to significant changes in the banking sector (Fasnacht, 2009). Today, the banking sector is in a period of transformation and consolidation due to the changes imposed by this century, which are primarily reflected in deregulation and financial liberalization, privatization and advanced information and communication technologies. Over the last ten years a large number of countries in transition have faced these changes, which required significant structural reform of the financial system, which reflects in the reduction of the total number of banks and an increased number of foreign financial institutions. By the end of 2000 fundamental changes in the banking sector followed in Serbia as the banking sector was ruined during 1990s. The process of reform and reconstruction of the banking sector has resulted in significant positive effects such as neutralization of financial loss, improved structure of banks, restored confidence of customers in the banking sector, especially in relation to citizens' savings, entry of the foreign capital resulting (in addition to recapitalization) in greater competitiveness by adopting new knowledge and experience from international markets, the application of international accounting standards, strengthening the capital base, as well as significant increase in employment (NBS, 2005). The 2008 global economic crisis spilled over from developed markets into the banking sector in Serbia as a result of close connections between financial markets, thus leading to the structural weaknesses of the banking sector. The recession, which started in 2009, represented a serious challenge for the banking sector in Serbia, and the banks are still struggling with it today.

Searching for answers to comprehensive technological and regulatory changes, more and more demanding customers, as well as the phenomenon of globalization and the global economic crisis, financial institutions are faced with the problem of inadequate organizational structure. In recent years this sector began with the consolidation of organization, creating a new business model adapted to the conditions of the 21st century. New trends in the economic environment have imposed the need for banks to constantly innovate, revise business models and revitalize the trust of customers in order to survive, keep sustainable competitiveness, long-term growth and development (Luftenegger et al., 2010).

3. CONCEPT OF OPEN INNOVATION IN THE FINANCIAL SECTOR

Chesbrough defines open innovation as "alternating use of meaningful inputs and outputs of knowledge to accelerate the internal innovation process and increase the market for external use of innovation" (Chesbrough et al., 2006). Additionally, Chesbrough et al. (2006) explains the concept of open innovation as "a paradigm which assures companies that they can and should use both external and internal ideas in the same way, and both internal and external paths to market to advance their technology". However, the model of open innovation is more than the use of external ideas and technologies in innovation management. To get a competitive performance on the open market, the concept of open innovation means a new way of thinking based on openness, flexibility, sharing of intellectual property, investment in the global foundation of knowledge and integration with customers, suppliers, partners, universities and other stakeholders, with the aim to incorporate new knowledge, ideas and resources from the external environment (Chesbrough, 2003a; Laursen & Salter, 2006). Also, according to the authors, the concept of open innovation is vital for achieving operational excellence and increase profitability (Fasnacht, 2009; Schmitt et al., 2013).

The conceptual framework of action toward a successful implementation of open innovation model in the financial sector is based on three basic guiding principles: a transition strategy from a closed to an open innovation model, dynamic managerial practices, and appropriate corporate culture of open innovation (Fasnacht, 2009).

Transition strategy towards the model of open innovation involves changing business models that are based on openness and flexibility, a holistic approach, as well as the integration of customers through appropriate architecture and business strategy. In the open innovation model, customers are at the core of the business focus (Fasnacht, 2009; Teece, 2010).

The shift in the transformation from a traditional organization characterized by vertical hierarchical and bureaucratic structure with the functional structure orientated to product development, into an organization that follows the principles of flexibility, openness, and a customer-oriented business model, represents a major challenge for managers in the financial sector. With that in mind, competitive advantage can be achieved if the management of the financial sector understands how to use resources and opportunities as an integrated system. Innovation strategy as well as growth strategy should be flexible enough so as to enable the organization to properly respond to changes in the ubiquitous environment. More importantly, building and strengthening confidence, which becomes increasingly important both for interfunctional relationships within organizations and with stakeholders in the external environment, implies the creation of new ideas, development of new skills and a dynamic management approach (Chesbrough et al., 2006; Fasnacht, 2009; Teece, 2010).

In addition, incorporation of employees' intellectual capital in the open innovation model and the organizational capability to ensure an appropriate business culture towards open innovation is essential for the banking sector. Otherwise, the organization's inability to provide a supportive organizational culture is the biggest barrier to innovation and profitable growth. Unlike the traditional model which features a closed command and control systems, creating a learning and innovation culture within an organization is the basis for the development of performance and profitability growth (Fasnacht, 2009). The development of a new brand of innovative management and an intensive collaboration have become a necessity in financial institutions in order to timely react to all the changes and challenges of this era (Huff et al., 2013).

As with any new concept, initial research is based on case studies, which cannot guarantee the success of applying the concept in practice (Huizingh, 2011). With that in mind, this paper includes a quantitative analysis of significant determinants and their relative weights with regard to benefits, opportunities, costs and risks in order to measure all effects of the choice of appropriate strategies for the successful introduction of an open innovation concept in the banking sector of Serbia.

4. ANP METHOD BASED ON BOCR MODEL

The method that is most commonly and widely used in the decision-making process is the AHP - Analytic Hierarchy Process method. After the wide application of the AHP method in various fields and in complex business environments, the need for the creation of new methods in the decision-making process has arisen because over the time it was observed that a large number of problems in the decision-making process cannot be represented by a hierarchical structure which is the basis of the AHP method. Thus, the AHP method evolved in the ANP method - Analytic Network Process.

4.1. Analytic network process (ANP)

Analytic network process (ANP) is a newer multi-criteria decision-making method representing a modified and improved model of the AHP method, also developed by Saaty T. '96. (Saaty, 1999). As a generalization of AHP method, the ANP method takes into account the dependency between the elements of the hierarchy, thus making this method more realistic when calculating results. The ANP method is based on the development of a network that spreads in all directions and includes cycles between clusters and loops within the same cluster (Saaty, 1999). In addition, this method enables establishment of connections not only between clusters but also between the elements contained within them. Moreover, it enables a demonstration of inner dependence through the establishment of interactions and feedback between elements in the cluster. Similarly, the ANP method enables a demonstration of outer dependence establishing relationships and feedback between elements from different clusters. In addition, the ANP method enables the connection of whole clusters (Saaty, 2005; Saaty, 2008). Thus, the ANP method is an upgrade of the AHP method based on modeling the complexities arising from the feedback connections between the elements of structured decision-making problems. This method allows the modeling of functional interactions of criteria and alternatives in the model, resulting in greater accuracy in obtained

results, and it can be used in two ways: by BOCR model (controlled hierarchy) or network model (system). In this paper, we have applied the BOCR model which is detailed in section 4.1.1.

4.1.1. BOCR model

Complex decision-making process usually requires an analysis of a decision against benefits (B), opportunities (O) as a potentially good chance that may result in future, costs (C) that may arise, and risks (R) that could potentially follow the decision (Saaty & Vargas, 2001; Saaty, 2009). From this it can be concluded that the benefits and costs refer to a short-term period, while the opportunities and risks refer to a long-term period. In addition, benefits and opportunities represent profit, while costs and risks represent loss of the decision. Figure 1 is a summary of the BOCR model observed in regard to the period of activity, as well as the final outcome of the decision.

BOCR model represents a controlled hierarchical structure of the ANP model. In such a structure, a global goal is at the first level, at the second level are criteria and sub-criteria (clusters of elements and their relations) on the basis of which alternatives, located at the third level, are evaluated. The hierarchical structure is very similar to the structure of the AHP method, but the essential difference of the BOCR model compared to the AHP method is that the BOCR model is based on the feedback from the entities at higher levels (Saaty, 2005; Saaty, 2008; Saaty 2009).

Once a hierarchical structure of the goal, criteria, sub-criteria and alternatives is established, we move on to the next, most important phase which is performed by a paiwise comparison. Comparison of alternatives and criteria is performed for each of the BOCR factor, and this modeling allows the existance of more interdependencies between elements that are defined by the BOCR criteria (Saaty, 2008; Saaty 2009).

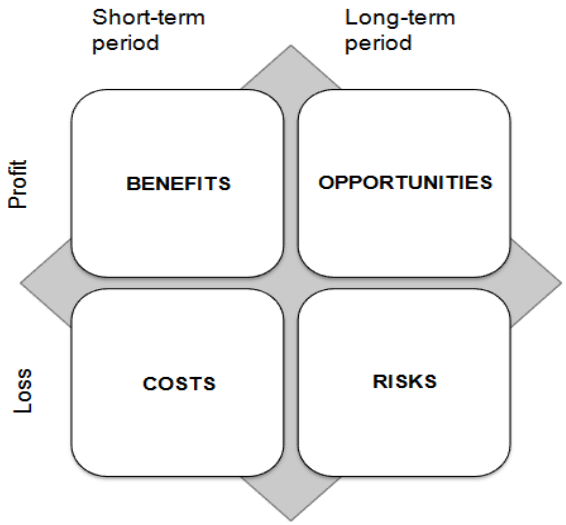

Figure 1: Summary of BOCR model in relation to the period and the final outcome of the decision (Source: Authors)

The comparison is made using a nine-point Saaty's scale as shown in Table 1, in which the rank 1 indicates equal importance between the two elements, while the rank 9 indicates the absolute importance of one element over another against which it compares (Felice & Petrillo, 2010). Reciprocal values shown in Table 1 represent the respective opposite values.

Table 1: Saaty's nine-point scale (Felice & Petrillo, 2010)

The intensity of importance shown by numerical grade	Definition	Reciprocal value
1	Equally important	1
3	Weak dominance	1/3
5	Strong dominance	1/5
7	Very strong dominance	1/7
9	Absolute dominance	1/9
2,4,6,8	Intermediate values	1/2, 1/4, 1/6, 1/8

When pairwise comparison is completed, the results are synthesed. To obtain the results, the following matrixes are used (Saaty & Ozdemir, 2005; Saaty, 2008):

1. Unweighted supermatrix is a matrix containing the priorities / weights obtained by pairwise comparison of elements in accordance with the inter-dependencies between the elements.
2. Weighted supermatrix is a matrix obtained by multiplying the unweighted supermatrice by cluster priorities / weights. Cluster priorities are shown in the Cluster matrix. Priorities in the matrix clusters are obtained by pairwise compersin of clusters in accordance with the dependencies between clusters. By this method a weighted matrix becomes a stochastic matrix in which the sum of each column equals 1.

3. Limit supermatrix is a matrix obtained by potentiating weighted supermatrix.

Figure 2 shows an example of a supermatrix.

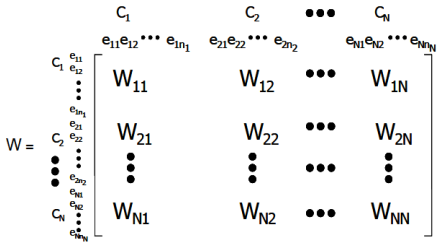

Figure 2: Supermatrix (Saaty, 2008)

In this model, C_x *(x=1, 2, … , n)* represents the hierarchy, while the elements are shown as e_{x1}, e_{x2}, … , e_{xn} (Saaty, 2008). Supermatrix is composed of so-called block matrix, W_{ij}, which shows the impact of each *i*-th element of the hierarchy on the *j*-th hierarchy. Figure 3 shows a supermatrix consisting of blocks.

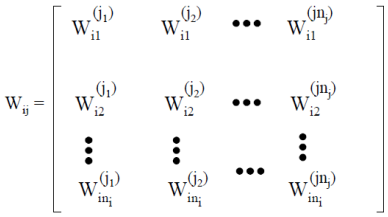

Figure 3: Supermatrix block (Saaty, 2008)

Unweighted matrix is obtained by assigning a weight to a supermatrix, which is calculated using a pairwise comparisons of elements. By forming unweighted matrix, the pairwise comparison of clusters is performed. Following this comparison, a multiplication of blocks of unweighted matrix by corresponding cluster weights is performed, using the following formula:

$$\bar{W} = a_{ij} * W_{ij} \tag{1}$$

where:
$\bar{W}$ – weighted matrix,
a_{ij} - appropriate weight,
W_{ij} - blocks of unweighted matrix (Sekitani & Takahashi, 2001).

In order to obtain the weights a_{ij} in the ANP method, the limit process is used $\lim_{v\to\infty} S^v$, but the weight vector of object *u* is the solution of the equation $S_u = u$ only if S is a random (stochastic) matrix, which is necessary in the ANP method (Sekitani & Takahashi, 2001). If the weighted matrix has zero values, it indicates that there are no interdependences between the clusters. Further, by the exponentiation of weighted matrix to the point of convergence a limit matrix is obtained. In the limit matrix all rows have the same value. Clusters which indicate other clusters must be pairwise compared to understand their impact on the clusters. To this end a cluster of the matrix is used. Comparison is made in regard to the criteria in columns and a comparison of all clusters whose value is not zero, and which are listed below these criteria, is carried out (Sekitani & Takahashi, 2001; Saaty & Ozdemir, 2005; Saaty, 2008).

To obtain the final result, during the synthesis of the whole model, the final ranking of alternatives is obtained. There are two ways to calculate the final rank of alternatives. The first may be the use of "multiplicative" formula: *BO/CR* which means that the product of the benefit-priority (B) and the opportunity-priority (O) vectors is divided by the product of the cost-priority (C) and risk-priority (R) vectors. By applying this formula there are no negative results of final priorities. The multiplicative method obtains marginal values, so that these results are considered short-term. Another way to calculate the final ranking of alternatives is the use of "additive" formula: *bB+oO-tT-rR*, where the values of *b, o, t* and *r* are priorities from the ranking model, and *B, O, T* and *R* are calculated in the same way as in the first approach. In this case the final solutions can be negative. The results obtained in this manner are considered long-term (Saaty & Ozdemir, 2005; Saaty, 2008).
When analysing the results in the BOCR model, we seek for a solution with the greatest benefit, and with the greatest opportunity to meet the control criterion. Unlike criteria *B* and *O*, which tend to the maximum value, the other two factors, cost and risk, require the solution with the lowest values. While observing the costs and risks, we should strive for a solution that carries the lowest risk and lowest cost. Additionally, in some cases,

we should take into account the alternative with the highest ratio of *BO/CR*. After the results are obtained and the most appropriate decision is made using the ANP method, we can conduct sensitivity analysis using "what-if" analysis (Saaty & Ozdemir, 2005; Saaty, 2008).

5. APLICATION OF THE METHOD IN BANKING AND THE ANALYSIS OF RESULTS

This chapter reviews the applications of the ANP multicriteria method in modeling and analysing relevant alternatives and their relative weights in regard to benefits, opportunities, costs and risks (BOCR), in order to assess all effects of the selection of appropriate strategies for the successful introduction of open innovation concept in the Serbian banking sector. The assessment was made on the basis of knowledge and professional experience of the authors of this paper; and for problem solving the software package *Super Decisions*[1] was used.

5.1. The structure of the BOCR model

Decision-making problem is decomposed into a controlled hierarchical structure, as shown in Figure 4, at the top of which is the main objective which is the development of the concept of open innovation in the banking sector. At the second level there are four criteria that reflect both positive and negative impacts on the ultimate goal, and they are: benefits (B), opportunities (O), costs (C) and risks (R). Each criterion contains a set of sub-criteria derived from the broader literature.

The criterion *benefits* (B) includes the following sub-criteria: reducing time-to-market, reducing the risk of guessing what the market wants, profiting from ideas from the external environment, reducing operating and research and development costs.

Under the criterion of *opportunities* (O) there are five sub-criteria: potential for the productivity development, potential for synergy between internal and external innovation, potential to increase profitability, the possibility of achieving sustainable growth and development of the organization and the ability to achieve competitive advantage in the market.

The criterion *costs* (C) contains the following sub-criteria: investment in the development of information technology and infrastructure, investment in the development of intellectual capital of managers and employees, investment in new business models and coordination costs.

The criterion *risks* (R) has four sub-criteria: brain-drain, lack of control and increased complexity in an open innovation model, possible release of classified information, unclear definition of strategies that employees cannot fully understand.

The development of the concept of open innovation (OI) in the Serbian banking sector can be achieved by choosing one of the sets of alternatives which are derived from the broader literature. It will, then, form the basis for the choice of an appropriate strategy for successful introduction of OI in banking, and it comprises: development of ambidextrous organization, building learning organization or knowledge-based organization, development of organizational culture as a platform for introduction of the concept of OI, the development of open, flexible and service-oriented business model, developing "digital banking", proactive role of innovation management along with the development of a new set of management skills, integration of employees in the innovation process, integration of internal and external knowledge into the developing process of products and services, improvement of internet technologies as a multi-distribution channel, developing an open architecture based on the use of "smart" mobile phones, the development of intellectual property (IP) of generators and associates including external stakeholders such as customers, universities, agencies for research and development, suppliers, and the development of intellectual property markets.

The *Super Decisions* software package uses a dual-layer BOCR model in which the main goal is located at the top of the hierarchy, while benefits, opportunities, costs and risks represent control criteria, i.e. control network. Within each control criterion B, O, C and R, there are two clusters. One cluster includes all alternatives, while the other comprises the sub-criteria. Both clusters within each of the control criterion include elements. Within the clusters of alternatives, the elements are the set of all alternatives, while in the second cluster the elements are a set of corresponding sub-criteria among which internal and external connections are established.

[1] www.superdecisions.com

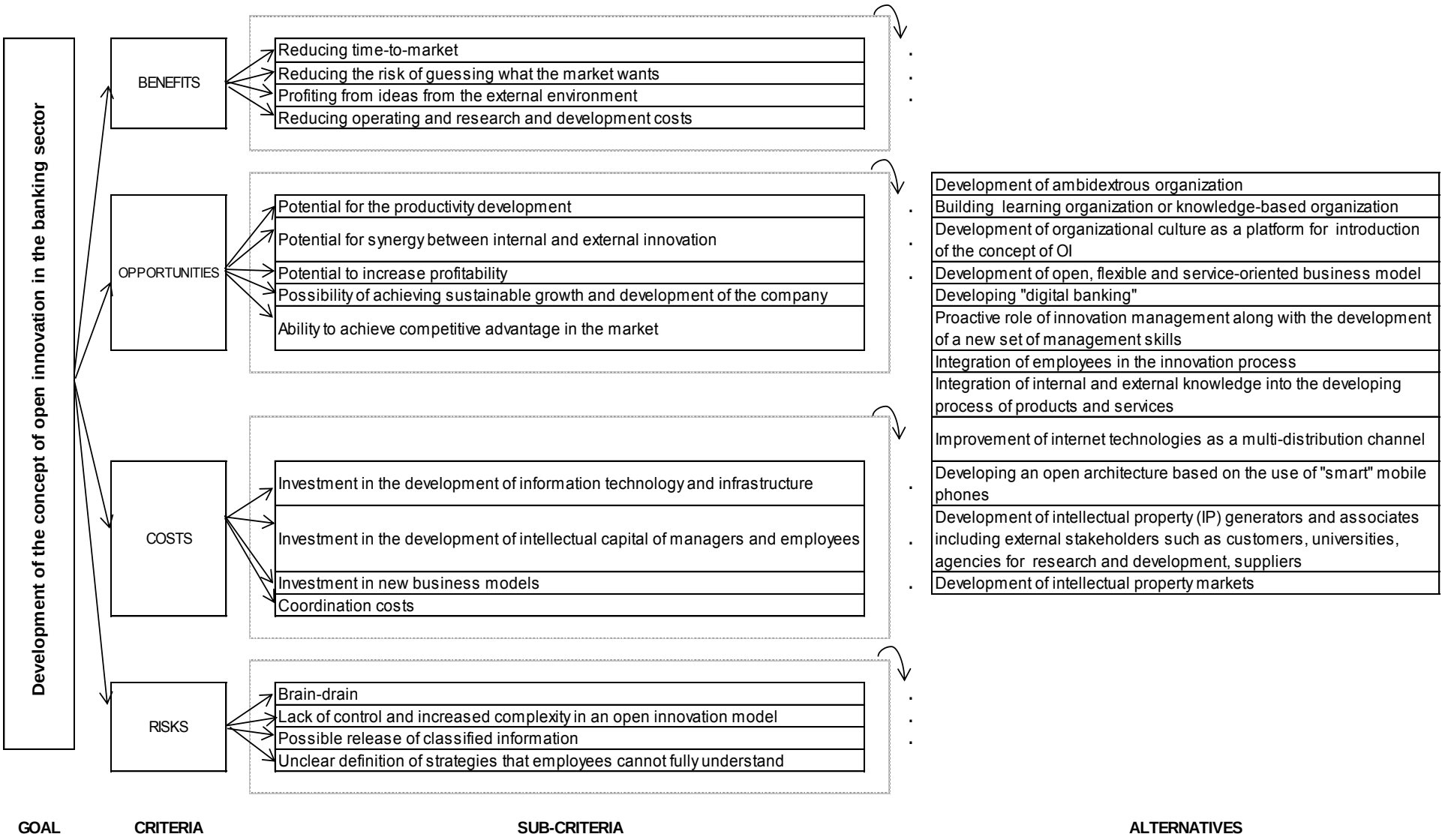

Figure 4: BOCR model (Source: Authors)

5.2. Analysis of results

Setting priorities of alternatives in the BOCR model involves pairwise comparison according to pre-defined connections between the elements and clusters within the control criterion. In the model presented in this paper, in assigning relative weights in relation to benefits, opportunities, costs and risks, the highest rated alternatives in regard to benefits and opportunities represent the greatest benefits and the greatest opportunities to meet the criteria. In contrast, in the evaluation of costs and risks, the highest-rated alternative is the one that causes the greatest costs, i.e. potentially carries the greatest risk. The results of pairwise comparisons are proved to be consistent.

After determining priorities within each of the control BOCR criterion, the synthesis of results within each control area network (BOCR) is performed, followed by the synthesis of the results of the overall model. By synthesis of the results of the overall model the final priorities of alternatives are obtained, i.e. the final ranking of options for decision-making. In this paper we have used additive formula: ***bB+oO-tT-rR***, which is considered to give long-term results.

Results obtained by software package *Super Decisions* can be expressed in three ways: 1) *Ideals* - priority list of alternatives defined in regard to an instrument that has the highest priority value, 2) *Normals* - vector of priorities in a normalized form and 3) *Raw* - priority vector of alternatives obtained after the synthesis of all impacts and the calculation of a limit matrix. The results of the final synthesis of alternatives are presented in Table 2.

Table 2: The final priorities of alternatives for decision-making

Alternatives	Ideals	Normals	Raw	Priority
Building a learning organization	1.0000	0.1354	1.0000	1
Development of ambidextrous organization	0.9264	0.1254	0.9264	2
Development of IP markets	0.8467	0.1146	0.8467	3
Integration of internal and external knowledge in the development process of products and services	0.8231	0.1114	0.8231	4
Development of IP generators and associates including external stakeholders such as customers, universities, research and development agencies, vendors	0.7583	0.1026	0.7583	5
Building "digital banking"	0.6033	0.0817	0.6033	6
Imrovement of Internet technology as a multi-distribution channel	0.5394	0.0730	0.5394	7
Development of open, flexible and service-oriented business model	0.4481	0.0606	0.4481	8
Proactive role of innovation management along with development of a new set of management skills	0.4361	0.0590	0.4361	9
Integration of employees in the innovation process	0.3748	0.0507	0.3748	10
Development of an open architecture based on the use of "smart" mobile phones	0.3660	0.0495	0.3660	11
Development of organizational culture as a platform for the introduction of the concept of open innovation	0.2655	0.0359	0.2655	12

The concept of a learning organization is based on the proposition that every organization that operates in a dynamic, technologically prominent and knowledge intensive environment must establish mechanisms for continuous learning, improvement and adaptation in order to strengthen competitive advantages. In addition, this concept allows greater flexibility for organizations, continually increasing their own capacity in order to achieve better business results and enhance them for finding new ways of managing and adapting to the increasingly difficult foreseeable circumstances in a turbulent environment.

Based on the results reported in Table 2, the highest ranked alternative in regard to benefits, opportunities, costs and risks is the alternative *building a learning organization*, i.e. *a knowledge-based organization*. The second most important alternative is the *development of ambidextrous organizatio*n, followed by the alternative *development of intellectual property markets*. On the fourth and fifth place of priority are alternatives which suggest integration of both internal and external knowledge in the process of product and service development, as well as incorporating stakeholders and external experts in the innovation process. Alternatives according to the final priority are also presented in Figure 5.

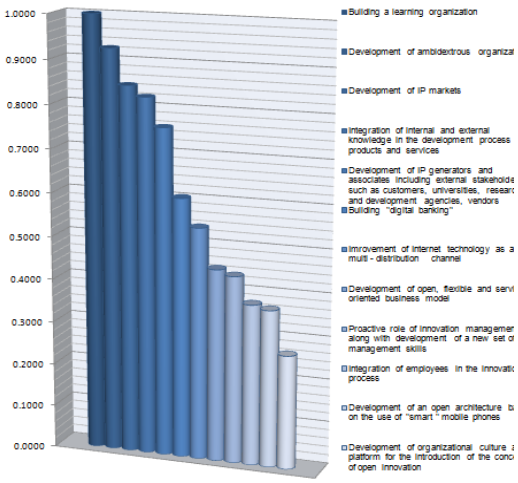

Figure 5: The final priorities of alternatives (Source: Authors)

Furthermore, in order to survive and obtain a long-term growth and development, banks should be developed into organizations that are able to simultaneously achieve harmonisation in current operations on

one hand, and on the other hand to effectively adjust to changes in the required environment, i.e. to become ambidextrous organizations.

The development of ambidextrous organizations implies a change in the management approach, which is, in the modern business environment, based on a systematic and holistic approach to management. In addition, in order to minimize market failure and the lack of adequate performance, the banking sector needs to find new ways of managing innovation and redefine existing strategies of innovation. In an effort to strengthen competitive advantages, closed concept of innovation has become inadequate to successfully generate profits from innovation. In addition to connecting various functional areas of the innovation process within an organization, it is necessary to develop a market for the exchange of intellectual property, to make innovation networks by linking various participants in the creation of superior value. The key business processes need to engage customers, representatives of research organizations, universities, partners, suppliers, and even competitons.

The authors of the paper maintain that these five alternatives are the most important elements for the successful introduction of the concept of open innovation in the banking sector of Serbia. Also, the authors are of the opinion that each company needs to adjust the priority of alternatives according to their own capacities and predefined strategic goals.

6. CONCLUSION

This paper presents the ANP method in multi-criteria decision-making which is used to carry out a quantitative analysis of alternatives and their relative weights in regard to benefits, opportunities, costs, and risks, thus performing an objective assessment of factors that affect the final decision.

According to the results obtained by the ANP method, the highest ranked alternative in regard to benefits, opportunities, costs and risks is the alternative *building a learning organization*, i.e. *knowledge-based organization*. The second most important is the alternative *development of ambidextrous organization*, followed by the alternative *development of intellectual property markets*. On the fourth and fifth place of priority are alternatives which suggest integration of both internal and external knowledge in the process of product and service development, as well as incorporating stakeholders and external experts in the innovation process.

Thus, for the successful introduction of the concept of open innovation in the banking industry, and with the aim to survive and enable long-term growth and development of the banking sector in Serbia, the authors are of the opinion that the sector needs to focus on building a learning organization concept that allows organizations greater flexibility, continuous increase of their own capacity in order to achieve better business results and empower companies for finding new ways of managing and adapting to the increasingly difficult-to-predict circumstances of a turbulent environment. Also, knowledge is a pre-requisite for the success of business as well as the imperative to conditions imposed by 21st century.

In parallel, the banks need to be developed into organizations that are able to simultaneously achieve harmonisation in current operations and to effectively adjust to changes in the demanding environment, i.e. to become ambidextrous organizations. In addition, in order to minimize market failure and a lack of adequate performance, the banking sector needs to redefine existing business strategies of innovation by developing intellectual property markets and continually incorporating internal and external knowledge in the innovation process.

Based on the obtained results, the paper demonstrates the possibility of the ANP method to support effective decision-making in complex business environments as it provides a comprehensive, quantitative and objective approach to all relevant, tangible and intangible factors in the decision-making process.

Subjective assessment of the authors in the process of the evaluation of alternatives is a potential constraint to the paper. However, this work can contribute to theorists and managers in the fields of decision-making, business decision-making, innovation management, and banking sector. In order to find a proper application in practice, future research on the concept of open innovation should include testing on a larger number of samples of different stakeholder groups.

REFERENCES

Chesbrough, H. (2003). The era of open innovation. *MIT Sloan Management Review, 44*(3), 35-41.

Chesbrough, H. (2003a). *Open innovation: The new imperative for creating and profiting from technology*. Harvard Business Press.

Chesbrough, H., Vanhaverbeke, W., & West, J. (Eds.). (2006). *Open innovation: Researching a new paradigm*. Oxford university press.

Christensen, C. M. (1997). The innovator's dilemma: when new technologies cause great firms to fail. *Harvard Business Press*.

Čupić M., & Suknović M. (2010). *Odlučivanje*. Belgrade, Faculty of Organizational Sciences.

Drucker, P. F. (1967). The effective decision. *Harvard Business Review, 45*(1), 92-98.

Drucker, P.F. (1988). The Coming of the New Organization. *Harvard Business Review*, 45-53.

Fasnacht, D. (2009). *Open Innovation in the financial services: growing through openness, flexibility and customer integration.* 1st edn. Springer.

Felice, F. D., & Petrillo, A. (2010). A new multicriteria methodology based on Analytic Hierarchy Process: the "Expert" AHP. *International Journal of Management Science and Engineering Management*, *5*(6), 439-445.

Gassmann, O., & Enkel, E. (2004, July). Towards a theory of open innovation: three core process archetypes. In *R&D management conference*, 1-18.

Heizer J., & Render B. (2010). *Operations Management*. 10th edn. Prentice Hall.

Huff, A. S., Möslein, K. M., & Reichwald, R. (Eds.). (2013). *Leading open innovation*. MIT Press.

Huizingh, E. K. (2011). Open innovation: State of the art and future perspectives. *Technovation*, *31*(1), 2-9.

Huo, J., & Hong, Z. (2013). The Rise of Service Science. *In Service Science in China* (39-68). Springer Berlin Heidelberg.

Laursen, K., & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. *Strategic management journal*, *27*(2), 131-150.

Lawrence J.A., & Pasternack B.A. (2002). *Applied Management Science*. New York: Wiley.

Löfsten, H. (2014). Product innovation processes and the trade-off between product innovation performance and business performance. *European Journal of Innovation Management, 17*(1), 61-84.

Luftenegger, E., Angelov, S., van der Linden, E., & Grefen, P. W. P. J. (2010). The state of the art of innovation-driven business models in the financial services industry. Beta Report, Eindhoven University of Technology.

NBS. Izveštaj o stanju u finansijskom sektoru Republike Srbije za 2005. godinu. Retreived from: http://www.nbs.rs/export/sites/default/internet/latinica/90/90_2/finansijski_sistem_2005.pdf.

Saaty, T. (1999). *Decision making for leaders: the analytic hierarchy process for decisions in a complex world* (Vol. 2). RWS publications.

Saaty, T. (2005). Theory and applications of the analytic network process: decision making with benefits, opportunities, costs, and risks. RWS publications.

Saaty, T. (2008). The analytic network process. *Iranian Journal of Operations Research*, *1*(1), 1-27.

Saaty, T. (2009). Applications of analytic network process in entertainment. *Iranian Journal of Operations Research, 1*(2), 41-55.

Saaty, T., & Özdemir, M. S. (2005). *The encyclicon: a dictionary of applications of decision making with dependence and feedback based on the analytic network process*. RWS Publications.

Saaty, T., & Vargas, L. G. (2001). *Models, methods, concepts & applications of the analytic hierarchy process* (Vol. 1, p. 46). Boston: Kluwer Academic Publishers.

Schmitt, R., Humphrey, S., & Köhler, M. (2013). EMOTIO: Systematic Customer Integration into the Process of Innovation. In *Future Trends in Production Engineering* (241-250). Springer Berlin Heidelberg.

Sekitani, K., & Takahashi, I. (2001). A unified model and analysis for AHP and ANP. *Journal of the Operations Research Society of Japan*, *44*(1), 67-89.

Teece, D. J. (2010). Business models, business strategy and innovation. *Long range planning*, *43*(2), 172-194.

West, J., & Gallagher, S. (2006). Challenges of open innovation: the paradox of firm investment in open-source software. R&D Management, 36(3), 319-331.

Wood, R., & Bandura, A. (1989). Impact of conceptions of ability on self-regulatory mechanisms and complex decision making. *Journal of personality and social psychology, 56*(3), 407-415.

ERP SYSTEM IMPLEMENTATION ASPECTS IN SERBIA

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Abstract: *In this research paper, based on the systematic study of the relevant literature and research performed in chosen companies in Serbia, with different types of activities, production processes and the ownership structure, on a representative sample, the methodological aspects of the implementation process of ERP system have been evaluated. The process of implementation and usage of ERP system has been researched and analyzed, emphasizing: the extent and factors which are influencing the implementation and usage of ERP solutions by the company users, business factors that influence the selection of ERP solutions analyses, ERP solutions presentations of different providers for midsize companies, comparison of the development phases of ERP solutions, analyses of the cost performance improvements, and the motives for the introduction of ERP solutions to companies in Serbia.*

Keywords: *ERP system, implementation, information system, company.*

1. INTRODUCTION

The goal of the research study was to gain insight into the research aspects of the Critical Success Factors (CSF) in the project management implementation of the Enterprise Resource Planning (ERP) systems in certain companies in Serbia. ERP solutions today are playing a major role in standardization, rationalization and automatisation of processes. [1] To accommodate today's challenging and competitive business environment, companies are introducing ERP systems in order to achieve the capability to plan and integrate company resources, and to be prepared to respond to all customers' requirements. This research study is attempting to systematically investigate the ERP literature and to identify the advantages in the world market, markets in the region, organizational culture and critical success factors of ERP implementation. The study aims to improve understanding of the critical factors that influence the success of ERP implementation in Serbia. Famous authors Boddy, D. Boonstra, A.& Kennedy, G. (2008) emphasize that ERP coordinates all activities, decision making and knowledge among different business functions, levels and units in anticipation of increasing efficiency and service. [4] ERP also provides direct access to current operational information to the management by enabling the integration of customer information, financial data, standardization of production processes and inventory reduction improving level of companies decision making, enabling the IS connection of the suppliers and customers with the internal IT processes. [5]

2. ERP CHARACTERISTICS

The below given figure 1 represents the percentage of unsuccessful and successful implementation, as well as the extended deadlines in a research period of ten years. The research showed that a large percentage of projects, whether it is the introduction of new or upgrade of existing IS, are not completed timely or the estimated cost increased.

Organization Standish Group International Inc. performed a study which concluded that 28% of all corporate IT development projects are abandoned before completion, 46% of projects is not completed within the stipulated time, estimated cost and in the expected volume. [13] Even when ERP solutions were being implemented, a large percentage of omissions are shown in implementation of the ERP (35%); also it is shown that the implementation of ERP is not completed within the stipulated time, with an increase of the estimated costs or estimated time (55%). The same source shows that only 10% of ERP implemented projects are being successfully installed. [3]

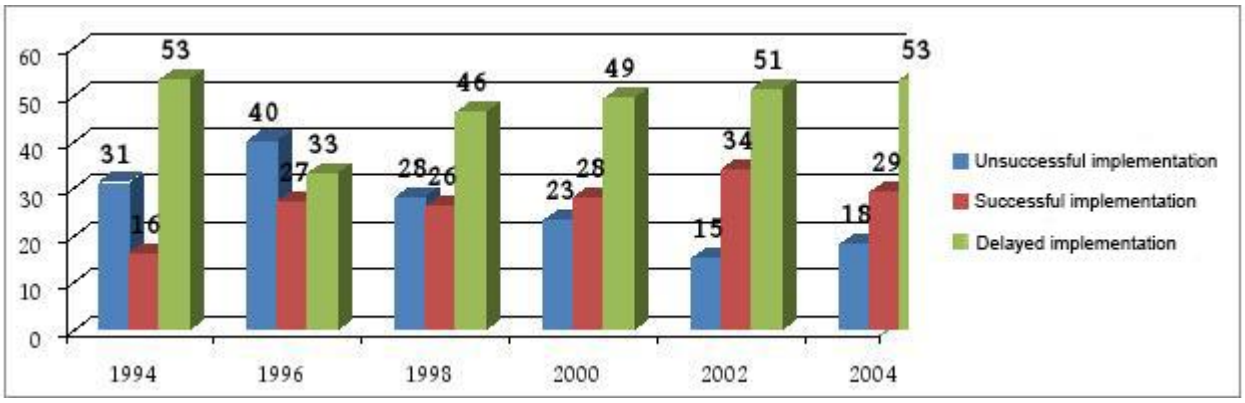

Figure 1: The success of ERP implementation [21]

Standish Group's research highlighted that, on average, there is 25% of successful ERP implementation, and that the planned implementation time, on average, was increased for 202%, exceeding the estimated budget by an average of 214%. [21]

The ERP Solutions recognize the following characteristics: [17]

- prepared software solutions designed for the client / server architecture, regardless of whether they use conventional or Web clients,
- connection of the most of the business processes in the company,
- processing of the major part of the company's transactions,
- utilization level of the database in which each data is recorded only once,
- provision of the access to data in real time to all users of the solution,
- recording and processing the majority of transactions in the company,
- enabling the design of different types of production (single, continuous and procedural) and different production environments (custom production, warehouse, assembly and a combination of mentioned environments).
- ERP solutions broke down the inefficiency of independent systems linking data in order to support multiple business functions, which are shown in Table 1.

3. IMPLEMENTATION OF ERP SYSTEMS

Projects for the implementation of the ERP systems shall be adjusted to the specific needs of the companies and business systems in Serbia. Many authors, such as Adur et al. (2002), and Akkermans Helden (2002), Bancroft et al. (2001), and Florin Bradford (2003), Estaves et al. (2002), Jarrar et al. (2000), Khan (2002), Mabert (2003), Sternad (2005) and others, are exploring the affecting factors on the successful implementation of ERP solutions. They came to the conclusion that conditions under which the selected ERP solution is going to be implemented shall be organizationally prepared within the stipulated time and the estimated costs. This means that companies have to be aware of the Critical Success Factors of ERP implementation. [20]

Five largest providers of ERP solutions have in their offer ERP solutions shown in Table 1.

Table 1: ERP solutions for medium-sized companies [2]

Company	Focus on the activity (type of the activity	ERP solutions
Infor	Footwear and textiles, automotive, chemical and food industries. ICT industry, equipment industry. Insurance, metal and plastics, shipbuilding, electrical industry, paper industry, water supply, heating, communications, management facilities, financial services, healthcare, hospitality, public administration, retail, food processing.	COM, BPCS, ERP LN, ERP LX (BPCS), MANMAN, MKManufacturing, KBM, MAXCIM, CAS, PEMS, Masterpiesce, Infinium, Prism, Protean,BAAN,Visual, TRANS4M,Xpert, XA, Syteline, Adage, System21, A+, FACTS, SX.e, Anael, Sun Systems and Varial.
Microsoft Dynamics*	Automotive, chemical, high-tech and electronics, oil and gas, procurement, manufacturing, food and shoes.	Microsoft Dynamics AX, Microsoft Dynamics GP, MicrosoftDynamicsNAV, MicrosoftDynamics SL.

Oracle	Banking and financial services, communications, healthcare, high technology, public sector, education, research, retail, supply, aerospace and defense, automotive, chemicals, mechanical engineering and building construction, manufacturing, and food processing and footwear	E-Business Suite, Peoplesoft Enterprise, JD Edwards Enterprise One, JD Edwards World.
Sage Software	Distribution and retail, automotive, construction, distribution, high tech, design, nonprofit organizations and government, health care, food and shoes	SageAccpac ERP, Sage MAS 90/200/500,Sage Pro ERP, Sage PWF ERP, SageERP X3ProcessSuite, Sage ERP X3Discrete Suite, SageERPX3 Distribution Suite.
SAP	Aerospace, automotive, chemical, engineering, construction, high technology, equipment and components, military products, mining, oil and gas	R/3, SAP Business Suite (includes SAP ERP),SAP Business One, SAP All-in- One, SAP Business By Design.

Legend: * Industry Solutions are sold to partners. The most prominent are Fullscope (to AX), Tectura and Hitachi Consulting (to AX).

The main features of the concept of governance, used applications, methodological approaches, technologies and a brief description of the development of ERP solutions are summarized in the following Table 2.

Table 2: Comparison of the developmental stage of ERP solutions [10, 15]

	1950 Editing stock	1965 MRP	1975 MRP II	1990 ERP	2000 ERP II
Characteristics	Economic ordering stock	Comprehensive planning of production	CIM, EIS	Complete design, OLAP, flowcharts, e-mail	Portals, BI
Menagerial concepts			TQM, JIT	The principle of best practice	SCM, CRM, SFA, e-commerce, SaaS
Oriented applications	Inventory control	Operational Planning and Control	Integration	Internal efficiency	Connect to applications from various organizations
The methodological approach	Manual systems	Scientific Solutions	Simplicity	Business Solutions	Virtual Business Solutions
Technology involved	Machine language	Third-generation programming languages (Fortran, COBOL)	Open Systems, 4th generation programming languages (eg SQL)	GUI, objects, components, TCP / IP	WAP, VoIP.
Hardware	Mechanical	Batch processing	Minicomputers and workstations	Client / Sertver, LAN	Distributed Network

Description (Focus on Performance)	Orientation to performance. Management control in the process of ordering and timely warnings. Provided they fill a variety of techniques, supply coordination, and report on actions.	Focus on sales and marketing. Designed for process planning based on sales. MRP programs are generated drawings for production planning, work control and inventory management.	Focusing on the strategy of producing and providing quality. Programs MRP II helps production management in supply chain planning and manufacturing process (product planning, parts purchasing, inventory control and management costs).	Focus on the integration of applications and customer management. Designed to improve the capabilities of internal business processes in the value chain of the company. Integrating the core business activities and support activities.	Focus on agility and global environment. Expansion of ERP solutions at all organizational systems enabling e-business. Enabling access anytime, anywhere to all partners; Inclusion of modules such as SCM, CRM, SFA, APS, and so on.

Today's ERP solutions are the result of three factors: the progress in hardware and software development (processing power, memory and communication), development of a vision of an integrated IS and changes in the organization from functional to process-oriented companies. [14]

The integrated IS or the ERP may lead to a more efficient business processes which cost less and in addition have the following advantages: [6]

- ERP enables easier global integration: language and cultural barriers can overcome automatically.
- ERP not only enables integration between people and information, but also eliminates problems with upgrades.
- ERP enables management of the operation, not only monitoring. This enables that all information are available to managers, allowing them to focus on improvement of the process.

Scott and Vessey emphasize that the ability to integrate all aspects of ERP have the strategic impact on the organization. [19] In terms of speeding up the restructuring of business processes to operate globally, it can be rapidly adapted to competition changes and thus can enable the integration of data throughout the organization. In terms of technology the installation architecture shall be speeded up, and that architecture is scalable and flexible and enables cost reduction in terms of the lease rather than in IS construction. [7] The company Aberdeen Group (2006) says that in order to have the successful ERP implementation it is essential to measure it in connection with the business benefits.

The following Table 3 shows the cost of performance improvement.

Table 3: Costs of performance improvement [1]

	small Businesses (<$ 50 Million)	Medium-sized companys ($ 50 Million - 1% Billion)	Large companies (> 1 Billion)
Reduction of the inventory costs	13.9%	14.5%	18.1%
Reduction of the operating costs of production	12.8%	12.8%	15.4%
Reduction administrative costs	13.4%	16.4%	11.4%
Full improvement and timely shipping	20.2%	21.0%	13.0%
Improved consistency of production schedules	19.3%	17.3%	12.1%
Average	15.9%	16.4%	14.0%
Cost in comparison to the percentage improvements	$ 389	$ 347	$ 130

Famous authors Motiwalla, L.F. & Thompson, J. (2009) emphasize that the advantages and limitations of the system shall be monitored from the business point of view, where results can be tangible or intangible, as well as short-termed or long-termed. [15]

Advantages and limitations of ERP system solutions are: [8]

- The integration of data and applications between functional areas of the organization (one entry of data and the ability to use data in all applications enhances the accuracy and quality of data).
- Easier maintenance and better support systems, IT professionals are focused on only one solution, and consequently on better support and the needs of the user.
- The unique user interface between different applications means less training for employees, increased productivity and easier movement of workers between business functions.
- Provides better security of data and applications through a central hardware, software and networks.
- The complexity of the installation, adjustment and maintenance of the system increases, which require specialized IT professionals for hardware, software and networks.
- Standardization of hardware and software is difficult to achieve.
- Transmission and data conversion from the old system to the new system can be time-consuming complex process.
- Employee training for IT ERP system can cause resistance and can reduce productivity in the first period.

Business advantages and limitations of ERP solutions are: [9]

- The flexibility of the organization which can respond quickly to changes in the environment (i.e. sales growth thus maintaining market share in the industry).
- Easier collaboration and teamwork to access information from different functional departments.
- To facilitate networking and exchange of data in real time between partners in the supply chain can improve the efficiency and reduce the cost of products and services.
- Higher quality of service to customers due to faster and better information flow within the organization.
- Improving business process trough re-engineering of the business processes.
- Staff training on the new system leads to additional costs.
- Amended business applications and department boundaries can cause resistance to the ERP system.
- Reduction of the cycle times in the supply chain from raw materials to product sales.

Kalakota, R.& Robinson, M. (2001), as the main advantages of ERP in the production stress out [12]

- part-time planning (95%),
- Part time delivery (10% – 40%),
- Part time production (10% – 50%),
- lower inventory levels (10% – 25%),
- reduction of delays in delivery (25% – 50%)
- increased productivity (2% – 5%).

There are six most common reasons why businesses and business systems need to implement ERP solutions, namely: [18, 19] the need for a single platform, process improvement, data visibility, reduction of operational costs, increased customer response and improved strategic decision-making. These reasons are related to each other and as a common platform they provide new opportunities for continuation of creation of significant results, as shown in Figure 2.

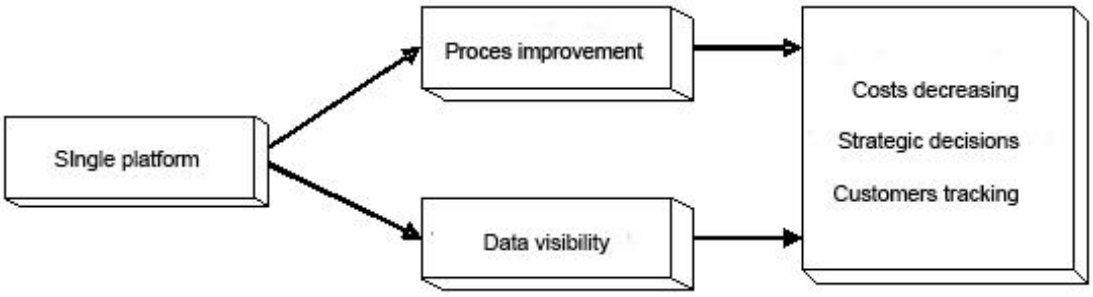

Figure 2: The motives for the implementation of ERP solutions [19]

The company or organization may decide to implement a new IS and thus to overtake competitors. This can be done through the following strategies: [16]

1. Cost leadership strategy where we become the manufacturer with the lowest cost per unit because IS reduces the cost of business processes and customers and suppliers cost.
2. Differentiation strategy where, with the help of IS, products / services can be differentiated.
3. Innovation Strategy where a unique product / service is being developed or integrated as a single performance in the markets.
4. Growth Strategy which significantly increases the production capacity of the company, accelerating the expansion of global markets, accelerating investment in new products and services, etc.
5. Alliances strategy which can be used to establish business relationships / alliances with customers, suppliers, competitors, consultants and other companies.

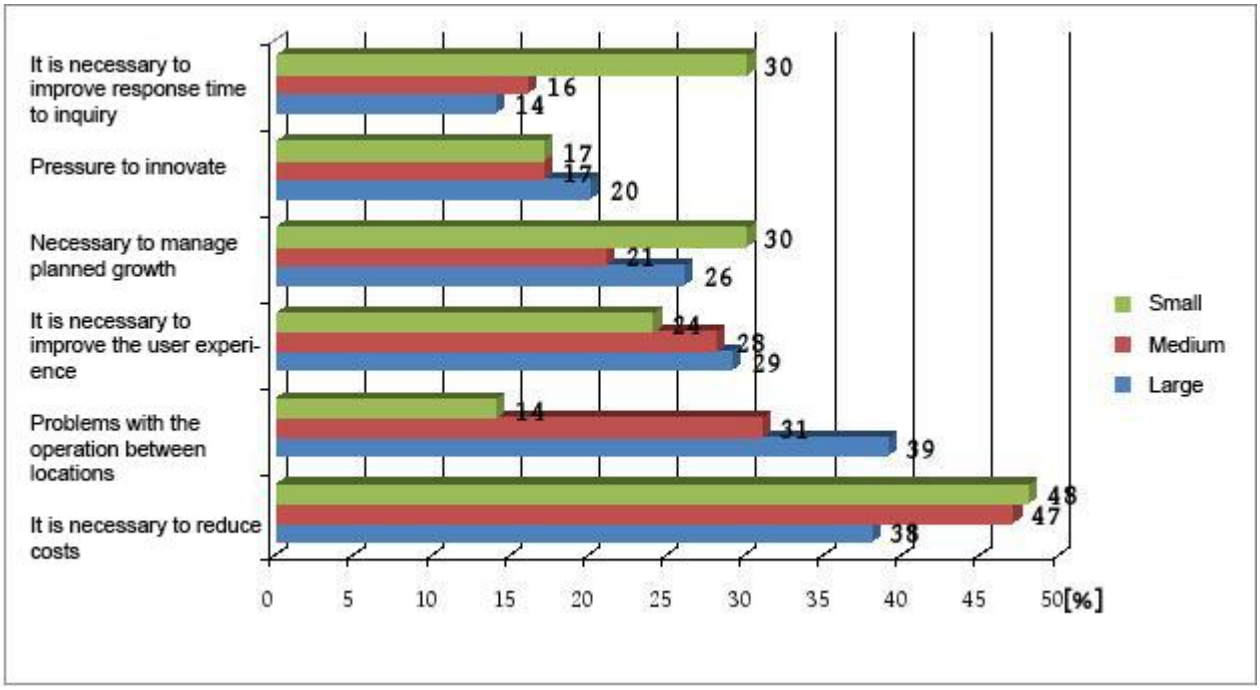

Figure 3: Business factors that influence the selection of ERP solutions [11]

The previous figure 3 showed that for small businesses and organizations the most important factors are cost reduction, the need to manage the expected growth of the organization and improvement and response time to customers. For medium and large companies and organizations the most important factors are cost reduction and solving problems of interoperability between locations.

4. CONCLUSION

Projects which include implementation of the ERP systems shall be adjusted to the specific needs of the companies and business systems in Serbia. The theoretical and practical part of the research shall be concluded with the presentation of the results of analysis of the installation of the implementation of ERP solutions in Serbian companies. In this research paper a study of methodological aspects of project management and ERP system implementation and installation is presented, where it is especially highlighted: comparison of developmental stages in ERP solutions, business factors that influence the choice of ERP solutions, motives for installation of ERP solutions, business benefits and limitations of ERP solutions, cost performance and thorough analysis of ERP solutions for midsize companies. The paper is presented as an important studious analysis which can help in the project management of ERP system implementation in companies, and help them to identify and allocate strategic resources for the successful implementation of the system. The realization of the project of introducing an ERP business information system, as a key resource, is always a complex and expensive with far-reaching consequences for the company. [6] However, no matter how long the project is being implemented, periodically in virtually all businesses and business systems, the complete project can often fail, mainly due to ignorance and disregard of the rules of governing such projects.

Investment in Business Information System is an important item in the cost of the organization and should be calculated within the budget. [8] In addition to financial moment, of the utmost significance are time and effort that management and employees shall invest in the project especially in organizations that already have negative experiences on previous similar projects; the staff can express its opposition to even start with the implementation if conditions are not completely provided in respect to complete project implementation. Also, what is rarely discussed is the price or lost profit if the company or business system does not implement a new concept of modern integrated ERP system. The longer the companies postpone the procurement and implementation of modern business system, their presence in the global market will be postponed, the profit and savings as a result of new system will not be made, neither the company will achieve a competitive advantage over the competition.

REFERENCES

[1] Aberdeen Group (2008b) The state of the ERP market. Accessed on April 12, 2014 on the website http://www.aberdeen.com

[2] Aberdeen Group (2009a) ERP in the midmarket 2009. Accessed on April 12, 2014 on the website http://www.aberdeen.com

[3] Bajwa D. S., Garcia J. E. & Mooney T. (2004) An integrative framework for the assimilation of enterprise resource planning systems: phases, antecedents, and outcomes. *The journal of computer information systems*, 44(3), 81-90. Factors: what does matter and what does not. V Lasker (ur.), *Acta systemica*. International Institute for Advanced Studies i Systems Reserch and Cybernetics. Ont., Can.: G. EWindsor.

[4] Boddy D. Boonstra, A. & Kennedy, G.(2008). *Managing information systems – strategy and organization*. England etc.: Prentice Hall.

[5] Denic N.: Menadzment informacioni sistemi, VTSSS Urosevac, 2010.

[6] Denic N., Dasic B., Maslovara J.: Profitability of the investment project of introducing modern business information systems, TTEM - Technics Technologies Education Management, Impact Factor: 0.414 (ISI Journal Citation Reports 2012), Vol. 8, No. 1, (2013) 367–372.

[7] Denic N., Moracanin V., Milic M., Nesic, Z.: Risks the project management of information systems, Tehnicki vjesnik, br. 6, 2014.

[8] Denic N., Zivic N., Siljkovic B.: Management of the information systems implementation project, Annals of the Oradea University, Fascicle of Management and Technological Engineering, Vol. XXII (XII), Issue #2, September (2013) 32–35.

[9] Denic N., Zivic N., Dasic B.: Analysis of factors of implementing ERP solutions in the enterprise, Annals of the Oradea University, Fascicle of Management and Technological Engineering, Vol. XXII (XII), Issue #2, September (2013) 27–31.

[10] Harwood S. (2004). *ERP: The implementation cycle*. Oxford [etc.]: Butterworth Heinemann.

[11] Jutras C.(2009b). ERP and the midmarket managing the complexities of a distribute enviornment. Aberdeen Group. Found on March 16, 2010 on the web site http://www.aberdeen.com

[12] Kalakota R.& Robinson M. (2001). *E-business 2.0: road map for success*. USA etc.: Addison-Wesley.

[13] Laudon K.C. & Laudon J. P. (2000). *Management information systems: organization and technology and The networked enterprise (6th ed.)*. London etc.: Prentice-Hall.

[14] Monk E.F. & Wagner B. J. (2006). *Concepts and Enterprise resource planning – second edition*. Australia etc.: Thomson Course Tehnology.

[15] Motiwalla L.F. & Thompson, J. (2009). *Enterprise systems for management*. Uper Saddle River: Pearson Prentice Hall.

[16] O'Brien J. A. (2003). *Introduction to information systems (12th ed.)*. Boson etc.: McGraw - HillIrwin.

[17] O'Leary D. E. (2000). Enterprise *resource planning system: systems, life cycle, electronic commerce and risk*. USA: Cambridge university press.

[18] Ross J. W. & Vitale M. R. (2000). The ERP Revolution: Surviving vs.Thriving. *Information systems frontiers,* 2(2), 233-241.

[19] Shanks G., Seddon P. B. & Willcocks L.P.(2003). *Second-wave enterprise resource planning system – implementing for effectiveness.* Cambridge etc.: Cambridge University Press.

[20] Sternad S. & Bobek S. (2004). ERP solution implementation critical success

[21] Warner N. (2009). Microsoft Dynamics Sure Step – Implementation Methodology. Europe - Academic Preconference (28.10.2009.). Accessed on April 12 in 2014. on the web site https://www.facultresourcecenter.com/curriculum/pfv.aspx?ID=8373

AN APPROACH TO A SURVEY SYSTEM AS A CORPORATE TOOL

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Abstract: *In the world dominated by data acquisition and evaluation, this paper is working on an idea of making data collection from survey participants manageable and simple. The proposed survey information system would allow companies and home users to define their own surveys to analyse and evaluate the opinion of survey participants. It should help them in obtaining some specific knowledge from the overall population without using the conventional off-line surveying methods. It aims to have a higher level of usability than similar available systems.*

Keywords*: data collection, survey, usability, decision support, public relations, local data storage*

1. INTRODUCTION

This paper proposes a concept of survey information system allowing companies and individuals to get data from the broad public. We argue that surveys should be introduced in organisations to allow easier decision making. Our concept should enable companies and users to define their own surveys and use the data obtained to get to different conclusions without harming the privacy of the end user.

The role of easily conducted surveys cannot be underestimated in a world where the amount of data is overwhelming. Google, one of the biggest data giants today, was processing more than 20 petabytes of data per day in 2008, as it was pointed out at the time (Dean & Ghemawat, 2008). Today, we are faced with the problem of data often seeming useless at a first glance. Much of the information is of little use on its own to end users, even if they were allowed to take a look. Most of the data is considered private and/or tools of the trade.

At the same time, all of the giant companies strive to collect a variety of data about their users, rivals, the usage of their programs and the like. In order to properly use the data, the information are backed up and restructured for data warehousing and analysis. The question of good date organisation, retrieval and analysis arises frequently (Vujošević D. et al., 2012).

The surveys performed today are usually very intrusive and aggressive, such that the usual reaction is dismissive. Having a system only for the purpose of surveys should ease the use and make the data more intelligible. Since the only activity of users will be completing and making surveys, the data obtained should be with less noise.

2. SURVEYS IN THE CONTEXT OF WEB AND USABILITY

Over the last thirty years, the technology for utilizing surveys has changed. The first e-mail surveys emerged in the 1980s and the initial web-based surveys in the 1990s. Schonlau et al. (2001) discussed that the services available could be found to meet the needs of a marketing research professional. Today, the web has grown so much more, giving the access to a wider public. The field of web research has been populated by companies such as AAPOR (American Association for Public Opinion Research, www.aapor.org) and CASRO (Council of American Survey Research Organisations, www.casro.org).

Online surveys are used for a variety of purposes. There are surveys purely conducted for entertainment, others conducted for public opinion evaluation and some even influencing decisions.

Today there are very little E-mail surveys. In most cases the data is obtained from a web form, and it is directly inserted into a database after which it can be analysed by data scientists.

As outlined in previous studies by (Joel R. Evans, 2005), there are numerous strengths and weaknesses to web surveys. The strengths that will be mentioned here are global reach, convenience, ease of data entry and analysis, and low administration cost.

Global reach is an ambiguous trait, such that it is useful depending on the scale of the research in question. For localized surveys, additional restrictions based on location of the participant should be implemented. It is undeniable that the global reach is otherwise invaluable to the large-scale research, whereas the regular paper-and-pen or telephone surveys would be very expensive and inherit some other issues on their own.

Web surveys are also perceived as convenient. They can be completed at one's own leisure, without peer-pressure and time constraints.

Since data is streamlined by forms, there is no chance of corrupted data, such as multiple choices in a single choice question. Data can easily be accessed and analysed. This streamlining also allows a variety of data inputs, as previously outlined (Joel R. Evans, 2005). Another highlighted advantage of online surveys is that they can be made more flexible, visual and interactive. The user can be drawn in by the sheer aesthetic of a survey, simplicity of input and multimedia content.

It is also possible for the interviewers to be absent and online surveys typically do not require any personal presence. This can avoid the effect of the interviewer, which can in some cases cloud the data (Bobby Duffy & George Terhanian, 2005).

The overall sense of individualism can be increased by personalising each survey to the participant, allowing a greater degree of potential involvement in completion of tasks and questions. The online surveys also have one key advantage – they can be completed at the leisure of the participant. The participant chooses when to start the survey, possibly pause it and complete at a later time. This brings out a potential issue for surveys where time passed between questions can be of great importance to the data, which we will discuss at a later time.

The survey response rate, also known as completion rate, is often taken as a measure of goodness (Schonlau, M., Fricker, Elliott, & M.N., 2001). Survey response rates can be calculated according to several different computation formulas (The American Association for Public Opinion Research, 2008). As it is pointed out (Kiesler, Sproull, & S, 1986), the respondents of online surveys exhibited fewer completion mistakes and fewer missing entries to a statistically significant degree. This allowed more complete data and truthful conclusions.

As technology becomes more available, the potential for online surveys increases as well. In developing countries this development provides the ability to survey quickly and efficiently. The administration costs decrease and the ability to reach a large group of individuals is key to conducting large surveys.

3. CURRENT SOLUTIONS

With the expansion of data and the need for knowledge, many solutions have been constructed to ease the acquisition and analysis of data. Most of these solutions are offered in the form of software as a service with a variety of subscription plans.

The current solutions have many different choices of features and payment options. These can be summarized by outlining the common features of the survey services:

- Basic users – Usually also considered 'trial'. There is an imposed limit on the amount of surveys/questions/participants.
- Personal users – Intended for personal use and small businesses. There can be an imposed limit on amount of surveys or participants. Some providers also offer integration via web windows, allowing surveys to be placed on other sites. This set of features is usually charged per month.
- Small firms – This subscription usually has neither imposed limits on surveys, nor on participants. There are greater tools for analysis offered, such as SPSS integration. Some additional optional features are also added, such as: question randomization and random assignment, among others. This list of additional features may vary from site to site.
- Large firms – This subscription method, usually having very little restrictions in terms of analysis and generation, seems not to have limits as compared to other subscription plans. It is intended for corporations and large firms. It can offer added-value features such as hosted internet domains.

The trend of software as a service might discourage occasional personal use. Besides, it certainly could limit the applicability of a survey in the case it turns out to be interesting/rewarding/engaging to the participants and becomes more widespread.

4. THE CONCEPT OF OUR APPLCATION FOR SURVEY CREATION

With the expansion of web and the applications moving from desktop to their web-based counterparts in the recent years (Vujošević & Kovačević, 2006), the appropriate choice for our application will be a web interface A web-interface requires a web-server and hosting services, which will have impact on the overall cost of maintaining such a service. The background data collection will be handled by an integration of database with a web-application. Upon completion of a survey, the data will be stored in a table that can be evaluated and analysed.

The data storage will be based on a relational database management system. It will consist of the following core tables (as shown on the Figure 1):

- Users – Storing the user data such as names, surnames, date of birth and any data useful for research
- Surveys – Each survey having a single user that created it, which can be shown to other users.
- Questions – Each question belongs to a unique survey, consisting of the text/picture for text.
- AnswerType – A pre-defined list of the answer types such as single choice, multiple choice, plaintext.
- Answers – Each row consists of an answer text, each answer belongs to a specific question.

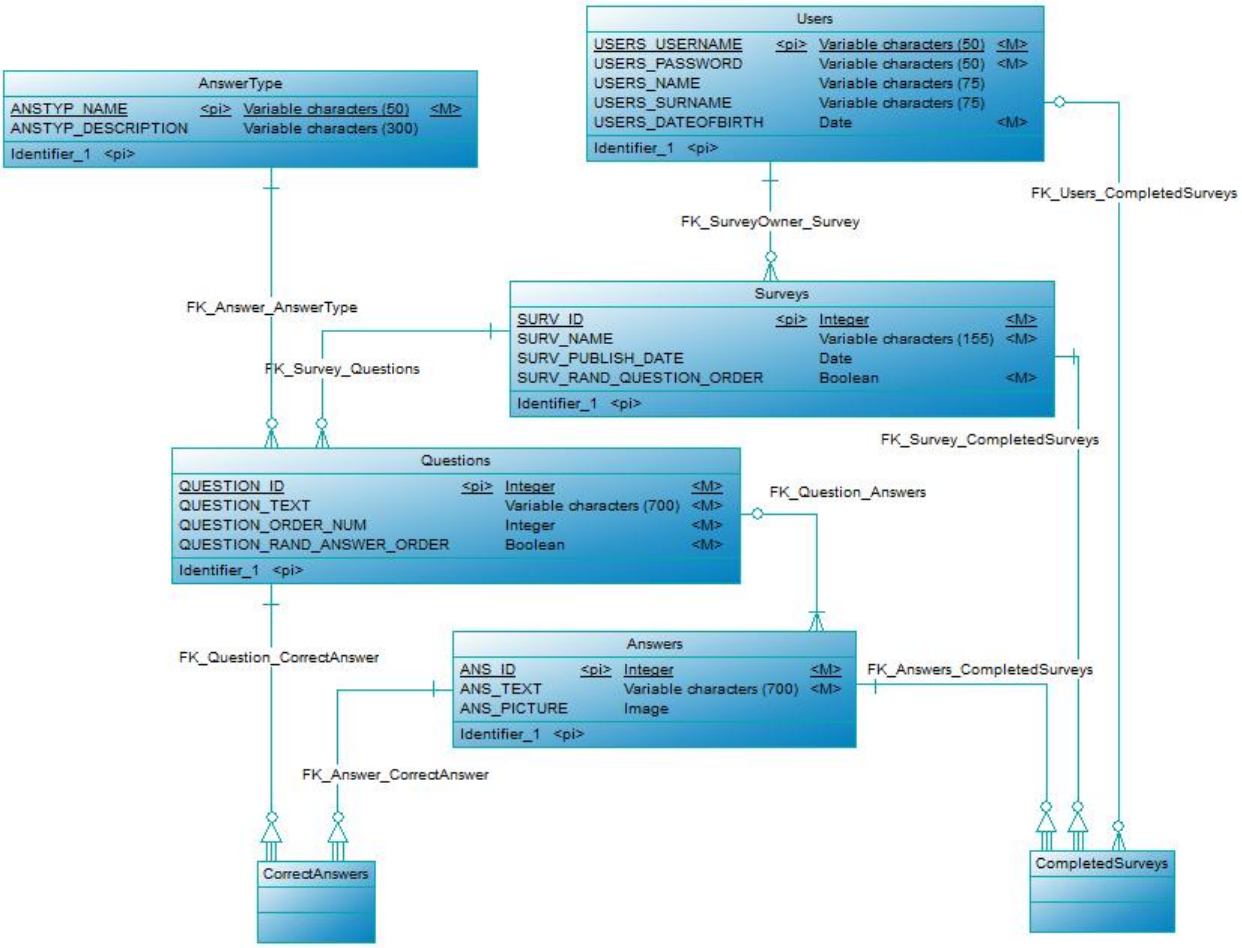

Figure 1: The data model of the proposed survey application

This would allow each survey to be data-driven, so that users could define their own surveys, their own questions, answers and correctness. The application itself would be web based, and the interface for defining surveys would also be accessed through a browser.

Allowing users to register and create surveys at first resembles a social network site. This could set apart our proposed solution in comparison with the current solutions. A social network site is defined (Boyd & Ellison, 2007) as a web-based service allowing individuals to:

- construct a public or semi-public profile within a bounded system
- articulate and update a list of other users with whom they share a connection

- view and traverse their list of connections and those made by others within the system

The one main difference would be the connection between the users – other sites call these "friends" or "followers" among others. In the proposed system, the only connecting medium between users would be the actual surveys.

In the present, the users are very much accustomed to using browsers in accomplishing nearly everything. This would mean that we expect that a minimal time will be needed for users to understand the usage of our application.

The final usability of the survey information system will be dependent on the interface design, which should be addressed during implementation. The greater the usability, the more will the system be accepted.

5. USER INTERACTION IN THE PROPOSED CONCEPT

Currently, there are three types of users planned for our system:
- Visitor User – This user is not registered, and as such is able to browse other surveys, but he is unable to submit a new survey or complete surveys.
- Registered User – The user has created a profile on the application and therefore is recognised. This user is able to complete surveys at his own accord.
- Survey Submitting User – This user has all the functionalities of the registered user with the addition of the ability to create surveys for others to complete.

The difference between a Registered User and a Survey Submitting User could be handled by the Administrator or by the initial setting of the system.

In the social-network aspect of the tool that could be hosted on the internet for wide use, corporate and personal alike, the difference between a Registered User and a Survey Submitting User would be handled by the system. For example, a user that has completed some arbitrary number of surveys set by the Administrator gains the ability to create surveys. This would encourage all new users first to get acquainted with the system, by completing surveys and learning how to use the interface, and at the same time, gaining insight which surveys were more enjoyable and which were less enjoyable, perhaps understanding how they should create their own surveys.

In a corporate use of the tool, the Survey Submitting User could be designated by the management to create an instance of survey to gain some wanted insight about their employees. This would allow a centralised source of surveys within a corporation and avoiding unnecessary traffic of unwanted surveys.

6. POTENTIAL USES IN COMPANY DECISION MAKING

Modern management needs to be able to make quick decisions in real time. The ability to make decisions that have the greatest impact could be supported by this proposed system. The upper management could define a survey for the employees to complete and then they could evaluate the data.

This would provide a modest to immense magnitude of increase in productivity of each decision (because it would be based on real data). It would allow the management do define and tune their surveys to its best potential.

It should be noted that while there are other solutions to surveys, they usually depend on storing that same data somewhere else, which no longer makes it safe for the company. We argue that the data storage must be within the company. Thus, one of the main advantages of a local survey application would be that the internal data of the company would stay within the company. The proposed solution would be self sufficient in the data storage, evaluation and generic applicability. The implementation of this system is not limited to a single instance on the web. Companies could have their own local, internal copies of the application, allowing them to keep track of the data and its usage.

Defining who can and who cannot create surveys would also be a feature, such that only specific users could define surveys. This limit would allow the control of survey-creating and evaluation to specific individuals, do prevent unnecessary or excessive surveys within the company.

As pointed out (Bobby Duffy & George Terhanian, 2005), the speed of response are considerably shorter in the case of web surveys. This gives an additional edge of speed to the upper management when attempting

to asses data. Face-to-face surveys with employees can be more insightful, but the web surveys allow greater accumulation of data in a much shorter space of time, thus allowing faster decision making, i.e. a decision making with more impact.

The system could also be used by companies' public relations management to conduct their own surveys of the public. The users participating could be the company's clients, which would mean the company already has some demographic data that would aid in the analysis of the results. In contrast to the face-to-face surveys, the company could reach a much greater public.

7. FURTHER RESEARCH

In the following months, tests should be made with a prototype system for defining surveys and completing surveys. It should allow the concept to be tested and some new features should arise.

The interface concepts will be rigorously tested and experimented. The interface must be able to support a critical mass of users with minimal effort.

8. DISCUSCUSION AND CONCLUSION

There are systems in place for online surveys, offered by major companies, such as Google. But none of these allow the portability of being a single-unified system on the web, while still maintaining the possibility of having separate applications entirely in the company or local storage.

In contrast to face-to-face surveys which can be sampled from a fairly comprehensive database, online surveys reach into a much greater pool of potential participants. While databases exist for local participants, there is no way of knowing who will participate in a survey online. There is no online database of everyone who exists, and while it is being argued whether that is a step in the right direction, there is no real way to gauge the data, except for being based solely on the honesty of the participant.

The issues in the demographic aren't the only thing that needs to be addressed. The behavioural and attitudinal differences need to be addressed as well. The participants must be motivated in some way in order to give thought and proper participation in each question and task. Another problem with online surveys is that they can be perceived as 'spam' and annoying. This can also deter not only potential participants, but also willing participants.

There are also issues based on privacy of participants, some participants would like to remain anonymous. That would mean disclosing some of their data to the creator of the survey, and yet allowing participants the sense of privacy. It is known that factors such as age and education can be an effective tool in gauging the data from a survey, and disclosing this data could violate the privacy of a participant.

It is also being discussed that the computer literacy of participants can be a key factor. It has been argued (Roztocki & Lahri, 2003) that the researchers in the field of IT tend to prefer Web-surveys, while researchers from other fields preferred the traditional pen-and-paper format. While the conclusion reached was that the non-IT fields leaned as much to the Web-based survey as the IT researchers did, the computer literacy of the participants could prove to be a potential pitfall. The surveys would have to be designed in such a way that a potential control group would be able to complete it, with the average levels of computer literacy. Today, however, the average computer literacy is much higher than it was five years ago, and this might prove to be much less an issue in the future.

REFERENCES

Bobby Duffy, K. S., & George Terhanian, J. B. (2005). Comparing data from online and face-to-face surveys. International Journal of Market Research Vol. 47 Issue 6 .

Boyd, D. M., & Ellison, N. B. (2007). Social Network Sites: Definition, History, and Scholarship. Journal of Computer-Mediated Communication .

Dean, J., & Ghemawat, S. (2008). MapReduce: simplified data processing on large clusters. Magazine Communications of the ACM , 107-013.

Joel R. Evans, A. M. (2005). The value of online surveys. Emerald Insight , 15 (2), 195-219. doi: 10. 1108/10662240510590360.

Kiesler, S., Sproull, a., & S, L. (1986). Responses Effects in the Electronic Survey.

Roztocki, N., & Lahri, N. A. (2003). Is the Applicability of Web-Based Surveys for Academic Rsearch limited to the Field of Information Technology?

Schonlau, M., Fricker, Elliott, R. J., & M.N. (2001). Conducting Research Surveys via E-Mail and the Web.

The American Association for Public Opinion Research. (2008). Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys 5th Ed.

Vujošević D. et al. (2012). A comparison of the usability of performing ad hoc querying on dimensionally modeled data versus operationally modeled data, Decis. Support Syst., doi:10.1016/j.dss.2012.05.004, 2012. Elsevier.

Vujošević, D., & Kovačević, I. (2006). Web and Non-Web User Interface in Context of Attitude toward the Internet. Electronic services in private and public sector – opportunities and obstacles .

IMPLEMENTATION OF DATA MINING TECHNIQUES IN CREDIT SCORING

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Abstract: *Credit scoring is a technique that is mostly used by banks in order to decide whether to grant credit to customer or not. Its increasing importance can be seen in everyday life and study after study has shown that credit scoring is a vital part of a modern financial system. Credit score prediction is of great interests to banks as the outcome of the prediction algorithm is used to determine if borrowers are likely to default on their loans. This in turn affects whether the loan is approved. In this paper we described an approach to performing credit score prediction using random forests, an operator in RapidMiner. The dataset was provided by www.kaggle.com, as a part of the contest "Give me some credit". Our model, based on random forests, was able to make rather good predictions on the probability of a loan becoming delinquent. We were able to get an AUC score of 0.845190.*

Keywords: *credit scoring, banking, RapidMiner, classification, imbalanced data, random forest, AUC*

1. INTRODUCTION

The field of data mining has been growing due to its enormous success in terms of broad-ranging application achievements and scientific progress, understanding (Venkatadri, 2011). The last two decades have seen a rapid growth in both the availability and the use of consumer credit. Until recently, the decision to grant credit was based on human judgment to assess the risk of default (Thomas, 2000). The growth in the demand for credit, however, has led to a rise in the use of more formal and objective methods (generally known as credit scoring) to help credit providers decide whether to grant credit to an applicant (Akhavein, 2005). This approach, first introduced in the 1940s, has evolved over the years and developed significantly (Rimmer, 2005). In recent years, the progress in credit scoring was fueled by increased competition in the financial industry, advances in computer technology, and the exponential growth of large databases.

In this report we analysed the problem of credit scoring. Credit scoring algorithms, which make a guess at the probability of default, are the method which banks use to determine whether or not a loan should be granted and they are generally based on statistical pattern-recognition techniques.

As we did a research regarding models that were used for the competition on Kaggle's "Give me some credit" data set, we noticed that for the problem of classification other competitors used Blended model, decision three, different usage of attributes. Also, it is important to mention that they used different programs such as R, Viscovery, SAS, SQL etc. We created a model using the RapidMiner program, and its operators: W-Logistics, SVM, AdaBoost Decision Tree, Naïve Bayes and Random Forest, but the best results were achieved with Random Forest operator invented by Breiman and Cutler.

2. CASE STUDY

We obtained the data for this problem from the Kaggle challenge website (http://www.kaggle.com/c/GiveMeSomeCredit/). The website provides two data files - one for training and one for testing. The training data file consists of 150,000 cases. The test file contains 101,503 cases. The intention is that we test our classifier on the test data and submit our predictions via Kaggle's online submission process.

Each sample contains 11 attributes and one class attribute (*Table 1*). The data set has missing values and is class imbalanced (there are 139,974 cases with "0" as a class value and 10,026 cases with "1" as a class value).

Table 1: Data set

Variable Name	Description	Type
SeriousDlqin2yrs	Person experienced 90 days past due	Y/N

	delinquency or worse	
RevolvingUtilizationOfUnsecuredLines	Total balance on credit cards and personal lines of credit except real estate and no installment debt like car loans divided by the sum of credit limits	percentage
age	Age of borrower in years	integer
NumberOfTime30-59DaysPastDueNotWorse	Number of times borrower has been 30-59 days past due but no worse in the last 2 years.	integer
DebtRatio	Monthly debt payments, alimony, living costs divided by monthly gross income	percentage
MonthlyIncome	Monthly income	real
NumberOfOpenCreditLinesAndLoans	Number of Open loans (installment like car loan or mortgage) and Lines of credit (e.g. credit cards)	integer
NumberOfTimes90DaysLate	Number of times borrower has been 90 days or more past due.	integer
NumberRealEstateLoansOrLines	Number of mortgage and real estate loans including home equity lines of credit	integer
NumberOfTime60-89DaysPastDueNotWorse	Number of times borrower has been 60-89 days past due but no worse in the last 2 years.	integer
NumberOfDependents	Number of dependents in family excluding themselves (spouse, children etc.)	integer

3. DATA PREPARATION

Reviewing the data set, we found that there are 29,730 cases with missing values for certain attributes. Testing the performance of the model, we found out that the elimination of cases with missing values achieved better performance compared to replacing the missing values with the average.

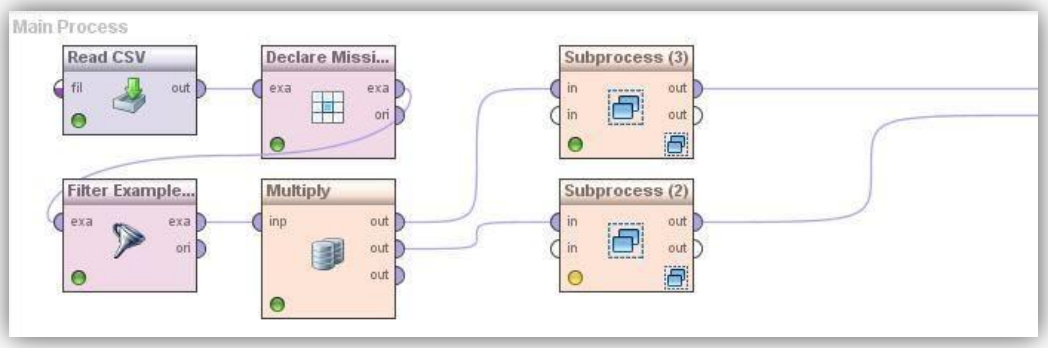

Figure 1. Data Preparation

Afterwards, examining the number of cases with “1” as a class value compared to the total number, we came to the conclusion that the data set is imbalanced. To solve this problem, we used clustering. We applied K-means algorithm on the cases with “0” as a class value to reduce their number to 6580. We divided the data set into two sets i.e. one set with the “0” as a class value and the other with “1” as a class value.

In order to get better performance of our model, we have reduced the data on 10%, because the algorithm for clustering indicated a problem in creating 6580 clusters. Then, we extracted centroids into the new data set and merged it with the set containing the cases with “1” as a class value using the operator *Append* in RapidMiner.

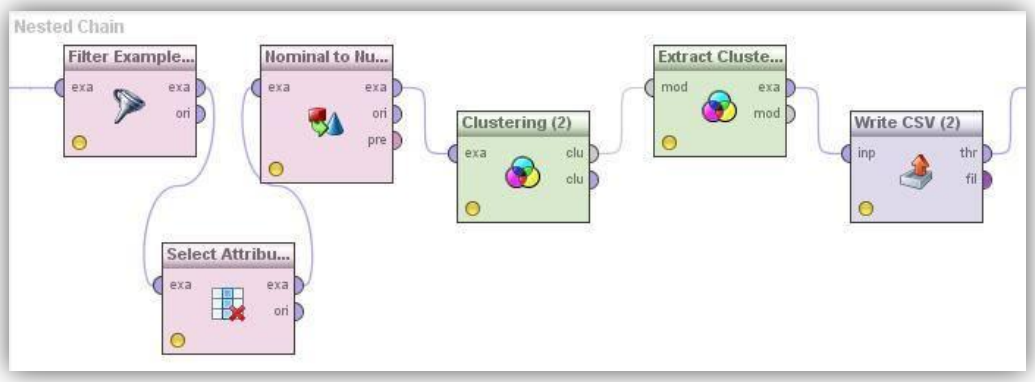

Figure 2.Subprocess 3 - clustering

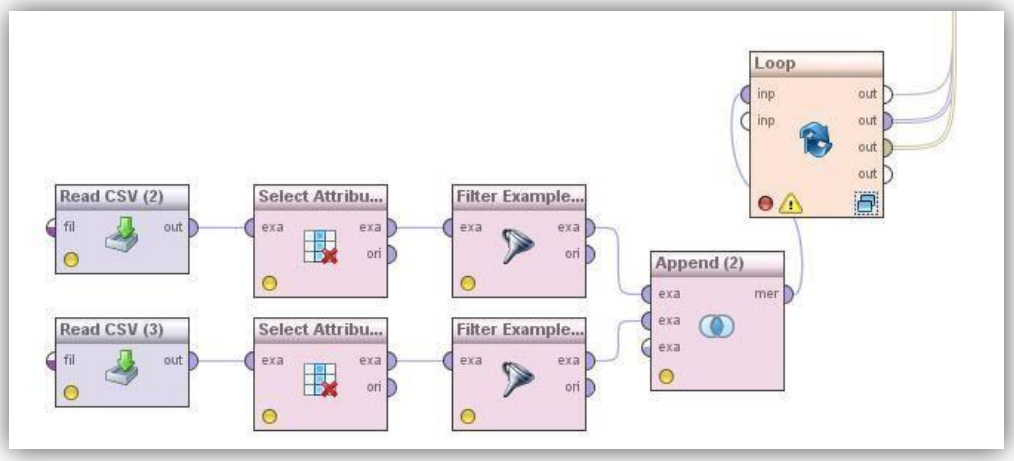

Figure 3.Merging data sets

For better understanding of the data set, we used operator *Correlation matrix* in order to determine which attribute influence the most on the output and how they are correlated.

attribute	weight
NumberOfTime30-59DaysPastDueNotWorse	0
NumberOfTime60-89DaysPastDueNotWorse	0.005
NumberOfTimes90DaysLate	0.014
NumberRealEstateLoansOrLines	0.347
MonthlyIncome	0.673
NumberOfOpenCreditLinesAndLoans	0.676
DebtRatio	0.686
RevolvingUtilizationOfUnsecuredLines	0.839
age	0.911
NumberOfDependents	1

Figure 4.Attribute weights

As shown in *Figure 5* attributes *NumberOfTime30-59DaysPastDueNotWorse, NumberOfTimes90DaysLate* and *NumberOfTime60-89DaysPastDueNotWorse* have almost perfect positive correlation. Also, we noticed that attributes *NumberOfDependents* and *age* have the biggest value of the negative correlation coefficient.

Attributes	RevolvingUt...	age	NumberOfT...	DebtRatio	MonthlyInco...	NumberOfO...	NumberOfT...	NumberRe...	NumberOfT...	NumberOfD...
RevolvingUti	1	-0.011	-0.015	-0.006	-0.001	-0.068	-0.014	0.007	-0.013	0.016
age	-0.011	1	-0.144	0.049	0.057	0.336	-0.146	0.183	-0.143	-0.401
NumberOfTi	-0.015	-0.144	1	-0.008	-0.018	-0.324	0.999	-0.168	0.999	-0.060
DebtRatio	-0.006	0.049	-0.008	1	-0.011	0.049	-0.009	0.087	-0.008	0.003
MonthlyIncor	-0.001	0.057	-0.018	-0.011	1	0.098	-0.018	0.089	-0.017	-0.012
NumberOfO	-0.068	0.336	-0.324	0.049	0.098	1	-0.333	0.683	-0.328	0.050
NumberOfTi	-0.014	-0.146	0.999	-0.009	-0.018	-0.333	1	-0.176	1.000	-0.064
NumberRea	0.007	0.183	-0.168	0.087	0.089	0.683	-0.176	1	-0.173	0.165
NumberOfTi	-0.013	-0.143	0.999	-0.008	-0.017	-0.328	1.000	-0.173	1	-0.064
NumberOfD	0.016	-0.401	-0.060	0.003	-0.012	0.050	-0.064	0.165	-0.064	1

Figure 5.Correlation Matrix

3. MODELING AND EVALUATION

For classification we used the operators: Naïve Bayes, AdaBoost Decision Tree, SVM, W-logistic and Random forest. We also tried to use the weight of the attributes to optimise the classification, but the result was much worse.

A Naïve Bayes classifer is a simple probabilistic classifer based on applying Bayes' theorem (from Bayesian statistics) with strong (naive) independence assumptions (Akhtar, Hahne, 2012).

Decision tree is a flowchart-like tree structure, where each internal node denotes a test on an attribute , each branch represents on an outcome of the test, and each leaf node holds a class label. The topmost node in a tree is the root node. This representation of the data has the advantage compared with other approaches of being meaningful and easy to interpret (Han, Kamber, 2006). AdaBoost operator tries to build a better model using the learner provided in its subprocess. AdaBoost, short for Adaptive Boosting, is a meta-algorithm, and can be used in conjunction with many other learning algorithms to improve their performance (Akhtar, Hahne, 2012).

SVM learner uses the Java implementation of the support vector machine mySVM by Stefan Rueping. This learning method can be used for both regression and classifcation and provides a fast algorithm and good results for many learning tasks (Akhtar, Hahne, 2012).

W-logistic - Class for building and using a multinomial logistic regression model with a ridge estimator and performs the Weka learning scheme (Rapid-I GmbH, 2008).

Random forest generates a set of a specifed number of random trees i.e. it generates a random forest. The resulting model is a voting model of all the trees (Akhtar, Hahne, 2012).

Result

For model evaluation we used AUC score because the accuracy is not precise when the class atribute is binary and the data set is class imbalanced.

By using operator Random forest, we got the highest ranking on Kaggle with an AUC score of 0.845190. As a reference, the top team got an AUC score of 0.869558.

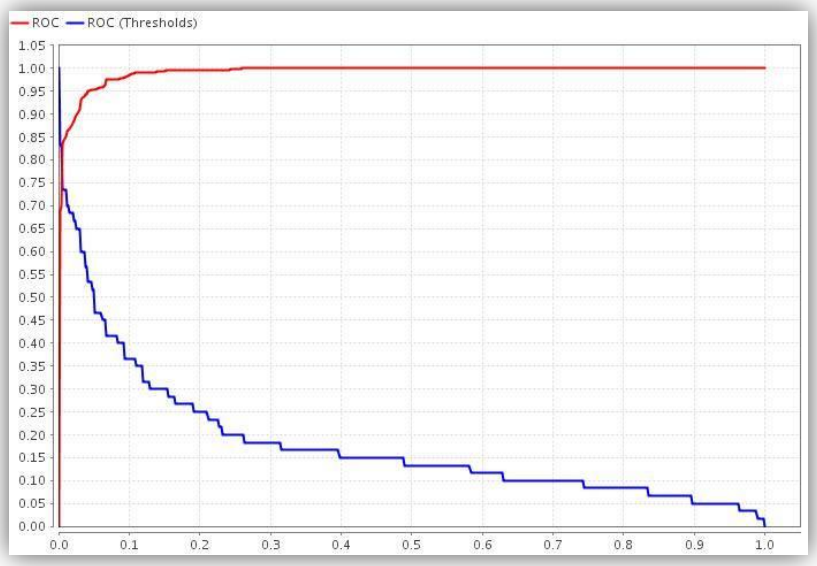

Figure 4.AUC in RapidMiner

4. CONCLUSION

To date, there exists no specialized algorithm coping with both the imbalance and largedata problem in loan default prediction, mostly because of the imbalanced datasets.In our work, we have presented a data mining model which applies classification methods using different algorithms for credit scoring. The most important part of our work was data preparation where we have used clustering. Clustering helped us to create balanced data set on which we applied Random forest algorithms. Using the knowledge gained during this project, there are a number of areas for possible improvement. Since data mining is a fast-growing area, there are numerous new techniques and programs that could be applied not only in credit scoring, but in all problems based on Big data, statistics and artificial intelligence.

REFERENCES

Akhavein, J., W.S. Frame, and L.J. White. 2005. The diffusion of financial innovations: An examination of the adoption of small business credit scoring by large banking organizations, *The Journal of Business* 78(2)

AktharFareed, Hahne Caroline, RapidMiner 5, Operator Reference,Rapid-I GmbH, 24th August 2012

Goldbloom Anthony, Kaggle, 2011 (http://www.kaggle.com/c/GiveMeSomeCredit/, April 2014)

Jiawei Han and MichelineKamber, Data Mining: Concepts and Techniques, Second edition, University of Illinois at Urbana-Champaign, Morgan Kaufmann Publishers, 2006

Lifeng Zhou, Hong Wang, Loan Default Prediction on Large Imbalanced Data Using Random Forests,TELKOMNIKA Indonesian Journal of Electrical Engineering Vol.10, No.6, October 2012, pp. 1519~1525

Rapid-I GmbH, The RapidMiner 4.2 Tutorial, 2008 (http://www.scribd.com/doc/15967723/Rapidminer-42-Tutorial, April 2014)

Rimmer, J. 2005. Contemporary changes in credit scoring, *Credit Control* 26(4)

Thomas, L.C. 2000. A survey of credit and behavioral scoring – forecasting financial risk of lending to consumers, *International Journal of Forecasting* 16(2)

TransUnion White Paper ~ The Importance of Credit Scoring for Economic Growth

Venkatadri M, Dr Lokanatha C. Reddy, “A Review on Data mining from Past to the Future”, International Journal of Computer Applications (0975 – 8887) Volume 15– No.7, February 2011

WALMART RECRUITING – STORE SALES FORECASTING

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Abstract: *Forecasting sales is one of the most important task of every business. Based on that prediction resources can be allocated, so business can generate bigger profit. In this research the goal was to forecast weekly sales of 45 Walmart stores, each having around 90 departments. We used Rapid-Miner software and its several key processes and operators that were the most suitable for this particular problem. Forecast had to be made based on 15 attributes, on 421570 examples. This problem, although complex, is more difficult because data has seasonality effects making predictions highly unstable. Using several different machine learning algorithms we were able to get the best WMAE score of 11.517,09.*

Keywords*: Regression, Algorithm, Forecasting, Data Mining, RapidMiner*

1. INTRODUCTION

Walmart is the world's largest retailer, operating in 27 countries and offering a wide variety of goods and services. Our goal was to forecast Walmart's weekly sales with least absolute error. The sample contains data of 45 stores in various regions, each store having around 90 departments. Regression problem was complex, and it required an appropriately complex methodology. We had used software package RapidMiner (Mierswa et al., 2006), making sure we chose the most suitable operators and processes for our problem.

Paper (Krause-Traudes et al., 2008) presents a use case of spatial data mining for aggregate sales forecasting in retail location planning. The forecast of potential sites is based on sales data on shop level for existing stores and a broad variety of spatially aggregated geographical, socio-demographical and economical features describing the trading area and competitor characteristics. The model building process was guided by a-priori expert knowledge and by analytic knowledge which was discovered during the data mining process itself. They used SVR (Support Vector Regression) data mining technique against the traditional state-of-the-art gravitational Huff-model. Findings reveal that the data mining model highly outperforms the traditional modeling approach.

Paper (Parikh, 2013) presents data mining based solution for demand forecasting and product allocations applications. This paper proposes two data mining models, Pure Classification model and Hybrid Clustering Classification model. Pure Classification model uses k-Nearest Neighbor Classification technique, and Hybrid Clustering Classification first uses k-Mean Mode Clustering to define clusters and then k-Nearest Neighbor classification to find k most similar objects.

In research written by (Napagoda, 2013) author was using support vector machine (SVM), Gaussian Process, Multilayer Perceptron, Linear Regression and SMO Regression. Based on the evaluation results they concluded that SMO regression and Linear Regression algorithms are better suited for forecasting web site related information and also using Linear Regression on pre-processed data gives more accurate results.

In paper (Hulsmann et al, 2012), the performance and limitations of general sales forecast models for automobile markets based on time series analysis and Data Mining techniques were analyzed. The models were applied to the German and the US-American automobile markets. The Support Vector Machine (SVM) turned out to be a very reliable method due to its non-linearity. In contrast, linear methods like Ordinary Least Squares or Quantile Regression are not suitable for the present forecasting workflow.

2. EXPERIMENTAL SETUP

The sample data has been downloaded from www.kaggle.com competition is Walmart Recruiting – Store Sales Forecasting and data from the real world. It consists of 2 comma separated values data sets - one for training purposes and one for testing. The training data contains 421.571 comma values, while test data has 115.065 comma values.

Table 1. Data description

Attribute	Description	Data Type
Store	ID of the store	Polynomial
Dept	ID of the department	Polynomial
Date	Week of the year	Integer
Weekly_Sales	Sales for the given department in a given store for given week	Real
IsHoliday	Binary values representing whether the week is a special holiday week or not	Bit
Temperature	Average temperature for given week in the region where store is located	Numerical
Fuel_Price	Cost of fuel in the region for a given week	Numerical
MarkDown i (i=1,…,5)	Anonymized data related to promotional markdowns that Walmart is running. MarkDown data is only available after Nov 2011, and is not available for all stores all the time. Any missing value is marked with an NA.	Numerical
CPI	The consumer price index in region of store for given week	Numerical
Unemployment	The unemployment rate in region of store for given week	Numerical

Our output attribute is Weekly Sales. Linear regression, and most other regression algorithms, allows only numeric values only, so polynomial attributes are converted to numerical attributes. MarkDown 1-5, represents promotional discounts for the following holidays:

Super Bowl: 12.02.2010, 11.02.2011, 10.02.2012, 08.02.2013.
Labor Day: 10.09.2010, 09.09.2011, 07.09.2012, 06.09.2013.
Thanksgiving: 26.11.2010, 25.11.2011, 23.11.2012, 29.11.2013.
Christmas: 31.12.2010, 30.12.2011, 28.12.2012, 27.12.2013.

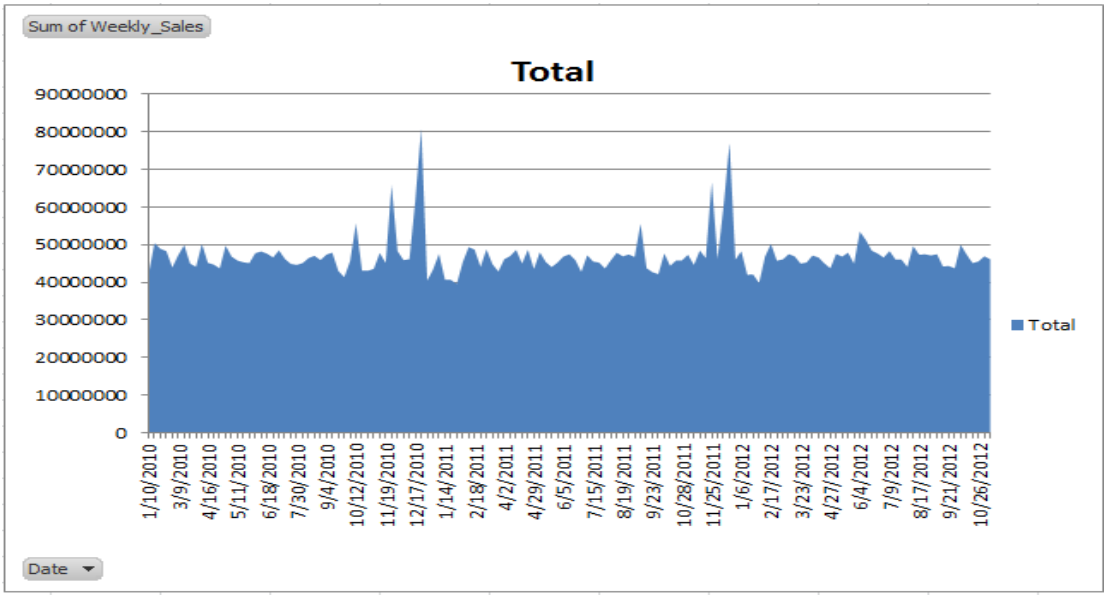

Figure 1. Weekly sales by time

Based on Figure 1 it can be seen that sales forecasting have high seasonality which is presented with peaks in December 2010 and January 2012. Shortly after that sale drops, this is seen in January 2011 and February 2012.

3. MODELING

In this paper, several linear regression algorithms to forecast weekly sales was used. Experiment is conducted in Rapid Miner as its inner operator structure allows easy setting up of the experiment. The experimental process was organized in 3 levels. On the first level we used Loop operator. This operator iterates over its subprocess for a specified number of times. The subprocess can use a macro that increments after each iteration, which, in our case, was 45 times. On the second level we had defined operators within the Loop operator and set the iteration on stores.

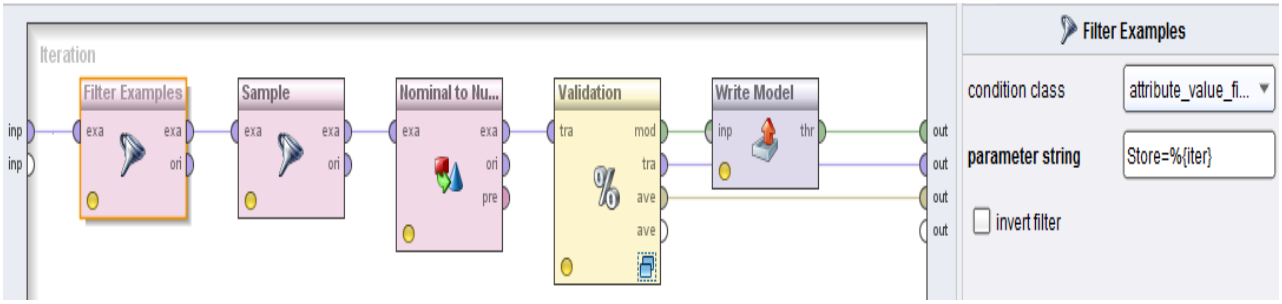

Figure 2. Inner operator structure of the Loop

On the third level we measured classification accuracy of every algorithm which is evaluated through 10-fold cross validation. The X-Validation operator is a nested operator. It has two subprocesses: a training subprocess and a testing subprocess. The training subprocess is used for training a model. The trained model is then applied in the testing subprocess. The performance of the model is also measured during the testing phase. On this level we used several linear regression algorithms to get the least absolute error.

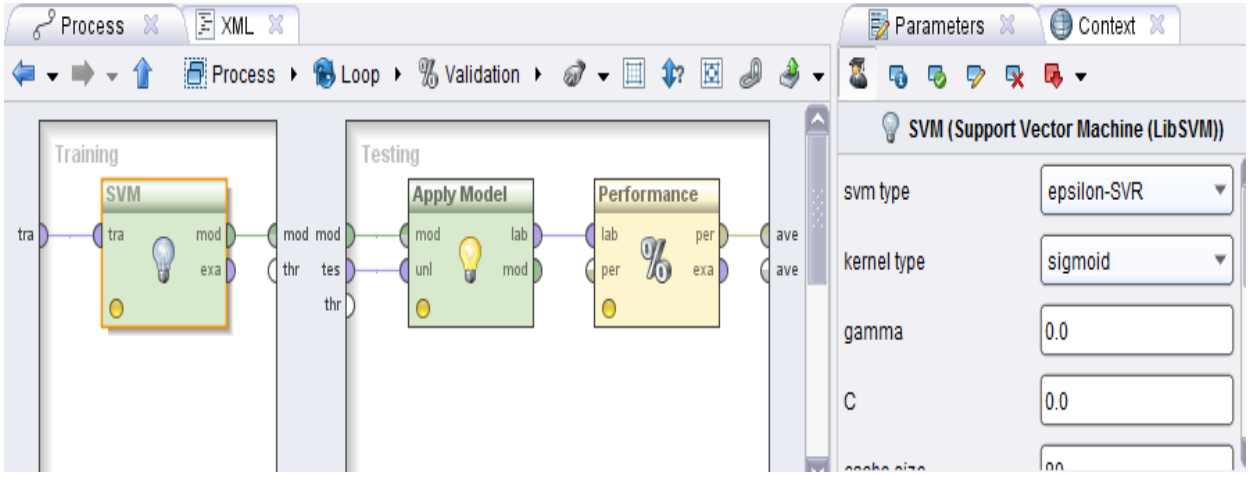

Figure 3. Inner operator structure of the X-Validation

Algorithms which we used were K-NN (k-Nearest Neighbor), W-Isotonic Regression, Linear Regression, Neural Network and SVM (Support Vector Machine (LibSVM)).

K-NN operator generates a k-Nearest Neighbor model from the input ExampleSet. This model can be a classification or regression model depending on the input ExampleSet. W-Isotonic Regression learns an isotonic regression model. It picks the attribute that results in the lowest squared error and missing values are not allowed. It can only deal with numeric attributes. Linear Regression is a technique used for numerical prediction. Regression is a statistical measure that attempts to determine the strength of the relationship between one dependent variable (i.e. the label attribute) and a series of other changing variables known as independent variables (regular attributes). Neural Network operator learns a model by means of a feed

forward neural network trained by a back propagation algorithm (multi-layer perceptron). Neural network is a mathematical model or computational model that is inspired by the structure and functional aspects of biological neural networks. SVM (Support Vector Machine) is supervised learning model with associated learning algorithms that analyze data and recognize patterns, used for classification and regression analysis. SVM training algorithm builds a model that assigns new examples into one category or the other, making it a non-probabilistic binary linear classifier (Mierswa et al, 2006)

4. RESULTS

SVM algorithm gave the best results:

Table 2. Results

Model	Absolute error
SVM (Support Vector Machine)	11.517,09
Neural Network	11.899,511
W-Isotonic Regression	14.1807,728
Linear Regression	14.528,238
K-NN (k-Nearest Neighbor)	20.633,996

The Support Vector Machine (SVM) approach represents a data-driven method for solving classification and regression tasks (Fawcett et al. 1998). It has been shown to produce lower prediction error compared to classifiers based on other methods like artificial neural networks, especially when large numbers of features are considered for sample description. We have used the test data for the testing process. Using the Loop operator gave us 45 models, each model representing one store. Then we used the Append operator, which merged all models into one model, which we then used to get the final result.

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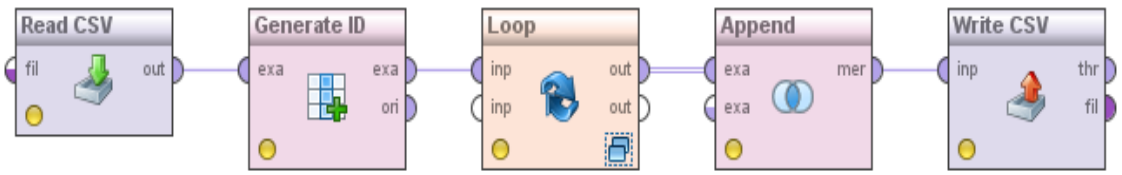

Figure 4: Final process – testing

5 .CONCLUSION AND FUTURE WORK

Preparing the data for our weekly sales forecasting project required us to replace missing values with zeros and identify the most relevant attributes for our goal output attribute. The validation process gave us 45 models which we then merged into one final model, using the Append operator. We then tested the final model and got the result (Picture 4). During the modeling phase we used several Rapid Miner's algorithms, where SVM gave us the best result, scoring the absolute error of 11.517,09.
Our conclusion is that Walmart's weekly sale is on a gradual rise a week prior to holidays. It rapidly increases during the Labor Day, Thanksgiving and Christmas holidays.

Our goal was to forecast weekly sales of 45 Walmart stores. We used Rapid Miner software and its several key processes and operators that were the most suitable for this particular problem. We needed to analyze factors and their impact on the process of sales forecasting. In order to find the solution with the least

absolute error, we tested linear regression models such as: K-NN (k-Nearest Neighbor), W-Isotonic Regression, Linear Regression, Neural Network and SVM (Support Vector Machine (LibSVM)).

We plan to detect outliers and execute same experiment again. Also, we plan to optimize parameters of algorithms, such as SVM, since performance is highly dependent on value of complexity parameter C and kernel type. Additionally, we plan to use more algorithms such as Gaussian Processes and neural networks.

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REFERENCES

Bhavin Parikh (2013), Applying Data Mining to Demand Forecasting and Product Allocations, The Pennsylvania State University, The Graduate School

Chandana Napagoda (2013), Web Site Visit Forecasting Using Data Mining Techniques, INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH VOLUME 2, ISSUE 12, DECEMBER 2013

Maike Krause-Traudes, Simon Scheider, Stefan Rüping Harald Meßner (2008), Spatial data mining for retail sales forecasting 11th AGILE International Conference on Geographic Information Science, University of Girona, Spain

Cohen, J., Cohen P., West, S.G., & Aiken, L.S. (2003). Applied multiple regression/correlation analysis for the behavioral sciences. (2nd ed.) Hillsdale, NJ: Lawrence Erlbaum Associates

Cook, R. D. 1977. Detection of influential observations in linear regression. Technometrics, 19, 15-18.

CRISP-DM 1.0. Technical Report, The CRISP-DM Consortium, 2000.

G Lino and M Berry (2011). Data Mining Techniques: For Marketing, Sales, And Customer Relationship Management,.3rd edition.Wiley Publishing

Mierswa, M. Wurst, R. Klinkenberg, M. Scholz, and T. Euler (2006), YALE: rapid prototyping for complex data mining tasks, in Proceedings of the 12th ACM SIGKDD International Conferenceon Knowledge Discovery and Data Mining (KDD '06), pp. 935–940, ACM, August 2006.

Marco Hulsmann, Detlef Borscheid, Christoph M. Friedrich, Dirk Reith (2012), "General Sales Forecast Models for Automobile Markets and their Analysis," Ibai Publishing, P Chapman, J Clinton, R Kerber, T Khabaza, T Reinartz, C Shearer, and R Wirth.

T Fawcett. ROC GraDraper, N.R.; Smith, H. (1998). Applied Regression Analysis (3rd ed.). John Wiley.

SENTIMENT ANALYSIS OF MOVIES REVIEW

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Abstract: *The main of this paper is to propose a model for sentiment analysis that can recognize emotion in specific words, phrases and sentences. Usually, database form platforms for microblogging are used for this kind of research for model learning, but also specially prepared for specific problem. In this paper a sentiment analysis movies reviews database from movies critics portal is used. Classification models have ben developed. The best model had the following results: accuracy is 51,06%.*

Keywords*:Text mining, Sentiment analysis, Classification, K-NN, Rapid Miner*

1. INTRODUCTION

Knowledge about what people think and feel is a prerequisite of good decision making. Before the Internet Age people relied on opinions and experiences of others during decision making, but now experiences are more available either about making choices which film to watch, product critics or even comments about some places (Lee, Pang, 2008). These short comments are especially interesting for sentiment analysis which is a part of text mining. Analysis tends to discover authors attitudes using machine learning and language analysis (Yessenov, Misailovic, 2009). Microblogging services such as Twitter, Yahoo, Facebook, Tumblr (Pak, Paroubek, 2010) and movie and books critics are used as databases for analysis. Textual information can be categorized into two main types: facts and opinions. Facts are objective expressions and opinions are usually subjective expressions (Liu, 2010).

Text mining is a new field in computer science which combines techniques of data mining, machine learning and language processing for data discovery and knowledge management (Feldman, Sanger, 2007). Sentiment analysis is becoming more and more popular in recent years because it is applicable in business environment through customer feedback analysis in form of a product critics, organization's reputation management in public, but also in new campaign planning (Yessenov, Misailovic, 2009).

In this paper sentiment analysis is based on short critics of movies from portal "Rottentomatoes" (www.rottentomatoes.com). For contest proposes, main goal is to achieve the best predicting results meaning to achieve the best accuracy in predicting sentiments using operators which provides this kind of results. Also,it is very important to understand concept of Text mining and what kind of results it is providing ,to understand operators of text mining for purpose to make the best predicting model and achieve best possible accuracy . Idea behind contest is based on critics from which we can create model that can predict emotions that are incorporated in it, and hence makes classification easier. Database has been downloaded from portal "Rottentomatoes" which presents movies and allows readers to make comments. Besides mark which movie gets from every author, there is also possibility of putting fingerprints such as "rotten" or "fresh".

2. BUSINESS UNDERSTANDING AND DATA UNDERSTANDING

The data has several columns: Phrase ID, Sentence ID, Phrase and Sentiment. Phrase can include one word, several words or even a whole sentence (Figure 1). Every phrase has its unique ID while based on sentence ID we can conclude if several phrases are part of the same sentences. Sentiment presents an exit and takes value on scale from 0 to 4, where 0 is extremely negative emotion and 4 is extremely positive. According to database the most frequent value is 2 which analysis confirmed as modus.

Besides 4 columns, database has 156000 records and it is important to underline that every record does not represent logical phrase. It is possible to find phrases made of articles like "A" and "The".

PhraseId	Sentiment	SentenceId	Phrase
1	1	1	A series of escapades demonstrating the adage that what is good for the goose is also good for the gander , some of which
2	2	1	A series of escapades demonstrating the adage that what is good for the goose
3	2	1	A series
4	2	1	A
5	2	1	series
6	2	1	of escapades demonstrating the adage that what is good for the goose
7	2	1	of
8	2	1	escapades demonstrating the adage that what is good for the goose
9	2	1	escapades
10	2	1	demonstrating the adage that what is good for the goose
11	2	1	demonstrating the adage
12	2	1	demonstrating
13	2	1	the adage
14	2	1	the
15	2	1	adage
16	2	1	that what is good for the goose
17	2	1	that
18	2	1	what is good for the goose
19	2	1	what
20	2	1	is good for the goose

Figure 1: Presentation of data

3. DATA PREPARATION

It is necessary to reduce data sample because of huge amount of records, precisely 156 000 records in database,which is beyond capacities (working memory) of RapidMiner. In this research this amount of records has been reduced, and it takes 6% of records. Moreover, irrelevant data such as SentenceID and data made of articles has been removed. Attribute Sentiment is marked as label. Also, it is necessary to transform attribute Phrase from Nominal to Text using special operator or during data import.

4. MODELING AND EVALUATION

Operator Process Document (Figure 2) from data was used during the process of modeling with the aim to execute tokenization. Suboperators used in process are Tokenize, Filter Tokens by Length, Stem and Filter Stopword (English) (Figure 3). Operator Tokenize recognize everything that is not a single letter as a special word (Token) meaning that option “non letter” is on. For filter Tokens operator minimal word length is setup to be 3 characters (because of words like “bad” which can carry strong emotion) and for maximum 25 characters. For word rooting Porters algorithm for “stemming” is used. At the end an operator for removing English stopwords is applied.

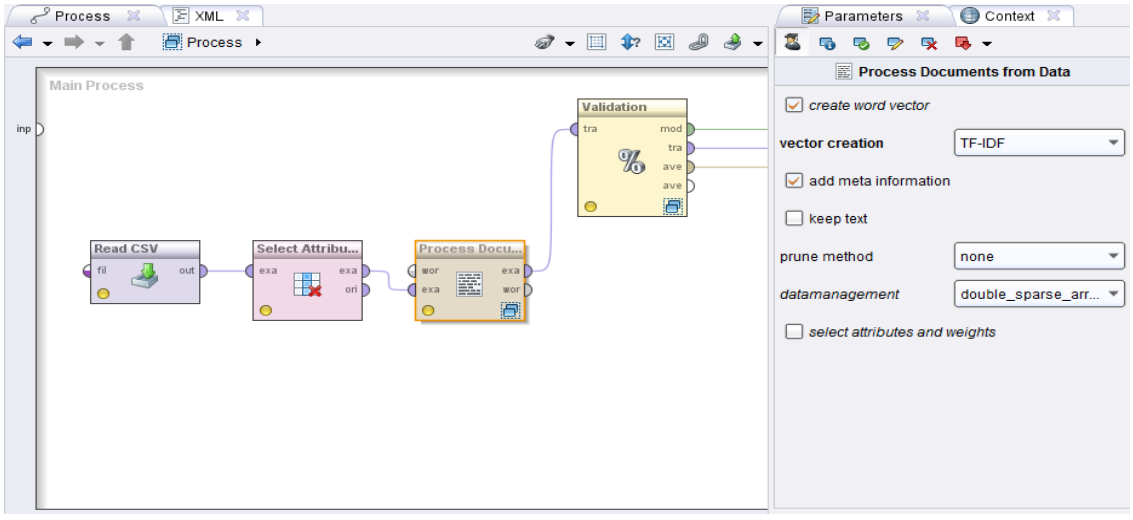

Figure 2: Process Documents from Data

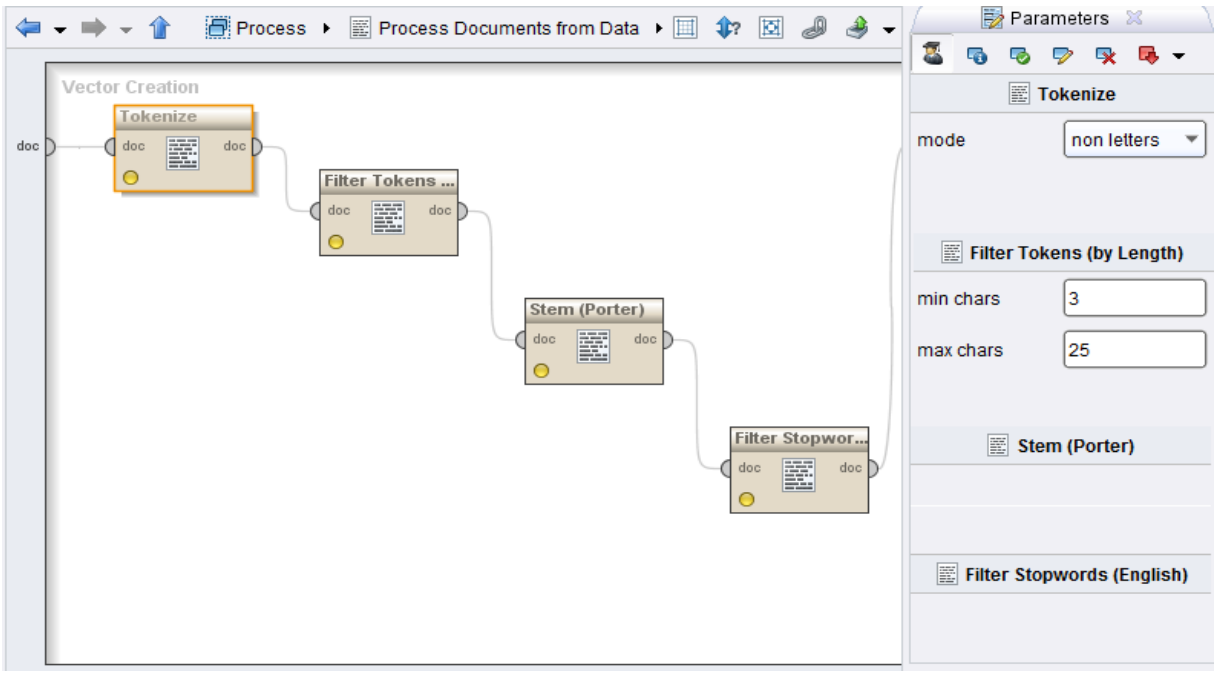

Figure 3: Process text suboperators

Several models for classification were used: k-NN, W-IB1 (Weka classifier) and Naive Bayes (Table 1). It turned out that using operator Naive Bayes takes shorter time for execution, but accuracy gained is lower comparing with two other operators (operator W-IB1 and operator Naive Bayes). Operator W-IB1 achieves precision as k-NN, but W-IB1 operator needs lot more time. So, k-NN operator, based on principle of neuron network, is used in this case. For assessment of optimal number "k" the Optimize Parameters node was used while for measure type "Cosine Similarity" has been used.

For model evaluation, operator Validation(X-Validation) has been used. Number of validation is setup to 5 and the sample was stratified. Criteria of goodness was "accuracy" (according to contest propositions). The best result for predicting accuracy using operator k-NN was 0.53 on 6% of sample set (Figure 4). For operator Naive Bayes best accuracy achieved (in best case) is 0.22.

Table 1: Comparing result of 3 operators

MODEL		Time	Accuracy
K-NN	K = 1	1:59	49.39% +/- 1.29%
	K = 2	2:00	49.46% +/- 1.29%
	K = 3	1:52	51.06% +/- 0.57%
	K = 4	1:37	50.38% +/- 0.68%
W-IB1		16:43	accuracy: 49.20% +/- 1.09%
Naive Bayes		0:31	20.37% +/- 0.93%
	Laplace correction	0:32	20.37% +/- 0.93%

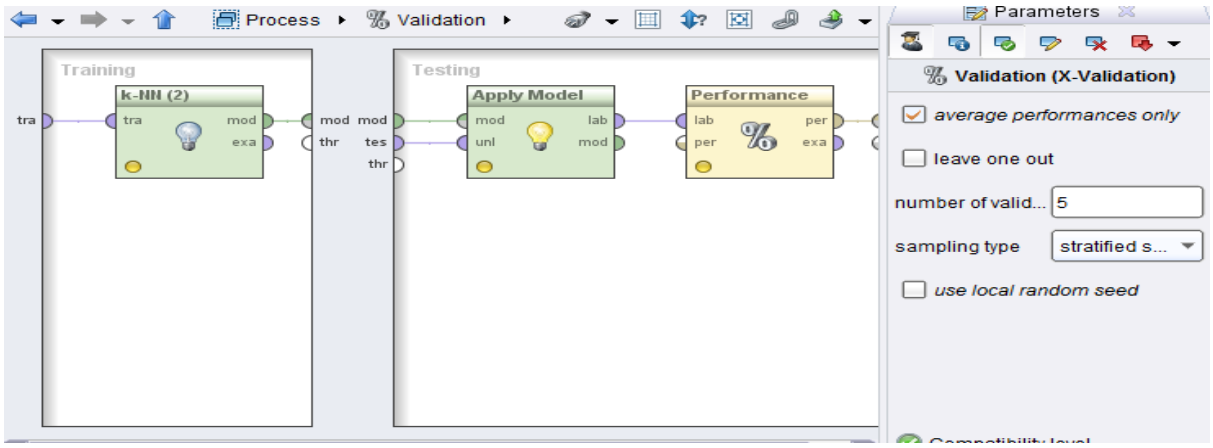

Figure 4: Usage of k-NN operator

5. CONCLUSION

Comparing results, conclusion is that operator k-NN is the best choice on this data set in order to get as much accuracy as it is possible and gained accuracy for k-NN is 51,06%(+/- 0,57%) using cross validation. Thanks to optimization operator optimal number 3 for k is gained. For data preparation it is necessary to use process document with operators Tokenize, Filter Tokens, Stem (Porter) and Filter Stopwords.

Suggestion for further studies refers integration for more different database comments from similar portals and that could provide higher accuracy for predicting results and also monitoring correlations between self-evaluation comments by authors and marks that model has given.

References

Feldman, R., Sanger, J. (2007). The text mining handbook : advanced approaches in analyzing unstructured data. New York. Cambridge University Press.

Liu, B. (2010). Sentiment Analysis and Subjectivity. United States of America. Taylor and Francis Group.

Pak, A., Paroubek, P. (2010). Twitter as a Corpus for Sentiment Analysis and Opinion Mining. Paris. Universite de Paris-Sud.

Pang, B., Lee, L. (2008). Opinion Mining and Sentiment Analysis. United States of America. Foundations and Trends in Information Retrieval.

Yessenov, K., Misailović, S. (2009). Sentiment Analysis of Movie Review Comments. United States of America. International Conference on Data Mining Workshops.

PREDICTION OF BOND'S NEXT TRADE PRICE WITH RAPIDMINER

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Abstract: *This paper aims to explain which algorithm is the best for predicting bonds price using RapidMiner. Whole work is based on CRISP-DM methodology. This research was cinducted on real data from competition on Kaggle. Accent was on reducing and preparing data for modeling. Through this paper we focused on popular algorithms for prediction, that are available in RapidMiner-open source data mining environment. Main goal was to compare different algorithms and find one which minimize the absolute error.*

Keywords*: Bonds price, Prediction, Linear Regression, Neural Networks, Support Vector Machines, Data Mining Forecasting, Rapid Miner*

1. INTRODUCTION

In nowadays technology financial institutions are able to produce huge datasets that build a foundation for approaching these enormously complex and dynamic problems with data mining tools. One of the most enticing application areas of data mining in these emerging technologies is in finance, becoming more amenable to data-driven modeling as large sets of financial data become available. In the field of finance the extensive use of data mining applications includes the area of forecasting stock market, pricing of corporate bonds, understanding and managing financial risk, trading futures, prediction of exchange rates, credit rating etc. (Murthy, 2010).

We used RapidMiner (I. Mierswa, 2006) for implementing research process. RapidMiner is a software platform developed by the company of the same name that provides an integrated environment for machine learning, data mining, text mining, predictive analytics and business analytics. It is used for business and industrial applications as well as for research, education, training, rapid prototyping, and application development and supports all steps of the data mining process including results visualization, validation and optimization (Markus Hofmann, 2013).

Scientific research aimed at gaining insights on the future, related to a high-importance domain such as business evolution, has the main goal of finding a way to minimize the risks and reduce the insecurity pressure in a business world affected by the economic crisis. Companies have turned to knowledge, processing and analyzing information in order to realize short-term or long-term forecasting based on powerful software applications. In this paper we used supervised learning algorithms (Banica L., 2012). The goal of a supervised learning algorithm is to obtain a classifier by learning from training examples. A classifier is something that can be used to make predictions on test examples. This type of learning is called "supervised" because of the metaphor that a teacher (i.e. a supervisor) has provided the true label of each training example (Elkan, 2013).

In Performance comparison of time series data using predictive techniques are focused on methodology used in applying the Time Data Mining techniques to financial data calculating currency exchange rates of US dollars to Indian Rupees. Four models were used: Multiple Regression in Excel, Multiple Linear Regression of Dedicated Time Series Analysis in Weka, Vector Autoregressive Model in R and Neural Network Model using NeuralWorks Predict (S. Saiglas, 2012).

Nowadays, many current real financial applications have nonlinear and uncertain behaviors which change across the time. Therefore, the need to solve highly nonlinear, time variant problems has been growing rapidly. These problems along with other problems of traditional models caused growing interest in artificial intelligent techniques. Comparative research review of three famous artificial intelligence techniques, i.e., artificial neural networks, expert systems and hybrid intelligence systems, in financial market. Results show that accuracy of these artificial intelligent methods is superior to that of traditional statistical methods in dealing with financial problems, especially regarding nonlinear patterns (Bahrammirzaee, 2010). Regression

modeling, while presenting a potential black box solution to the issue with market timing, has proven to be both flexible and robust relative to a static trading rule (Harvey, 2014).

2. FINANCIAL FORECASTING AND ALGORITHMS FOR PREDICTION

Regression analysis is one of the most widely used techniques for analyzing multifactor data. Linear regression attempts to model the relationship between two variables by fitting a linear equation to observed data where the relationship between the variables can be described with a linear model. Linear regression is a predictive model that uses training and scoring data sets to generate numeric predictions in data. It is important to remember that linear regression uses numeric data types for all of its attributes. For long time linear regression was very common algorithm for prediction tasks. But, now are more typical methods such as neural networks, support vector machines (SVM) (North, 2012).

Advantages/limitations of linear regression model:

1. Linear regression implements a statistical model that, when relationships between the independent variables and the dependent variable are almost linear, shows optimal results
2. Linear regression is often inappropriately used to model non-linear relationships
3. Linear regression is limited to predicting numeric output
4. A lack of explanation about what has been learned can be a problem (Douglas C. Montgomery, 2013)

2.1. Neural Networks

Several linear and nonlinear statistical models were proposed in the literature to solve the problem of financial phenomena forecasting. (Clements, 2004)Forecasting accuracy is one of the most important factors involved in selecting a forecasting method. Besides, nowadays artificial intelligence (AI) techniques are becoming more and more widespread because of their accuracy, symbolic reasoning, flexibility and explanation capabilities. Among these techniques, particle swarm optimization (PSO) is one of the best AI techniques for optimization and parameter estimation (Hadavandi E., 2010). Neural networks have become increasingly popular in finance as financial services organizations have been the second largest sponsors of research in neural network application. An accurate forecast into the future can offer tremendous value in areas as diverse as financial market price movements, financial expense budget forecasts, website click through likelihoods, insurance risk, and drug compound efficacy, to name just a few. Many algorithm techniques, ranging from regression analysis to ARIMA for time series, among others, are regularly used to generate forecasts. A neural network approach provides a forecasting technique that can operate in circumstances where classical techniques cannot perform or do not generate the desired accuracy in a forecast. Neural networks offer a modeling and forecasting approach that can accommodate circumstances where the existing data has useful information to offer, but it might be clouded by several of the factors mentioned above (Omidi A., 2011). Neural networks can also account for mixtures of continuous and categorical data. These attributes make neural networks an excellent tool to potentially take the place of one or more traditional methods such as regression analysis and general least squares. Thus, neural networks can generate useful forecasts in situations where other techniques would not be able to generate an accurate forecast. In other situations, neural networks might improve forecasting accuracy dramatically by taking into account more information than traditional techniques are able to synthesize. Finally, the use of a neural network approach to build a predictive model for a complex system does not require a statistician and domain expert to screen through every possible combination of variables. Thus, the neural network approach can dramatically reduce the time required to build a model (Edward R. Jones, 2004). Artificial neural networks (ANNs) have been popularly applied for stock market prediction, since they offer superlative learning ability. They often result in inconsistent and unpredictable performance in the prediction of noisy financial data due to the problems of determining factors involved in design (Kyoung-jae Kim, 2012).

2.2 SupportVector Machines

SVMs were developed by Cortes & Vapnik for binary classification. SVMs represent a powerful technique for general (nonlinear) classification, regression and outlier detection with an intuitive model representation (Hamel, 2011). Support Vector Machine (SVM) is a relatively new learning algorithm that has the desirable characteristics of the control of the decision function, the use of the kernel method, and the sparsity of the solution (Meyer, 2012). SVMs are currently a hot topic in the machine learning community, creating a similar enthusiasm at the moment as Artificial Neural Networks used to do before. SVMs nowadays have become a popular technique in flexible modelling. There are some drawbacks, though: SVMs scale rather badly with

the data size due to the quadratic optimization algorithm and the kernel transformation. Furthermore, the correct choice of kernel parameters is crucial for obtaining good results (Yuan, 2011).

2.3 Bonds and Financial Forecasting

A bond is a fixed interest financial asset issued by governments, companies, banks, public utilities and other large entities. Bonds pay the bearer a fixed amount a specified end date. A discount bond pays the bearer only at the ending date, while a coupon bond pays the bearer a fixed amount over a specified interval (month, year, etc.) as well as paying a fixed amount at the end date. A bond that provides a standard against which the performance of other bonds can be measured. Government bonds are almost always used as benchmark bonds. Also referred to as "benchmark issue" or "bellwether issue". More specifically, the benchmark is the latest issue within a given maturity. For a comparison to be appropriate and useful, the benchmark and the bond being measured against it should have a comparable liquidity, issue size and coupon (Investopedia, 2014).

The bond price prediction can help banks and financial institutions to build their portfolio in diversified manner. Using the trade price, the investor can assume not only the price of that bond, but can also the interest rates, and hence, has a very useful tool in his hand for investment purpose, thus making decisions about whether to invest or not, and if invest then when to invest (Diebold, 2006).

3. DATA AND METHODOLOGY

Data mining becomes a cutting-edge information technology tool in today's competitive business world. It helps the company discover previously unknown, valid, and actionable information from various and large databases for crucial business decisions (Bramer, 2013).

Data Mining methodologies have been evolving over time. In today's ever-changing economic environment, there is ample opportunity to leverage the numerous sources of financial data now readily available to the savvy business decision maker. This data can be used for business gain if the data is converted to information and then into knowledge (Kantardzic, 2011). Data mining processes, methods and technology oriented to transactional-type data have grown immensely in the last quarter century. There is significant value in the interdisciplinary notion of data mining for forecasting when used to solve bond price problems. The intention of this talk is to describe how to get the most value out of the myriad of available data by utilizing data mining techniques specifically oriented to data collected over time (Hui Li, 2012).

Investors use predicted bond trade prices to inform their trading decisions throughout the day. In this paper we want to show how linear regression can be used to predict the next trading price of a US corporate bond. We use bond price data provided through Benchmark Solutions and Kaggle.com[1], which includes variables such as current coupon, time to maturity, and details of the previous 10 trades, among others. Regression models are useful and understandable models which are used for prediction and data fitting.

One of the most enticing application areas of data mining in these emerging technologies is in finance, becoming more amenable to data-driven modeling as large sets of financial data become available. In the field of finance the extensive use of data mining applications includes the area of forecasting stock market, pricing of corporate bonds, understanding and managing financial risk, trading futures, prediction of exchange rates, credit rating etc.

This research was driven by CRISP-DM methodology. The CRISP-DM (CRoss Industry Standard Process for Data Mining) reference model for data mining. It contains the phases of a project, their respective tasks, and their outputs (Suknović Milija, 2010).

1. Business understanding
2. Data understanding
3. Data preparation

[1]http://www.kaggle.com/c/benchmark-bond-trade-price-challenge/data

4. Modelling
5. Evaluation
6. Deployment

Every phase of this life cycle is important, but most time takes to prepare data. The data preparation phase covers all activities to construct the final dataset (data that will be fed into the modeling tool(s)) from the initial raw data. Data preparation tasks are likely to be performed multiple times, and not in any prescribed order. Tasks include table, record, and attribute selection, data cleaning, construction of new attributes, and transformation of data for modeling tools (Galit Shmueli, 2011).

In this project the model was built up to predict the Benchmark Bond Trade Price. This price will be the estimated price at which the US corporate bond or government bond might trade at. The data set consisting of current coupon, time to maturity and a reference price was used for price prediction. Details of the previous 10 trades were also used for prediction (Kaggle, 2014).

We saw that this dataset comprises 61 columns of attributes. These parameters include the row ID (can be used for time series analysis), the bond ID (there is data for almost 8,000 different bonds), current coupon, previous trade prices, and more. The output variable is the trade_price column, as this is the value that we are trying to solve for.

The idea was to make smaller set, that will in a good was represent our whole set of training data. Originally set had over 700 hundreds instances, but we were using several data mining techniques to get smaller set. We prepared our data through: data reduction, handling missing values, inconsistent data, and attribute reduction. First, we reduced size of data set with sampling – relative sample with sample ratio 0.01. Cases with the missing values were removed; did not make sense to impute, considering type of date. We did not detect any outliers, also idea was to make some clusters, and then to split data sets for analysis, but there is more than 800 types of bonds, so that did not make sense to implement. Negative values were in attribute reporting_delay (The number of seconds after the trade occurred that it was reported – so it is impossible to be negative) and we removed cases with negative reporting_delay value. For attributes, first we checked correlation – because similar attributes act in same way, dropping out one of the correlated attribute, we lose little information, but speed algorithms a lot. Before implementing correlation operator in RapidMiner, we had to make sure that all data was numerical. Original set had 61 attribute, after correlation process 31 regular attribute and one special attribute – label. After we removed correlated attributes, we wanted to try weighting attributes. We selected all attributes, except label trade_price, and using generate weight LPR operator – but, we had not found any relevant result. Next step was using Principal Component Analysis - where we have reduced 32 to 14 attributes (components). PCA variance threshold was 0.99 – it means that 99% of previous data set was described with 14 new components – more than that number will give same results, as it is shown in *Figure 3.* Although we reduced the processing time, we have also made our prediction accuracy worse, so we decided to do modeling on data set after correlation.

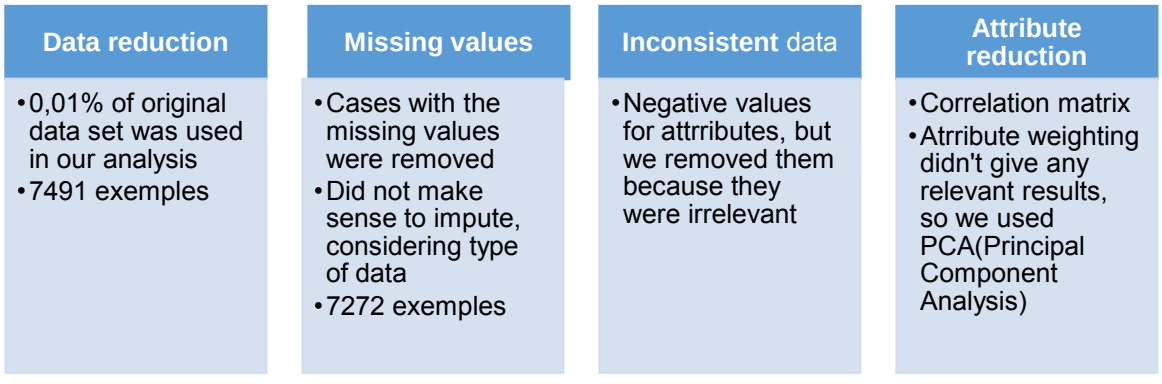

Figure 1: Data preparation

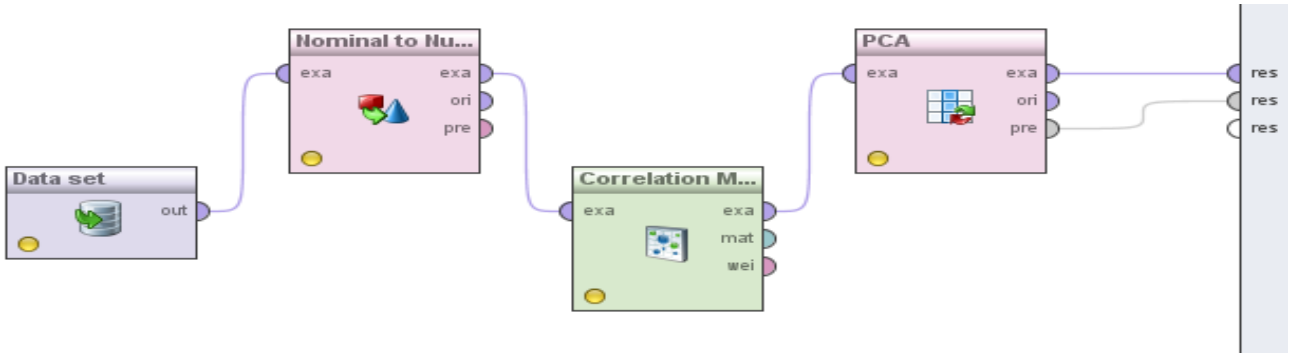

Figure 2: Principal component analysis

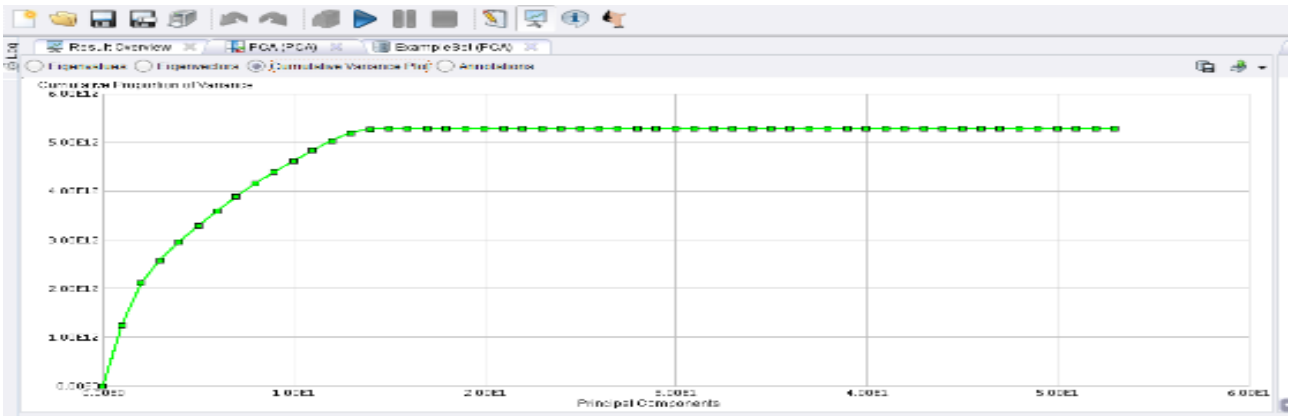

Figure 3: Cumulative variance plot

3. MODELING, EVALUATION AND RESULTS

Previous we have explained how we prepared our data, and here we focused on models, their performances and results of our work. Performance evaluation was conducted using mean absolute error. We wanted to show which algorithm gives the lowest absolute error and forecasts the best next bonds trade price. Whole, main process is shown in *Figure4, Figure5, and Figure 6.*

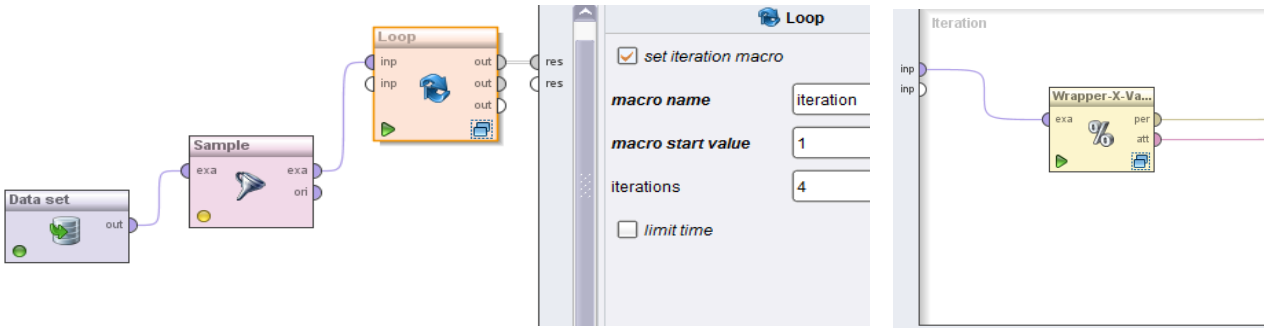

Figure 4: Start of a main process - loop operator

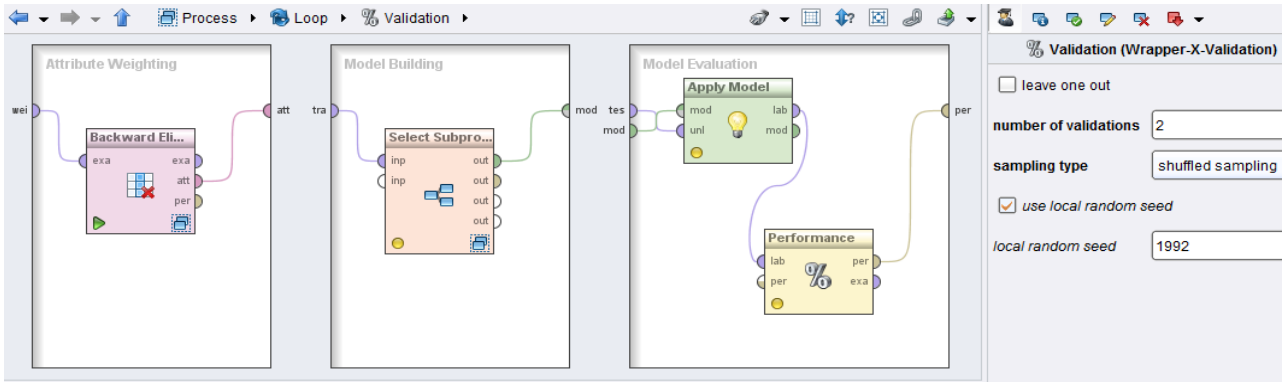

Figure 5: Wrapper-X-Validation

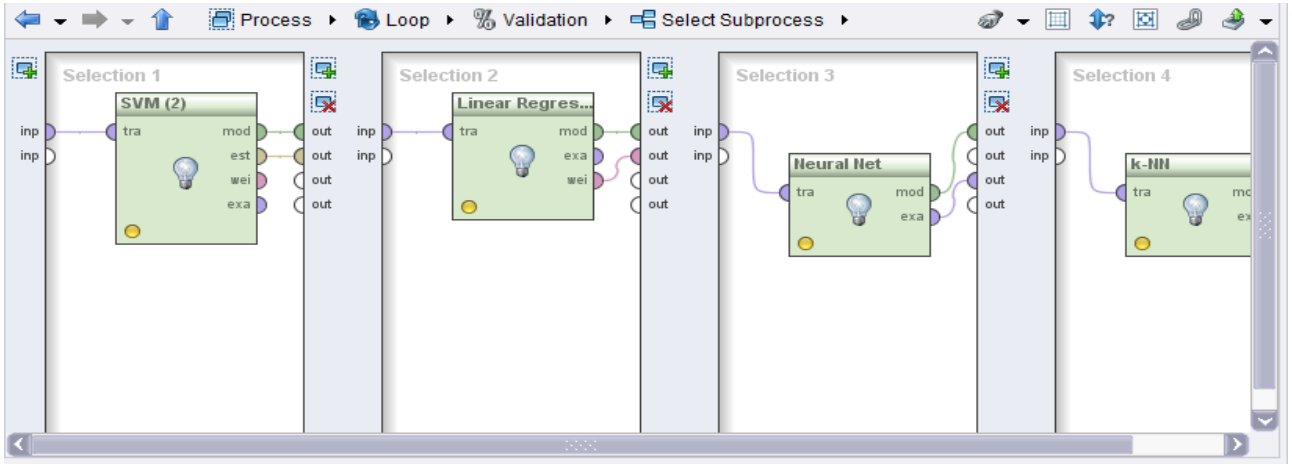

Figure 6: Algorithms

We have compered our results, which are shown in next table:

Table 1: Attribute optimization

		Optimize Selection	Forward Selection	Optimize Selection (Evolutionary)	Backward Elimination	PSO
ALG1	SVM	2.058+/-0.210	8.679+/-0.615	5.937+/-0.414	5.430+/-0.156	6.185+/-0.811
ALG2	Regression	0.807+/-0.027	5.728+/-0.263	5.742+/-0.318	4.618+/-0.164	5.053+/-0.211
ALG3	Neural net	1.328+/-0.084	7.48+/-1.033	7.467+/-0.734	6.213+/-0.289	7.915+/-0.831
ALG4	K-NN	6.128+*-0.053	8.805+/-0.532	9.108+/-0.798	8.035+/-0.196	7.694+/-0.027

Our goal was to discover which algorithm in RapidMiner gives the best results in prediction of bonds price. Our focus in this paper was on linear regression, neural nets, support vector machines, k-nns. But main thing was using real data sets and reducing them to applicable size. As we can see in *Table 1*, regression algorithm gave best results for our prepared data. That was no expected, but sure there is something we could improve in our preprocessing of the data. When compered our results with results from data mining tool called Eureka. They have got most accurate solution 0.547 absolute error. Having our possibilities as students in mind, the result was satisfying. It means that that this model can predict the future trading price of

a bond with an average error of only $0.807. We supposed that neural networks and support vector machines would give better results than simple linear regression, but we were wrong.

4. CONCLUSION AND RECOMMENDATION

In this paper we tried to do data preparation and algorithm optimization in order to minimize the absolute mean error of predicted trade price for bonds. Not expected, but linear regression was better than support vector machines and neural networks. We have tried to implement almost every available technique for data preparation, but RapidMiner is not good enough in processing financial data. Despite that, the results were pretty acceptable. The recommendation for future work is to try different kind of validation and optimization in other suitable programs. Also, it is important to inspect every possible technique of data preparation – selection and optimization of attributes, reducing data in way to improve results.

REFERENCES

Bahrammirzaee, A. (2010). A comparative survey of artificial intelligence applications in finance: artificial neural networks, expert system and hybrid intelligent systems. *Neural Computing and Applications* .

Banica L., P. D. (2012). Financial Forecasting using Neural Networks. *International Journal of Advances in Management and Economics*.

Bramer, M. (2013). *Principles of Data Mining.* Springer.

Clements, M. F. (2004). Forecasting economic and financial time-series with non-linear models. *International Journal of Forecasting*, 169-183.

Deutsch, G. (2010). *RapidMiner from Rapid-I at CeBIT 2010.* 2010: Data Mining Blog.

Diebold, F. (2006). *Elements of Forecasting.* Cengage Learning.

Douglas C. Montgomery, E. A. (2013). *Introduction to Linear Regression Analysis.* Wiley.

Edward R. Jones, P. (2004). *An Introduction to Neural Networks.* Visual Numerics.

Elkan, C. (2013, May 28). Predictive analytics and data mining. Retrieved from cseweb.ucsd.edu.

Galit Shmueli, N. R. (2011). *Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner.* John Wiley & Sons.

Hadavandi E., G. A.-N. (2010). Developing a Time Series Model Based on Particle Swarm Optimization for Gold Price Forecasting. *Business Intelligence and Financial Engineering (BIFE)*, (pp. 337-340). Hong Kong.

Hamel, L. H. (2011). *Knowledge Discovery with Support Vector Machines.* John Wiley & Sons.

Harvey, C. (2014). Utilizing predictive regression modeling to forecast equity . *FINANCE 663: International Finance*.

Hui Li, J. S. (2012). Financial distress prediction using support vector machines: Ensemble vs. *Elseviere*.

I. Mierswa, M. W. (2006). Yale: Rapid prototyping for complex data mining tasks. *12th ACM SIGKDD international conference on Knowledge discovery and data mining* (pp. 935–940). ACM.

Investopedia. (2014, April 4). Retrieved from Investopedia: http://www.investopedia.com/terms/b/benchmarkbond.asp

Kaggle. (2014, March 15). Retrieved from Kaggle: http://www.kaggle.com/c/benchmark-bond-trade-price-challenge

Kantardzic, M. (2011). *Data Mining: Concepts, Models, Methods, and Algorithms.* Wiley.

Kyoung-jae Kim, H. A. (2012). Simultaneous optimization of artificial neural networks for financial forecasting. *Applied Intelligence* .

Markus Hofmann, R. K. (2013). *RapidMiner: Data Mining Use Cases and Business Analytics Applications.* CRC Press.

Meyer, D. (2012). *Support Vector Machines.* Wien: Technische Universit¨at Wien.

Murthy, I. (2010). *Data Mining- Statistics Applications: A Key to Managerial Decision Making.* Dehradun : indiastat.com.

North, M. (2012). *Data Mining for the Masses.* Global Text Project.

Omidi A., N. E. (2011). Forecasting stock prices using financial data mining and Neural Network. *International Conference on Computer Research and Development*, (pp. 242-246). Shanghai.

S. Saiglas, D. M. (2012). *Performance comparison of time series data using predictive techniques* .

Suknović Milija, D. B. (2010). *Poslovna inteligencija i sistemi za podršku odlučivanju.* Belgrade: FON.

Yuan, C. (2011). *Predicting S&P 500 Returns Using Support Vector Machines.* St. Louis: Center for Research in Economics and Strategies Fellowship.

STOCK MARKET TIME SERIES DATA ANALYSIS

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Abstract: *Financial market is very dynamic and unpredictable environment. It is becoming more and more complex since the amount of data is growing rapidly. These data besides increasing too fast, also change quickly. Algorithms of data mining and time series analysis can be used extensively in the field of finance to help financial forecasting. The ability to predict direction of stock price accurately is crucial for market dealers or investors to maximize their profits. The aim of my research is to compare approaches and different data mining techniques that were used in past, related to time series analysis in finance and to analyze each of them. In the end, I will draw a general conclusion and propose solution that I think is good enough in struggle with time series analysis in order to help better future forecasting and making more profitable business decisions.*

Keywords*: Time series analysis, Data mining, financial market, Support Vector Machine, forecasting*

1. INTRODUCTION

A financial market is a market in which people and entities can trade financial securities, commodities, and other fungible items of value at low transaction costs and at prices that reflect supply and demand. Securities include stocks and bonds, and commodities include precious metals or agricultural goods. Nowadays financial market is defined as a very unstable and unpredictable place, that is expand constantly according to Ou, P., & Wang, H. (2009). Data mining and time series analysis are very popular in the field of finance. They are often used as major factors of competitor's advantage. The key area of application of time series analysis is in forecasting. In Tsay, R. S. (2005) the author draw general conclusion that time series data provide useful information about the financial market generating the time series, such as: stock exchange indices, share prices, index values, trading volume, etc.

Time series analysis and data mining have a strong relationship. Data analysts have to be familiar with data mining techniques and algorithms so that they could do the financial tasks and understand financial problems and results properly. Researchers in the data mining field have focused their efforts on obtaining algorithms in order to deal with huge amounts of data (Kacprzyk, Janusz, Leonid Sheremetov, and Lotfi A. Zadeh, 2007). It is amazing how volume of information in the world has grown over the last two decades. In the 1990s data analysts worked with terabytes of data by using RDBMS (Relational database management system) and Data Warehouse and today they are faced in their work with exabytes of data. Classical example for this is data from the astronomy science, and especially images from earth and space telescopes (Wang, J. (Ed.), 2006). The main techniques used today to work with and store this large amount of data are no-sql and key/value paradigm. The amount of data grew 1000000% in last twenty years (1 exabyte = 1000000 terabytes (TB[1])). We can see the trend of constant and rapid growth of information and this is the thing that will definitely complicate work of data analysts in the future.

Data Mining has found increasing usage in financial areas that need to work and analyse large amounts of data to discover knowledge, patterns (Wang, K., Zhou, S., & Han, J, 2002) and future trends in business in order to improve its position on the financial market. In Marketos, G. D., Pediaditakis, K., Theodoridis, Y., & Theodoulidis, B. (2004) the authors concurred that data mining techniques and algorithms provide some capabilities required in cases where the evolution of the existing data need to be observed through the time dimension. For a stock market as a specific area of finance it is very important to use advantages of Data Mining approach. This will help and support stock market traders in their main function, by suggesting possible stock market trading transactions and better business decisions.

Financial forecasting is very popular among data scientists. In the literature several data mining approaches were developed for a financial forecasting. Zafra-Gómez, J. L., & Cortés-Romero, A. M. (2010) in their research propose using of CHAID (Chi-squared Automatic Interaction Detector) for analyzing the financial condition of local authorities in Spain. Support vector machine (SVM) and Neural Net are very popular tools for prediction. Wang, J., Xu, W., Zhang, X., Bao, Y., Pang, Y., & Wang, S. (2010) propose using of these techniques as a method for crude oil market analysis and forecasting. Kim, K. J. (2003) suggest using of support vector machine (SVM) as a promising method for the prediction of financial time series. Batyrshin, I. Z., & Sheremetov, L. B. (2008) in their work describe a new technique of time series analysis based on a

[1] 1 TB = 1000000000000 bytes = 10^{12} bytes

replacement of time series by the sequences of slopes of linear functions approximating time series in sliding windows by using MAP (Moving Approximation). For a stock market prediction authors like Bose, I., & Leung, A. (2009) suggest exertion of machine learning for problems of stock index movements, change of exchange rates, and variations of bond prices.

In this research I am exerting data mining techniques for the problem of data series analysis. I have used four different approaches (Neural net, Support vector machine, Naive Bayes and K-NN classification) at the same data set and compare results that I got in every individual analysis. I also worked with specific dataset from a period of Global Financial Crisis that hits stock market. I am trying to forecast and predict the future trends of daily closing values of the stock.

2. FINANCIAL TIME SERIES ANALYSIS

A time series is a sequence of data points, measured typically at successive points in time spaced at uniform time intervals. It can be used only in cases where the past is observable. Time series analysis is the analysis of data organized across units of time and it is widely used in financial institutions. According to Nanni, M., & Spinsanti, L. (2010) time series analysis is based on the extraction of trends and other behavioral models that are then matched to the current situation to forecast future values. Results that these analyses provide are highly important since they can lead to a large potential for analytical studies and they can be the key competitive advantage in business.

Bose, I., & Leung, A. (2009) defined financial time series as sequence of financial data obtained in a fixed period of time. The key area of application of time series analysis in finance is in forecasting. Movement of stocks in the financial market is a typical example of financial time series data. At the stock market the main question that time series analysis should provide answer is: What is the likely future price of this stock? The answer to this question will help stock market traders to decide whether they should buy or sell stock.
Financial time series data is a promising area of research. It is definitely that it is going to be more and more popular among data scientists. Future is something that we want to predict for centuries and this methodology is just one way in future forecasting related to financial area. Financial time series data is quite different from traditional data that data scientist handle every day. For this reason working with financial time series is a bit harder but if you know how to use data mining techniques, understand algorithms that you are using and know how to interpret the result of analysis it is a big benefit for you and your company.

3. STOCK MARKET

Stock market is the market in which shares of publicly held companies are issued and traded either through exchanges or over-the-counter markets. Also known as the equity market, the stock market is one of the most vital components of a free-market economy, as it provides companies with access to capital in exchange for giving investors a slice of ownership in the company.

There are many factors that play significant role at the stock market. Each stock is not only characterized by its price but also by many others variables. All those variables are not independent; they are related to one another. In the analysis we have to check relationship between them, not only to do individual research. The main variables that can be identified at the stock market according to Marketos, G. D., Pediaditakis, K., Theodoridis, Y., & Theodoulidis, B. (2004) are shown in the table below.

Table 1: Stock variables

Variable	Description
Price	Current price of a stock
Opening price	Opening price of a stock for a specific day
Closing price	Closing price of a stock for a specific trading day
Volume	Stock transactions volume(buy/sell)
Change	Opening and closing stock value difference
Change (%)	Percentile Opening and closing stock value difference
Maximum price	Maximum stock price within a specified time interval (day, month etc.)
Minimum price	Minimum stock price within a specified time interval (day, month etc.)
Adjusted Closing Price	A stock's closing price on any given day of trading that has been amended to include any distributions and corporate actions that occurred at any time prior to the next day's open

Many researches in the field of finance including Marketos, G. D., Pediaditakis, K., Theodoridis, Y., & Theodoulidis, B. (2004) and Taylor, S. J. (2007) showed in their works that there are some factors that have big influence in the price of the stock. These factors are usual in everyday business with stocks and we could identify them as following:

Table 2: Possible stock price influence factors

Influence Factor	Description
Volume	How many dealings are taking place
Business Sector	The sector in which a stock belongs
Historical Behaviour	Fluctuation of a stock over time
Rumours	There is a rule suggesting to "buy on rumors sell on news" so that may cause some unpredictable behaviour
Book (Net Asset) Value	The accounting value of a company
Stock Earnings	Percentile difference of the stock price value over a period of time
Financial position of a company	The financial status of a company
Uncertainty	Are there any unpredictable factors?

All the above mentioned factors are proof that time series analysis and forecasting at the stock market are very complex.

4. PREDICTION OF STOCK MARKET

Stock market prediction is the attempt to predict and determine the future value of a stock traded at the financial market. The successful prediction of a stock's future price could yield significant profit.

4.1 Data

The dataset that I used for this research is NASDAQ[2] prices from the January 1, 2011 till the 15 April, 2014. I also worked with S&P 500 (^GSPC) [3]dataset that contains data from the stock market at the period of Global Economic Crisis, period from 2007-2008.

Table 3: A part of data set that i have used for this research

Date	Open	High	Low	Close	Volume	Adj Close
4/14/2014	18.01	18.13	17.72	17.82	72500	17.82
4/11/2014	17.92	18.03	17.72	17.76	51400	17.76
4/10/2014	18.36	18.44	18	18.02	78600	18.02
4/9/2014	17.84	18.22	17.84	18.21	51800	18.21
4/8/2014	18.1	18.12	17.6	17.8	131000	17.8
4/7/2014	18.06	18.06	17.8	17.99	91900	17.6
4/4/2014	18.71	18.71	17.97	18.01	137100	18.01

4.2 Experimental setup

In this research several regression algorithms are used:

Support vector machine (SVM) – this algorithm can be used for both regression and classification and provides a fast algorithm and good results for many learning tasks. It takes a set of input data and predicts, for each given input, which of the two possible classes comprises the input, making the SVM a non-probabilistic binary linear classifier. An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible.

[2] http://finance.yahoo.com/q/hp?s=QQQX+Historical+Prices
[3] http://finance.yahoo.com/q/hp?s=^GSPC+Historical+Prices

Neural Net (NN) - an artificial neural network (ANN), usually called neural network (NN) is a mathematical model or computational model that is inspired by the structure and functional aspects of biological neural networks. A neural network consists of an interconnected group of artificial neurons, and it processes information using a connectionist approach to computation (the central connectionist principle is that mental phenomena can be described by interconnected networks of simple and often uniform units). In most cases an NN is an adaptive system that changes its structure based on external or internal information that flows through the network during the learning phase. Modern neural networks are usually used to model complex relationships between inputs and outputs or to find patterns in data.

K-nearest neighbor (k-NN) – this algorithm is based on learning by analogy, that is, by comparing a given test example with training examples that are similar to it and it is one of the simplest of all machine learning algorithms.

Naïve Bayes - a Naive Bayes classifier is a simple probabilistic classifier based on applying Bayes' theorem (from Bayesian statistics) with strong (naive) independence assumptions. According to Congdon, P. (2003) the advantage of the Naive Bayes classifier is that it only requires a small amount of training data to estimate the means and variances of the variables necessary for classification.

In this experiment the time series model is created by using already mentioned algorithms and time series operators. The model applies algorithm on training data which are uploaded from data set and try to forecast the value of attribute that we have already marked as output. That output is something that we want to predict and it is called label. In this experiment label attribute is Close (daily closing price of a stock). The parameter series representation defines how the series data is represented. In this experiment encode series by examples approach is used in which the series index variable (e.g. time) is encoded by the examples where each example encodes the value vector for a new time point. . For this model it is also important to decide how many days ahead we want to do forecasting. In this research it is decided to forecast next day closing price and for this it was used time series parameter horizon (value of this parameter was set to 1). Step size is set to 1 and it means that each row of input data was processed. Another very important operator that has been used in this experiment is windowing. This operator allows work with multivariate value series data and that was something that is needed since data set was made of 7 attributes. It also transforms a given example set containing series data into a new example set containing single valued examples. For this purpose, windows with a specified window and step size are moved across the series and the attribute value lying horizon values after the window end is used as label which should be predicted.

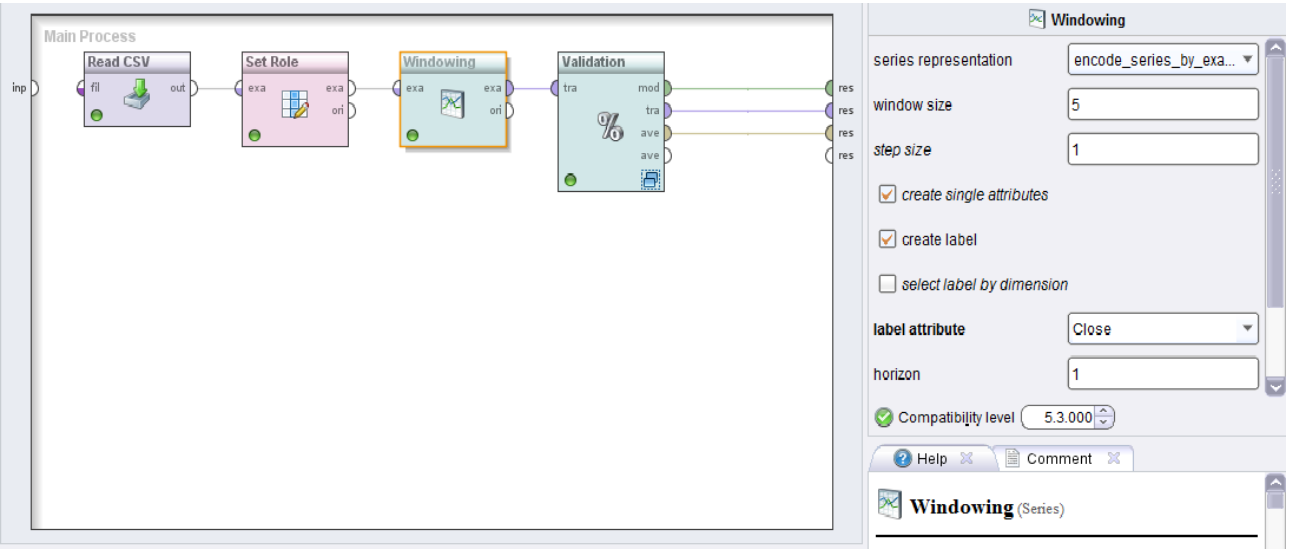

Figure 1: A part of experiment and example of using windowing operator

4.3 Evaluation and result

The results from previously described experiment are showed in table 4.

Table 4: Summary result of prediction performances for NASDAQ data set

Algorithms	Accuracy	Deviation	Rank
SVM	0.744	0.22	1
Neural Net	0.68	0.243	2
K -NN	0.533	0.242	3
Naive Bayes	0.455	0.295	4

The Figure 1 shows that closing price of stock is something that changes very quickly and unpredictably. In 2011 there was a trend that these prices extremely go up – down, but in 2013 there was a good period of time when closing prices were only growing. This is another indicator how hard is working with financial time series and how difficult is to create patterns for stock market.

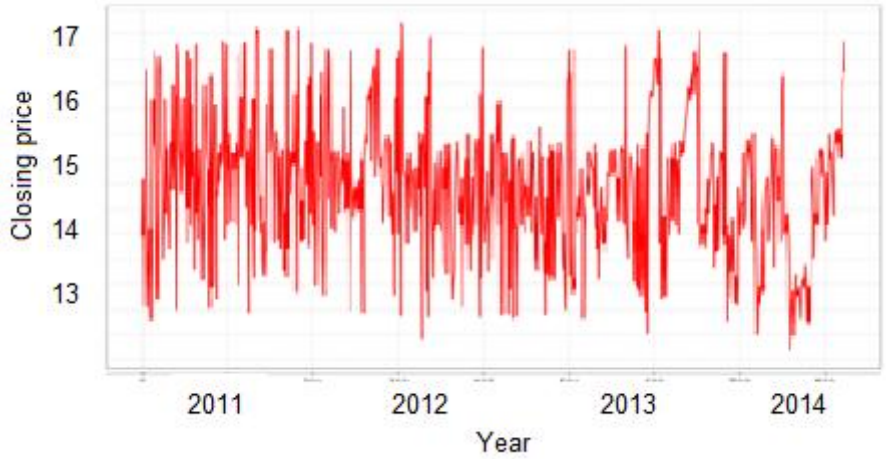

Figure 2: Daily closing prices of NASDAQ Stock Market

The result that I got while I was working with S&P 500 (^GSPC) data set were not so good. Even pre-processing data and doing parameter optimization could not help in increasing my model performance. After complex analysis I have discovered that the reason for this lies in the fact that this data set is from the period when Global economic crisis hits whole financial market and also stock market as a part of it.

5. CONCLUSION

This paper presents results of four different techniques of data mining to forecast movement direction of daily closing price of stocks from NASDAQ stock market. Prediction rate of these models vary from 45% to 75%. Support Vector Machine (SVM) and Neural Net outperform other two models since their algorithms guarantee to efficiently obtain global optimal solution which is unique. Other models may be reliable for other markets, but in this case they did not show satisfactory result. SVM and Neural Net are recommended for forecasters of stock prices and the better model, SVM, is more preferred.

Future work could include modelling the same problem by combining these approaches with other data mining techniques (e.g. fuzzy logic). The upwards/ downward tendencies can be considered as event types and be combined with others (e.g. Central Bank announcements). For stock market dealers it is not only important to know whether stock price will go up or down, but also how much will be that change. The key thing in working with stocks is to predict trends on time. The aim is not to buy cheap stocks, but these that have an upward tendency. Therefore, it will be good to combine all different approaches into the one solution that will help all participants at the stock market in their everyday work and provide them valuable information about future tendencies and possible results.

REFERENCES

Batyrshin, I. Z., & Sheremetov, L. B. (2008). Perception-based approach to time series data mining. *Applied Soft Computing*, *8*(3), 1211-1221.

Bose, I., & Leung, A. (2009). Financial Time Series Data Mining.

Congdon, P. (2003). *Applied bayesian modelling*. John Wiley & Sons.

Kacprzyk, Janusz, Leonid Sheremetov, and Lotfi A. Zadeh, eds. *Perception-based Data Mining and Decision Making in Economics and Finance*. Vol. 36. Springer, 2007.

Kim, K. J. (2003). Financial time series forecasting using support vector machines. *Neurocomputing*, *55*(1), 307-319.

Marketos, G. D., Pediaditakis, K., Theodoridis, Y., & Theodoulidis, B. (2004). *Intelligent stock market assistant using temporal data mining*. University of Manchester.

Nanni, M., & Spinsanti, L. (2010). Forecast Analysis for Sales in Large-Scale Retail Trade. *Data Mining in Public and Private Sectors: Organizational and Government Applications*, 219.

Ou, P., & Wang, H. (2009). Prediction of stock market index movement by ten data mining techniques.

Modern Applied Science, *3*(12), P28.

Taylor, S. J. (2007). Modelling financial time series.

Tsay, R. S. (2005). *Analysis of financial time series* (Vol. 543). John Wiley & Sons.

Wang, J., Xu, W., Zhang, X., Bao, Y., Pang, Y., & Wang, S. (2010). Data Mining Methods for Crude Oil Market Analysis and Forecast. *Data Mining in Public and Private Sectors: Organizational and Government Applications*, *184*.

Wang, J. (Ed.). (2006). *Encyclopedia of data warehousing and mining*. IGI Global.

Wang, K., Zhou, S., & Han, J. (2002). Profit mining: From patterns to actions. In *Advances in Database Technology—EDBT 2002* (pp. 70-87). Springer Berlin Heidelberg.

Zafra-Gómez, J. L., & Cortés-Romero, A. M. (2010). Measuring the Financial Crisis in Local Governments through Data Mining. *Data Mining in Public and Private Sectors: Organizational and Government Applications*, 21.

PREDICTING BANKRUPTCY OF COMPANIES USING NEURAL NETWORKS AND REGRESSION MODELS

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Abstract: *This paper provides a detailed analysis and comparison of different methods used in order to forecast possible bankruptcy of companies within the Republic of Serbia in the next year. We collected data for the 52 different companies in our country and calculated financial ratios based on Altman's Z-score model for each company in order to use these ratios as inputs in further analysis. Firstly, we used neural networks for prediction and tested how successful they are when it comes to this kind of problem. We applied pattern recognition and probabilistic neural network. Afterwards, we used regression analysis and tried to find most appropriate one for our data set. We used linear and logit regression models with different variants of dependent and independent variables. Finally, we mutually compared the results of each of the proposed models used for forecast of companies' bankruptcy*.

Keywords: *Altman's Z–score, Pattern recognition, Probabilistic neural network, Linear regression, Logistic regression*

1. INTRODUCTION

During the last decade considerable effort has been invested in the complex and demanding analyses of companies financial reports, in order to define more certain business strategies in the future. More accurate determination of company"s future market position is attempted by analyzing and studying the financial data of the company using many different kinds of analyses.

Successful management of the company"s business is always a very challenging task because of the frequent changes and volatility in political, social, financial and economic domain. Every business decision that is made brings both financial and business risks. There is always a possibility to have really bad business results, due to poor business decisions, that sometimes could even lead to the bankruptcy of the company. That needs to be prevented.

In this study we demonstrated different methods and models which are capable of forecasting the probability that company might bankrupt in the future. Every prediction of this kind aims to improve the company"s business performance.

So far, in literature and previous studies many mathematical models and techniques had been used to provide probability for the company"s departure into bankruptcy. Among the advanced techniques of data analysis, which are suitable for forecasting the probability of bankruptcy, it is possible to single out regression models and artificial neural networks. Regression models are very often used to determine correlation between several factors influencing the observed phenomena. On the other hand, neural networks, compared to multivariate regression techniques, have a completely different approach in solving this kind of problem. So far, the neural networks were successfully used in a variety of financial areas (McNelis 2005), such as the determination of credit risk, forecasting of stocks, pricing actions on a given day, the prediction of success in the financial market, etc. Our goal is to compare these two approaches and to determine which one is better in forecasting probability of company"s bankruptcy.

In order to solve the problem of bankruptcy prediction using neural network and regression we selected software Matlab 2012.

2. REVIEW OF COLLECTED DATA

For the purposes of this study, data from the 52 companies registered in the Republic of Serbia were collected. Within selected companies there are 26 companies which are still active and 26 of them went bankrupt or are in the process of bankruptcy. All data are taken from official website of Agency for Business Registers (2014), because it is mandatory to have data from regular annual financial statements. Among these reports there are balance sheet, income statement and statistical annex for a given year. All data

necessary to calculate the indicators included in the model of financial statements are related to the period of two years before the bankruptcy proceedings started.

3. ALTMAN'S Z-SCORE MODEL

One of the most cited and most used model for predicting bankruptcy of enterprises is E. I. Altman's model. In his work, Edward I. Altman (1968) introduced the Z-score, which is a linear combination of the five selected financial ratios. Presented statistical model uses accounting information in order to predict the probability with which one company will go bankrupt in next year or two. All the necessary data can be obtained from financial reports.

It was necessary to determine which financial ratios can show possibility of bankruptcy most precisely, as well as a weight for each selected indicator. Edward I. Altman used multivariate discriminate analysis for model formulation, which is not that popular such as regression analysis in this area, but it was very successful at the end. In his research, E. I. Altman used data for 66 companies from which one half got bankrupt and the other half not. From 22 financial indicators used by multivariate discriminate analysis he chose 5. Using these 5 indicators he formulated next Z score:

$$Z = 1{,}2T_1 + 1{,}4\,T_2 + 3{,}3T_3 + 0{,}6T_4 + 0{,}999T_5 \qquad (1)$$

Where:
T_1 = Working Capital / Total Assets;
T_2 = Retained Earnings / Total Assets;
T_3 = EBIT (Earnings before Interest and Taxes) / Total assets
T_4 = Market Value of Equity / Book Value of Total Liabilities
T_5 = Sales / Total Assets

The original work of Edward I. Altman referred to public manufacturing companies with total assets of more than a million dollars. Later on, the field of application of Z-score was significantly extended to other types of companies. The value of obtained Z-score is interpreted differently depending on the type of the company for which is calculated. In 2002 Altman introduced new versions of Z-score model, Z_1 and Z_2. They differ from previous one in that they are applicable both in public and private manufacturing companies, but also in non-manufacturing and service providing companies. Also, when calculating quotient T4 instead of Market Value of Equity, he used Book Value of Equity. Model for private manufacturing is as follows:

$$Z_1 = 0{,}717T_1 + 0{,}847\,T_2 + 3{,}107T_3 + 0{,}42T_4 + 0{,}998T_5 \qquad (2)$$

The weights of coefficient are different from the first presented model. It may be noted that the third and fifth coefficient are minimally changed which means that their influence remained almost the same.

On the other hand, for non-manufacturing companies and emerging markets the model as follows is given:

$$Z_2 = 6{,}56T_1 + 3{,}26\,T_2 + 6{,}72T_3 + 1{,}05T_4 \qquad (3)$$

A characteristic feature of this model is that doesn't take into account ratio of sales and total assets, i.e. T5, just because it comes to non-manufacturing companies. Therefore, the ratio of net working capital and total assets has dramatically greater impact than in previous models. Also, the quotient of EBIT and total assets has coefficient more than twice greater compared to the two previous models.

Seeking for the critical value that would represent the border between healthy companies and those who are in crisis, Altman has concluded that the value of 2,675 of Z-score is dividing companies into two groups on the best possible way.

In his further work, after detailed analysis, Altman is pointing out that for public manufacturing companies original model also applies, and if the calculated value of Z-score is less than 1.81, probability that a given company will go bankrupt is very high. If Z-score takes value from interval 1.81-2.99, then given company is in so-called "grey" zone and probability for bankruptcy is 50%. Finally, if the value of Z-score is greater than or equal to 2.99, the company is in safe zone and has very little chance of going bankrupt within year or two.

On the other hand, for the private manufacturing companies the boundaries are somewhat lower. For private manufacturing companies grey zone is between 1.23 and 2.9 and for non-manufacturing is 1.1-3.75.

After research it was found that the performance of bankruptcy predictions using the first presented Altman's Z-score is about 72%. In a series of tests and studies in next 30 years it has been established, on larger sample, that the performance of bankruptcy predictions within one year is actually between 80% and 90%,

with an error of the second level of 15% - 20%. Error of second level refers to the classification of the companies that didn't bankrupt in bankruptcy group.

The aim of Z-score model is not to predict when exactly the company will bankrupt, but to point out certain similarities with companies that have already bankrupted. The value of Z-score should be used as a warning and indicator of potential instability of the company.

4. ANALYSIS OF OBTAINED RESULTS FOR ALTMAN'S Z-SCORE MODEL

Table 1: Statistical successfulness of Z-score model

Model	Bankrupt and classificated into B	Not bankrupt and classificated into A	Bankrupt and classificated into A	Not bankrupt and classificated into B	Grey zone	
					Bankrupt	Not bankrupt
Z-score	Z<1,81 **24 (92%)**	Z>2,99 **18 (69%)**	**0**	**2 (7%)**	**2 (7%)**	**6 (23%)**
Z_1-score	Z_1<1,23 **21 (81%)**	Z_1<2,9 **6 (23%)**	**0**	**2 (7%)**	**5 (19%)**	**18 (69%)**

(A is a group of active and B is group of bankrupted companies)

Z-score model correctly classified 81% of companies in active or bankrupt group. From analyzed data may be noted that no company with Z-score greater than 2.99% went bankrupt in next year.
The revised Z_1-score model has been adjusted to the today's market at the beginning of this century in the way that weights of the parameters used for bankruptcy predictions have been changed. Each of these models has been defined in the United States. As seen in previous table, Z_1-score model didn't give expected results for our market. It can be noticed that great difference between markets exists and it's almost impossible to define universal model that would fit each market. Z_1-score classified barely 21% of successful companies in correct group of active manufacturing subjects. Also, model classified even 69% of companies in grey zone, even though they were doing business successfully. From this we may conclude that our market isn't on high level of development such as global market, therefore it is not mature enough for analysis using newer Z_1-score model. The older Z-score model has proven as much more precise. Considering that our data set contains only manufacturing companies, Z_2-score model is not applicable at the moment.

5. BASIC CONCEPT OF NEURAL NETWORKS

Neural networks are artificial systems made to recognize the rules that connect complex data in order to formalize existing correlations between given input and output data. Neural networks can even recognize laws that are, due to their complexity, hard to be seen by humans. Neural networks are characterized by parallel and fast information processing and large number of elements namely neurons of networks.

The structure of neural network

The structure of neural network shows the way in which the neurons of a network are linked together. In most of topology one can see the input, output and hidden layer neurons. Neural networks differ by how many hidden layers they possess, but it does not need to have a hidden layer of neurons.

Neural networks training

Before using neural networks for problem solving, they need to be prepared, i.e. trained. Training of neural networks is a process of passing appropriate data set through the network. The values obtained at the output are to be compared with expected values. Weights of connections between neurons are to be modified in order to reduce the difference of actual and desired outputs. This process is based on the observed differences.

The network learns the received data until it is able to provide an output that is in accordance with the set criteria (the number of training epochs or error tolerance).

Application of neural networks

In this study we used popular Pattern recognition that is based on feedforward neural network and Backpropagation learning method as well as Probabilistic neural network (PNN). PNN is multilayered feedforward network, which is driven from the Bayesian network, probabilistic directed acyclic graphical model, and Kernel Fisher discriminate analysis.

PNN have three layers. They are often used for classification problems, because of their ability to map inputs to outputs, even if their mutual relation is hard to define. Also, probabilistic neural networks train really fast, because training is performed in one pass of each training instance, rather than several as with recurrent networks.

Architecture of probabilistic neural network is composed of input, radial basis, competitive and output layer. Radial basis layer record the difference between input vector and training vector. In this way, the vector, whose elements show how close inputs to the training inputs are, is obtained. The nest layer crates the sum of these contributions, for each category, and creates new vector of probabilities that describes the belonging of each instance to specific group. At the end, complete transfer function returns 1 for belonging class and 0 for other classes.

Feedforward neural network - Multilayer perceptron network for pattern recognition usually consists of three layers, input, hidden and output, but it depends of the complexity of the problem. Sometime there is a need for more complex network, with more than one hidden layer. Numbers of neurons in input and output layer are determined by the concrete data and its structure. These numbers are easy to define for each classification problem. On the other hand, number of neurons in hidden layer, depends of complexity of problem. Even though, in literature, there are many different opinions how to compute number of hidden neurons, there is no generally accepted formula.

Pattern recognition is based on backpropagation supervised learning algorithm. Backpropagation is really successful in classification problems (Chaudhari, 2010) and it is the most widely used method for training neural networks. Through algorithm learning minimum error function is defined, by using the method of gradient descent. Difference between target values and resulting output is computed is sent back trough the network in order to adjust the weights of each connection in network. Training network is based on minimization of this difference through iterative process.

6. ANALYSIS OF OBTAINED RESULTS FOR NEURAL NETWORKS

In order to predict probability of company bankruptcy we created two neural networks: multilayer perceptron and PNN. Inputs in both of neural network are financial ratios from Altman's Z model, and the output is class in which company belongs. Class indicates weather that company is active or bankrupt. Thus number of neurons in output layer is two and in input layer is five.

As we already said, data set consists of 52 companies which are registered in Serbia. In collected data there are 26 active firms and 26 bankrupt. In our case, we have five financial ratios in Altman's Z model therefore there are five neurons in input layer. On the other side, in output layer there is two neurons, because we are trying to classify each company in group of active or bankrupt firms. For hidden layer, we decided to use 10 neurons in only one layer.

Pattern recognition NN

First, we created pattern recognition neural network which used *Scaled Conjugate Gradient* for training. Data set was randomly divided in three groups: one for training, one for verification and one for testing network's performance. Our goal was to create new model that could better establish the correlation of the Altman's five financial ratios.

After training pattern recognition neural network for ten times, we got average training error of 0,03172. For computing training error we used method of least squared error. Neural network was trained so it could predict probability that company is going to bankrupt, for new data. Neural network successfully predicted bankruptcy for **82%** of new companies, with variance of **0.78**.

When we look closely to results we can see that pattern recognition mainly made mistake in classifying company's that are in Altman's gray zone. From this we can conclude that pattern recognition gave the similar significance to financial ration as Altman's Z score.

Probabilistic neural network

Second neural network that we created was probabilistic neural network. Average successfulness after 10 trainings and after usage of network for predictions under new data is **90.7%**, with variance is **0.55**.
Interesting comparisons:

Table 2: Examples of instances classification

T_1	T_2	T_3	T_4	T_5	Z score	Group	PNN
0,333229	0,341265	0,081139	0,659928	0,576239	2,11702	2	1
0,275887	0,170856	0,166042	0,296366	1,263757	2,558514	2	2
-0,03522	0,10808	0,128135	0,268307	1,334494	2,026038	2	2

In column *Group* there is 1 if company got bankrupt and 2 if company is still active. Column PNN shows group in which company was classified by neural network. It may be noticed that for the first company PPN is wrong and Z-score classified it in grey zone. PNN classified next two companies correctly, even though Z-score said they are in grey zone.

7. INTRODUCTION TO LINEAR REGRESSION

Regression analysis is statistical tool used for investigation of relationships between variables. Usually it is used to ascertain the causal effect of one variable on another. In this kind of research investigators often asset statistical significance of the estimated relationships which is actually the degree of confidence that estimated relationship is close to real relationship.

Regression is data mining function that is used for predictions.

Linear regression is one of the simplest regression models. It attempts to model relationship between two variables (dependent and independent) by fitting a linear equation to observed data. Before working with this regression, it is important to determine if certain significant association between two variables.
Linear regression has this form of equation: ***Y = a + bX,*** *where* **X** is independent (or explanatory) variable and **Y** is dependent variable. The slope of the line is **b**, and **a** is intercept (a=Y when X=0)

Logistic regression (logit regression) is a type of probabilistic statistical classification model where **X** (independent variable) can be numerical or categorical and Y is often coded as 0 („doesn"t belong to a group") or 1 („belong to a group"). Logistic model is based on linear relationship between natural logarithm (**ln**) of the odds of an event and numerical independent variable.
Logistic regression has the equation:

$$L = ln(o) = ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X \quad (4)$$

Where Y is binary and represents the event of interest (response), coded as 0/1 for failure/success,
p is the proportion of successes,
o is the odds of the event,
L is the *ln*(odds of event),
X is the independent variable,
β_1 and β_2 are the Y-intercept and the slope, respectively, and
Ɛ is the random error.

8. ANALYSIS OF OBTAINED RESULTS FOR REGRESSION ANALYSIS

Linear regression

We decided to use **linear regression** and to test how successful it is when it comes to comparison with neural networks. In our first iteration we set financial ratios as independent variables:
T_1 = Working Capital / Total Assets;
T_2 = Retained Earnings / Total Assets;
T_3 = EBIT (Earnings before Interest and Taxes) / Total assets
T_4 = Market Value of Equity / Book Value of Total Liabilities
T_5 = Sales / Total Assets.

Altman"s Z-score was set as dependent variable. Furthermore, multidimensional surface was created and based on that surface each instance was compared in sense of: is the result of function in one point under or below surface. Every instance under surface represents company that didn"t go bankrupt. Other way around, every instance below surface went bankrupt. Thus we got results as follows: 19 instances were classified in wrong groups (both bankrupt in active, and active in bankrupt). That means our linear regression was wrong in 36,54% of cases, and successful in 63,46%.

In further detailed analysis of results and comparison between regression results and Z-score we observed interesting facts:

- From 19 instances which were wrongly classified, Z-score gave correct results in 12 cases, which is around 63%.
- Only one instance we got wrong result both for Z-score and linear regression.
- In 6 cases where linear regression was wrong, Z-score classified in grey zone. Interesting observation here is that we have more cases when Z-score was sure will it go bankrupt or not while regression was wrong (12 cases), than when Z-score was in grey zone and regression was wrong (6 cases). Even though Z-score is more flexible and conservative because of grey zone existence, in this certain case, Z-score was more sure and showed better results alone than in combination with linear regression.
- On the other hand, from two cases when Z-score was wrong, we got improvement with linear regression in one case, which represents 50%.
- Whenever Z-score classified instance in grey zone and it was active in real, regression model was wrong with classifying it in bankrupt group. Other way around, whenever Z-score classified instance in grey zone and it was bankrupt in real, regression model classified it right, i.e. in bankrupt group. Therefore, whenever Z-score classifies an instance in grey zone, regression will classify it in bankrupt group.

In our **second iteration** we used the same input parameters but we didn"t use Altman"s Z-score as output parameter. Instead, we used concrete binary values for bankrupt (1) and active group (0) as output parameter. In this case our linear regression gave better results, and it was successful in 73% of cases, which is better than in first iteration.

In this case we noticed further facts:

- Wrong classifications are all the same. All 14 wrong cases have to be in bankrupt group, but our model classified them in active group.
- There was no mistake when it comes to group of bankrupt companies. But also, it is not the case that all really bankrupt companies are wrongly classified, just 14 of them.
- Using this model we can know for sure that all companies which were classified in bankrupt group will go bankrupt in next year. But we cannot be sure if all companies classified in active group will remain solvent in next year. We can claim that in around 63% of cases.
- If we compare all wrongly classified instances by regression with Z-score, we can conclude that in 86% Altman classified these instances in correct bankrupt group and 14% in grey zone. Therefore, after using regression model we should consider Altman"s Z-score and if it shows possibility of bankrupt, it may be very strong signal for caution.

As a **third iteration** for linear regression, we tried to adjust Altman"s Z-score to financial data for companies that are doing their business in Republic of Serbia. We kept financial ratios that Altman determined as the most important for bankruptcy predictions, but we changed weights of these ratios in our model.

Now, our regression has input parameters as follows: as independent variable we set financial ratios, and dependent variable is group to which companies belong (active, or bankrupt). Considering that we received new coefficients of linear combination for financial ratios from linear regression, this result is observed as a new model for bankruptcy prediction. The results of this model are interpreted as Altman"s Z-score model. It has been noticed that new value of Z-score has lower volatility than the real Z-score. Therefore, intervals that Altman defined in his work are not adequate now. If the intervals remain the same, all bankrupt companies will be well classified in appropriate group. However, if we look into active companies, we can see that new model doesn"t recognize them as active, but in grey zone or in group of bankrupt companies. Based on analysis of given results we concluded that intervals defined for Altman"s Z-score model are not appropriate now for new model given by linear regression. Empirically we defined new lowest limit as 1,11 and the highest limit as 1,41 for grey zone. Now we used these new intervals and based on them we will classify companies which will go bankrupt or will continue to operate successfully. New grey zone interval is now significantly smaller, but that was expected since we already mentioned that volatility of new Z-score is lower.

In this way, we got the model that should be better suited to companies in Serbian market. This score successfully predicted bankruptcy for 81% of companies, while on the other hand for active companies it predicted correctly that will not go bankrupt in 83% of cases. In grey zone there are now 10% of instances which is better than in first case when we had 15% in original Altman"s model. Updated Altman"s model is slightly better than the first, which is not defined for our market.

Logit regression

In **logit type of regression** analysis we used the same parameters as inputs, which are financial ratios. As output parameter in **first iteration** we used 1 for bankrupt group and 2 for active group. In this way, our logit regression classified well 79% of cases.

After deeper analysis of results, we have noticed:

- The same situation as for second iteration in linear regression happened. Actually, all wrongly classified instances are from group of bankrupt and this method classified them in group of active. Unlike linear regression (second iteration) we now have lower number of incorrectly classified which shows that logit regression is better model for our data set.
- If we compare Z-score results first we may notice that logit regression was successful in the cases where Z-score was incorrect. If we consider all grey zone instances from Z-score classification, in 75% our logit regression gave more precise and correct results. Therefore, whenever our Z-score classifies one instance in grey zone, we can consider logit regression to be surer what will happen when it comes to the solvency in next year.

Important information here is that we couldn't forward Altman's Z-score results as dependent variable because Z-score can have negative value, but logit regression always expects positive values. When Z-score gives this negative parameter that means company has really bad business results and soon bankruptcy can be expected.

In **second iteration** we tried to improve results so we involved probability of belonging to a group. We forwarded financial ratios as independent variable and belonging groups as dependent variable. After calling logit function we got 6 coefficients which we forwarded to a general form of logit function. Then we calculated value of function in one point and this result represents probability of belonging to one of the groups. Since we got result between 0 and 1 of a function in one point, we had somehow to define to which group each instance belongs. Therefore, we set a border of 0.5 in order to classify each instance. The truth is that border we set is really rough and we are losing information how close one instance to another group, but this is was only one logical way to define groups. In this case, our model was successful in 100% of cases.

9. COMPARISON OF USED MODELS AND ANALYSIS

In the table below we summarized all results and it can be noticed which method gave the best results.

Table 3: Summarized results for all methods

Name	Successfulness
Linear regression – Altman	63,46%
Linear regression – groups	73%
Linear regression – adjusted Z-score	82,69%
Logit regression -groups	79%
Logit regression – probability	100%
Pattern recognition NN	82%
Probabilistic NN	90.7%

We can see once again that Logit regression with probability was successful in 100% of cases. To be reminded, we set 0.5 as border in this iteration and, as we mentioned, this is really rough boundary. That's the reason we cannot be completely confident that in each case in future this method will give correct results. On the other hand, probabilistic neural network stands out as very good in bankruptcy predictions with successfulness result above 90%. This, now, means that probabilistic neural network can classify next company in future in correct group if appropriate input parameters are submitted. Therefore, everyone has to be sure if correct inputs are given to the network. Only in this way we can expect correct results.

10. CONCLUSION

As we said in previous chapter, probabilistic neural network was the most successful considering all factors and facts. Now we can use our network to classify every company with accuracy of 90.7% which can be very good indicator for business operations in next year for each company.

After researching neural networks and comparing them with regression analysis, we drew the following conclusions:

- Neural networks have possibility to modify themselves and easily adapt to different kind of problems. That's why they can learn fast and give accurate results.

- Neural networks can implicitly detect complex non-linear relationships between independent and dependent variables, which is for regression a bit harder. If a complex non-linear relationship exits, neural network model will adjust weights by itself in order to reflect these nonlinearities. Therefore, it is empirically proved that neural networks may provide tighter model than conventional regression (Tu, 1996)

Even though neural networks can model complex relationships and give pretty good results, still they are like black box. That"s why we cannot get an answer from neural network *why did one company go bankrupt?* or *why is still active*? These answers depend on various factors, such as management"s decisions, state of the market etc. That"s why it will never be possible to create perfect model which is successful in every single case. But, it is possible to seek for the best possible model, and for bankruptcy predictions of companies in Republic of Serbia this model is probabilistic neural network.
This research is based on small data set because of impossibility to gather more digital records in our market. For further analysis it is certain that data set has to be greater, but these results can give significant basis and can show good scientific directions for bankruptcy predicting.

REFERENCE

Altman, E.I. (1968). Financial Ratios, Discrimination Analysis and the Prediction of Corporate Bankruptcy, Journal of Finance, 23(4), 589-609.doi: 10.1111/j.1540-6261.1968.tb00843.x

Altman, E.I. (2002, May).Revisiting Credit Scoring Models in a Basel II Environment Prepared for Credit Rating: Methodologies, Rationale, and Default Risk, London Risk Books.

Chaudhari, J.C. (2010). Design of artificial back propagation neural network for drug pattern recognition, International Journal on Computer Science and Engineering (IJCSE). NCICT Special Edition, 1-6.

McNelis P.D. (2005). Neural networks in finance – Gaining predictive edge in the market, Burlington, MA01803, USA: Elsevier academic press.

Tu J.V. (1996). Advantages and Disadvantages of Using Artificial Neural Networks versus Logistic Regression for Predicting Medical Outcomes.J ClinEpidemid 49(11), 1225-1231. doi: 10.1016/S0895-4356(96)00002-9.

Agency for Business Registers (2014) Retrieved from: http://pretraga2.apr.gov.rs/ObjedinjenePretrage/Search/Search

METHODICAL PROBLEMS OF COORDINATING ATTITUDES OF THE SUBJECTS OF ORGANIZATIONS IN THE GROUP DECISION-MAKING PROCESS

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Abstract: *It is inconceivable that any organization could function properly, without agreed actions of its subjects. However, harmonizing opinions as important factor of group decision-making process, have not attracted sufficient attention in the contemporary literature. In this paper, we have identified, described and explained some of the possible methodological problems that arise in the process of harmonizing attitudes of the subjects of organizations in the group decision-making process.*

Keywords: *Decision-making process, group, coordination, organization, human resources management,*

1. INTRODUCTION

Making important decisions in the interest of the organization is not a simple product of thinking, the conclusion about what is the most beneficial for the organization at one time and long-term, what to do and how to do it at certain point... Specifically, in order to come to any conclusion about what represents the interest of the organization at some point, in order to make proper decisions, it is necessary to carry out the process of harmonization of the attitudes of important subjects of organization. One must not ignore the fact that the potential subjects - participants in the group decision-making process, can be bearers of various interests by themselves. Some interests are clearly internal, others external. In the process of finding the common interests of the group and making appropriate decisions, a lot of adjustments are required and they are taking place in various stages and phases.

2. DECISION MAKING AS AN IMPORTANT FACTOR IN MANAGING AN ORGANIZATION

If we try to find a common characteristic of all existing organizations, regardless of their type of activity, sectoral affiliation or business volume, we would undoubtedly come to the conclusion that an important part of their organization and functioning are primarily these subjects - people who form them. Irrespective of this fact, the personnel function in modern organizations is often unfairly overlooked, because the rapid technological development has put greater focus on the technical equipment and problems that arise from it. This trend is one of the main causes of the emergence of the crisis in the organization's operations and functioning.

People are the ones who manage the organization, make decisions and implement them. Management of each organization can be viewed as a complex process that involves several sub-processes, namely: planning, organizing, leading and controlling. Each of these sub-processes implies the adoption of a large number of decisions .

Randjić, Jokić and Lekić (2007) discuss that decision-making or decision-making process consider choosing between two or more alternatives (options) (p.81). But decision-making is not something that is done only by managers. Every individual in an organization is constantly involved in some form of decision-making while performing his tasks, as he is often in a position to select one or more options .

In this paper, we have especially focused on decision-making process in the domain of managers, concerning the planning, organization, management and control. In the planning process based on the environment analysis, directions of development are determined, objectives are positioned, and strategies are identified, selected and implemented. Decisions on organizational design and organizational structure are made in organizing. Management is conducted through implementation of a series of decisions that link motivation and communication with coordination (commands and instructions). Control involves continuous monitoring in order to determine deviations (errors), in order to take preventive and corrective actions.

Decisions that are dealing with the important issues of organization can be made individually or in the groups, depending on the number of people who take responsibility for decisions. This separating is conditioned by the situation that some decisions by its nature must be made by group, such as decisions on the adoption of key documents that define work rules of organization, such as statutes, regulations, or decisions on strategic ways of development and so on. While in individual decisions, one person makes a decision in accordance with the responsibilities and powers, in group decision-making there is a principle that the more people there is, the more they know, and at the same time, group decisions are opportunities for better understanding of the situation.

Regardless of whether decisions are taken individually or collectively, the ultimate goal is to make best decisions, that will lead organization to it's desired state. Therefore, in the process of decision-making, there is a task for management to contribute to a healthy organizational climate, to enable expression of positive potential of individuals, to channel potentials and resources and thus ensure high quality decisions.

3. CONCEPT AND IMPORTANCE OF A GROUP DECISION-MAKING

Contemporary environment impose complex issues to organizations, that need to be solved quickly. Organizations are forced to constantly adapt to the new requirements of the environment, changing markets and target groups. These conditions require the joint efforts of entities belonging to a particular organization, in order to devise the best solutions.

Jarić, Ćurčić and Jagodić (2009) point out "As more and more complex problems are appearing, interdisciplinary knowledge is required for their solving, but such knowledge is hardly to be possesed by an individual. Interdisciplinary knowledge can be found and achieved within the team" (p. 60). The need for the organization of teams and teamwork occurs at all levels, regardless of the organizational structure of the organization and hierarchical levels of decision-making. *Drucker (1996) discuss that development and expansion of the organization's activities, slightly overcome the power and capabilities of a single person in the decision-making process, and there appears a need for the establishment of the management team. Such teams are based on mutual understanding, and to achieve it, there is a lot of work to be done (p. 133).*

A prerequisite for achieving significant effect of teams that bring together actors of organization in the decision-making process is their positive acceptance by the leaders of the organization. These teams should not be considered as a threat to the authority of organization's management, but as an important factor of achieving the interests and goals of the organization. It is an indisputable fact, that the power of the team is greater than the sum of the powers of its members.

It is important to point out the differences between teams and groups. Each team represents a group, but each group is not a team. The main difference lies in the fact that the group work means the work of professionals who work in the organization and that their work is performed in accordance with the general laws of the organization, while the teamwork approach is used when you need to form a team of experts and solve a particular complex problem. Teamwork gives the opportunity for team members to be actors who are not employed by an organization that needs to solve particular problem, and usually when a solution is founded and task is completed, team would be disbanded.

Since we can consider that the objectives of group and team work are identical, namely that both increase the effectiveness and efficiency of common work, we have decided that in our paper we should use the concept of group decision making, which would also apply to decision-making entities in teamwork.

Both groups and teams make common group decisions in certain decision-making procedures. All decision-making procedures have their advantages and weaknesses and it is same for group decision making.

Identified advantages are the following:

- Overall knowledge of the group is greater than the knowledge of the individual, so there is a greater pool of knowledge and information that is focused on problem solving;
- It is possible to develop more alternative solutions for problems;
- Participation in decision-making increases the acceptance of the decision by the members of the group;
- For employees who participate in decision making, a need is developed to implement group made decisions.

Identified disadvantages are the following :

- The decision making process is much longer than in case of individual decision-making, and because of this sometimes in situations of crisis, group decision-making is not applicable;
- In case of disagreement, it is possible to hurt the feelings of the participants in the decision-making process;
- Bulk opinion does not mean that it is the best opinion;
- There is a risk of domination by one person or several of them, in which case opinions of other group members are not respected;
- There is a tendency for pressure in order to create agreement and consensus, and then there is a restraint of group members;
- Competition among group members becomes more important than the solution of particular problem, which leads to unnecessary backlash and sabotage of the process of adopting the decision;
- Also, there is a tendency of accepting the first solution that leads to consensus, without worrying about whether is that solution good enough or not.

All mentioned advantages and disadvantages of group decision making are showing us the importance of the process of harmonization of the attitudes of the subjects involved in the process of group decision making. Hence the need in our work to pay a special attention to methodological problems of harmonizing opinions of the subject - participants in group decision making.

4. TERM - ADJUSTMENT OF ATTITUDES

Adjustment is a social reality that can be seen in everyday life. It is a form of communication between two entities, where each of these two entities has its own attitude that differs in part or in whole of the the attitude of another entity. These attitudes may be different in form, content, relevance and orientation and can express perceptions, facts, judgments, conclusions, forecasts, expectations and so on.

Rečnik srpskog književnog jezika (1967) defines that "To agree means to bring one another into compliance. Agree means even unify and lead in the match (p. 223)". In everyday practice, there is a feature to equate harmonization and alignment . Although they appear similar, and often the explained one to another and vice versa in the literature, these terms can differ significantly. The difference between the concepts of alignment and harmonization, in terms of methodology, is reflected in the fact that reconciliation is only possible first phase alignment, and not his synonym.

We will focus our work on the process of adjusting attitudes of subjects - participants in group decision-making, that can occur in the following ways:

- polemics, if the views are opposed,and the adjustment of attitudes are made through proving and refuting certain attitudes of entities;
- the use of premises and knowledge, if subjects of adjustment act with the intent to agree, they point out common positions and soothe opposite.

5. AIMS OF ADJUSTMENT OF ATTITUDES IN PROCESS OF FINDING THE INTERESTS OF ORGANIZATIONS

Kukoleča (1972) discuss that each aim is a reasonable definition of a desirable, probably possible situation. The existence of the target is a prerequisite for the emergence of a new organizational system, and the individual and the society over the resulting system achieve articulated goal. Hence, certain principles are based on the characteristics and importance of each specific goal, which should be adapted to the structure, and functioning of the particular system, to achieve concrete goal (p. 221).

Mala politička enciklopedija (1966) points out that "In an embodiment of the process and goals of an organization there are two key moments, namely finding interests of the organization and its implementation. The term "interest" comes from the Latin word interesum, interesse, which means participating in something, be interested" (p. 390).

This is confirmed by the fact that the interest must:

- identify;

- classify;
- select;
- be articulated as interests of such organization;
- get approval of the competent entities, to proclaim itself as the interest of the organization;

Termiz and Milosavljević (2000) point out that "Exercising the interests of the organization is moving from the sphere of thought in the realm of facts and actions, so that the organization is trying to achieve by its collective power the idea about itself interest" (p. 20).

Decision in group decision-making should be preceded by adjustment of attitudes, ie achieving mental, psychological, emotional and rational agreement about:

- problems;
- solutions (problem solving).

Goals of adjustments are to overcome initial differences in attitudes and behaviors between the entities of the organization are to provide their common functional activity. That is one of the reasons why they can not be classified as targets in general. It is entirely appropriate to classify them, according to the areas to which they apply, and by the order of their implementation. According to the level of decisions that need to be aligned, goals can be divided into: strategic goals; operational goals and specific (instrumental) goals.

The ultimate goal of the implementation of process of adjustment of the attitudes of the subjects participating in group decision making is overcoming differences of attitudes which should be the part / content of the decision . This creates the prerequisite for ensuring actual compliance on important issues that are often related to current and future challenges, it increases efficiency, effectiveness, efficiency, rational use of resources , adaptability and flexibility of the system and the alignment of its components with the future development needs.

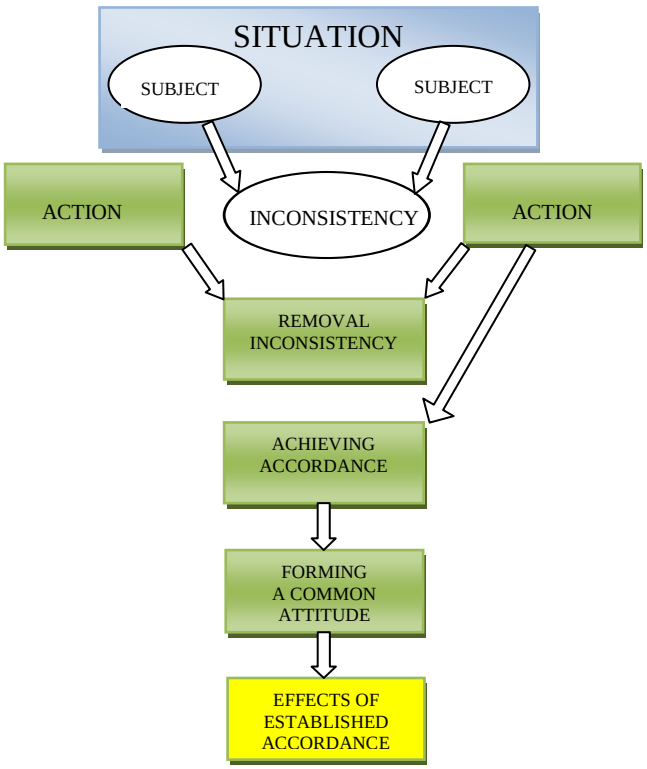
6. METHODICAL PROBLEMS OF ADJUSTING ATTITUDES

Adjustment, as well as every social process, is taking place in certain conditions. Conditions here imply the existence of a number of subjects and other factors that significantly influence the course and outcome of the decision-making process. One subject of adjustment , usually a manager, ascertains that there are certain needs of the organization for making important decisions. Because an individual, regardless of his expertise and position in the organization may not be able to independently make important decisions, or he is just seeking confirmation of his already formed opinions, he is forming a team of experts in order to make common - group decision that will be the basis to solve existing and potential future problems. Accordingly, he takes the following steps:

- Ensures associates in direct meeting those needs;
- All parties involved in the process of adjusting are informed about what are the conditions for meeting those needs;
- Forms a narrow group of people that will help him to evaluate options to meet the needs of decision;
- Defines the goal.

Yukle G., (2006) discuss that phases of adjustment are, as follows:

• Establishment of idea;
• Articulation of idea in to the initiative;
• Argumentation of the initiative;
• Making proposals for decision;
• Gain insights into counter-initiatives and counter-arguments;
• Debate the arguments from the perspective of the validity and according the criteria of benefit and damage;
• evaluation of the arguments;
• reaching agreement in ways how to evaluate arguments;
• development of a common attitude - unanimous decision (or compromise).



Scheme 1: The general model of adjustment process

Subjects - participants in the process of group decision making process, during of adjustment of their attitudes, in principle, attempt to reach a common attitude, but on this way they can find themselves in different situations. At first it may happen that managers who initiated and formed a team to solve some important problem and make decisions regarding it, through formall adjustment and consultations, just seek confirmation of their attitude. In the most severe variant, they demand the acceptance of their own attitude as a fundamental (paradigmatic), and its development into operational purposes.

Second possible situation is characterized by the occurrence that no one participant in decision-making group has not strongly formed attitudes, so there appears equal sharing of available notifications, assumptions, premises and arguments and while studying them, they formulate together an attitude as a structured consent - where disagreements were removed. This second situation is certainly better and helps to achieve a real consensus on an important issue.

However, adjusted attitude, formulated through the process of adjustments is not the final attitude without dissidence. Every attitude, even adjusted is achieved through at least two phases: the first is the interpretation of the attitude, and the second is the application of the attitude, its implementation in the process of communication, values and rules of behavior and action.

Interpretation of attitude includes:

• understanding of attitude and statement;
• understanding of the essence of the meaning of attitude - linked with the reality of social practice that points to.

Adjustments of attitudes, unfortunately, does not always accomplish such a level of accordance, especially not when it comes to very large differences in paradigmatic attitudes, or attitudes concerning the vital interests and values.

When large differences are subject of adjustments of attitudes, then adjusted attitudes are compositioned. The compromised common attitude, as a rule is attitude which is arising out of any loosening of parties - participants of group decision-making, according to rule that he is the one which has less power and it can to go to his damage. Compromised attitudes, no matter how clearly stated, are always subject to interpretation. The reason for this is, that most often both subject of adjustments are putting efforts to the interpretation and application of the attitude, in order to improve their position.

Achieving compliance is not an easy process and does not always end with success. Particularly significant are the problems of emergence of rapid consensus and the emergence of a quasi consensus. Emergence of rapid consensus is characterized by the adoption of the first or loudest alternative solution. Other alternatives are not given enough attention. Quasi consensus is characterized by adoption of a resolution by the members of the group, although they personally do not accept it by themselves. The reasons for such action may be: deference of opinion to authority or the majority, the desire not to jeopardize the harmonious atmosphere in group, or being subject to internal and external pressures to make decisions. This false consensus have negative impact on the quality of decisions, and the cohesion of the group.

In addition to building a consensus, alternative method of making decisions in the group would be the use of voting procedures. Their use typically precedes an exhaustive discussion of options and that means that members are well informed about their characteristics.

There are several voting procedures, but in practices most often used procedure is absolute majority. In the event that a group can not decide between two alternatives, conflict can be solved using this method. However, when choosing among several options, the method of absolute majority may be inefficient procedure and thus, prolong the final selection. The characteristics of this method are that decisions are made on the basis of majority support of an opinion, in which are the procedure established in advance and clear. The process is quick and proposals are clear, and members are opting for and against it. The aim of the discussion is to provide support to one option and denies the other, not to find the best solution. This decision may be the product of concessions.

There are also situations where the end result of the process of adjustments of attitudes during the group decision-making, is imposed attitude. One can not a priori have a negative orientation toward imposed attitude. There are two extreme terms concerning imposed attitude. Firstly, least common feature of such imposed attitude is acceptance of other people's attitude because of the force of argument and genuine notification that the caller was not enough known before adjustments. It could be said that these are extremely rare situation in ordinary circumstances, because each entity - a participant in the process of adjustments is preparing in advance to participate in the coordination of attitudes. Collecting information on the contents and characteristics of attitude of other subject in the process, is inevitable in order to guide their own behavior in the process of group decision making.

When the subjects of group decision making have no equal positions in the process of adjustments of attitudes, under normal circumstances, in fact, there is no true adjustments. Power of authority to establish final attitude is available to the competent authority, executive, manager. Their authorization in this regard are:
• to obtain necessary information for the formation of the attitude;
• to express, indicate the expert knowledge about the problem and its solution;
• to develop appropriate activities in the promotion and implementation of competent superior's attitude.

Methods of adjustments of attitudes in this process, in which the head of the organization has a regulating position, can legally be as follows:
• information;
• professional indication;
• some explanation;
• ability to influence the interpretation and during the execution;

7. **CONCLUSION**

Opting for the treatment of this subject, we were aware that we could not include, within this study, all issues of complex process of adjustment, nor we could adequately resolve it through science. So we started from the basic, scientifically validated and generally accepted knowledge. The complexity of this process is reflected in the fact that it is influenced by many factors and environmental conditions as well as the numerous parties involved in it.

We conclude that the methodological problems of adjustments opinions are numerous, but the process of adjustments is a good way to overcome initial differences of opinion with regard to the adoption of some important decisions for the organization. Adoptation of the quality group decision is preceded by true adjustment of attitudes, ie. achievement of mental, psychological, emotional and rational consensus on problems and solutions, ie. ways of solving problems.

REFERENCES

Drucker P.F., (1996), Inovacije, preduzetništvo praksa i principi, Grmeč, Beograd.

Jarić D., Djuricic R., Jagodic M., (2009), The organization of work and behavior, Novi Sad.

Kukoleca S.,(1972), Basic Theory of Organizational Systems, FON, Beograd.

Mala politička enciklopedija (1966), Savremena administracija, Beograd.

Milosavljevic S., Radosavljevic I., (2006), Osnovi metodologije političkih nauka, Službeni glasnik, Beograd.

Ranđić D., Jokić V, Lekić S., (2007), Menadžment, Viša poslovna škola, Beograd.

Rečnik srpskog književnog jezika (1967), Matica Srpska, Novi Sad.

Robbins S. (2003), Organizational Behavior, Englewood Cliffs, NJ: Prentice Hall Inc, New York.

Rot H. (1988), Psychology of Groups, Department of Books and Teaching Aids, Beograd.

Schermerhorn J, Hunt J, Osborn R, (2005), Organizational Behavior, John Wiley&Sons, New York.

Termiz Dž., Milosavljević S., (2000), Praktikum iz metodologije politikologije, Fakultet političkih nauka, Sarajevo.

Yukle G., (2006) Leadership in Organizations, New Jersey 337th (Translated by Naklada Slap (2008), Zagreb).

BUSINESS PSYCHOLOGY

OPERATIONALLY DEFINING CONCEPT OF WORK BEHAVIOUR: WORK BEHAVIOUR SELF-ASSESSMENT SCALE

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Abstract: *Observing job performance in the context of individual behaviour leads scholars to encompass in their measuring conceptions not only activities closely linked to tasks but also those that accompany performance, commonly called contextual. Inspired by endeavours to assess job performance on broader model, there is an attempt to develop and empirically verify scale of work behaviour. Scale was based on 5 theoretically defined indicators divided into two broader categories: behaviours related to the (1) results and to the (2) manners of conduct. Finally, principal component analysis showed structure of eight main components, that explains 64% of total variance. They are labelled according to the related items. Scale distribution does not deviate from normal with Internal consistency of Cronbach`s alpha=.79.*

Keywords*: work behaviour, psychological tests, self-assessment scale, Internal (consistency) reliability, Principal component analysis*

1. INTRODUCTION

Acknowledging the theoretically postulated idea that job performance should not be defined solemnly on achievements of employees, there is an initiative to develop empirically verified scale for assessing the concept of work behaviour that encompasses all activities leading to the final accomplishments.

As a matter of fact, existing paradigm of conceptualizing job performance considers wider framework. It includes all behaviours present in work context leading to the specific achievement and describing the way how work has been performed by employee (Jex & Britt, 2008). It analyses not only the results but also the manner of engaging in activities connected with the work process. It also takes into account different behavioural episodes according to the level of relevancy for organizational goals (Motowidlo, 2003).

We consider the fact that job performance comprises actions that go beyond the frame of employment`s formal demands. Bialek and colleagues (1977) claim that employees spend less than half of working hours engaged in activities given in their job description. Therefore, work appraisals should not be based on homogeneous, one-dimensional constructs. Rather, a more complex method of assessment that incorporate all key processes involved in achieving the work tasks, should be developed and applied.

2. THE CONCEPT OF WORK BEHAVIOUR

Motowidlo (Motowidlo, 2003) believes that there are, at least, two conceptual and practical advantages of observing performance in the context of individual`s behaviour, rather than linked to its results. First, there are some situational factors that modify the effects. Second, there are some psychological processes and principles that govern the course of action during the performance of the tasks. Since performance is expected organizational value of employees` contribution, results are seen as conditions that are changed by it, behaviour is the means of contributing organizational value by changing those conditions (through results).

Different conceptualizations of job performance and work behaviour are present in literature. Some of them are relevant for this study and their common qualities are universality and complexity. General definitions enable to include in concept all those behaviours that are not directly connected with concrete work tasks. Also, they cover these behaviours that contribute, as well as those that peril, the achievement of professional and organizational goals.

Campbell (1990) has categorized work behaviour according to the direction of influence on organizational effectiveness as: (1) productive, that contributes to the organization, and (2) counterproductive behaviours, that impair organizational, and interests of its members. Accordingly, productive work behaviours are related to the work performance, organizational citizenship behaviour and innovation (Jex & Britt, 2008). On the other side, different definitions of counterproductive behaviour could be integrated in one broad definition that explains it as: "*total expected value to the organization of behaviours that are carried out over a*

standard period of time with the intention of hurting other individuals or the organization as a whole and that have negative expected organizational value" (Motowidlo, 2003, 48).

Models of work behaviour commonly distinguish behaviours that are closely related to the work tasks and those that accompany performance. So, Murphy (2004) differentiates work behaviour according to the course of impact and its relation to the core activity, on those: (1) closely associated with the task, (2) considering human relations, but also (3) causing absenteeism, destructive and risk behaviours. Waldman and Spangler (1989), for example, develops integrative model of work behaviour that focuses on: personal characteristics (experience, abilities), effects (feedback information, job security) and environmental factors. These models tend to offer valid predictors. Work behaviour on individual level is seen as a consequence of job complexity (task requirements), knowledge and working skills (based on abilities and experience) and employee`s consciousness (personal characteristic) while operating on job (Jex & Britt, 2008). Studies have confirmed that cognitive ability predicts better technical skills and work effort, whereas some personal features are better predictors of contextual work behaviours as discipline (Pulakos, Broman & Hough, 1988).

Similar, Borman and Motowidlo (1993) emphasis that there are two sorts of work behaviours: (1) those directly linked with task performance and (2) those called contextual. Task performance considers activities that could be found in formal work description and refers to the working role. Contextual behaviours contribute to the organizational effectiveness due to the psychological, social and organizational work context. So, effects of contextual activities are executed via impact on others, increasing personal willingness to engage at work activities and through activities that has impact on organizational resources. These contextual behaviours serve to ease communication, sustain social interaction, reduce tension and disturbing emotional reactions, and are of highly importance to the issue of team work (Jex & Britt, 2008).

Van Scotter and Motowidlo (1996) describe the manner how contextual work activities contribute to the organizational effectiveness by shaping organizational and social environment that facilitate task activities. It is believed that those contributions have general value that is present in every each job and organization, while work activities linked to the task varies from job to job. So, distinction between contextual and activities tightly connected to the task, is of theoretical, as well as of practical significance, due to the fact that they are probably determined by different antecedents. Specific knowledge, skills and abilities are better determinants of someone's behaviour while completing job tasks. On the other hand, dispositional factors are better predictors of contextual work behaviour.

Arvey and Murphy (1998) claims that one should be careful with the idea of developing a new construct of contextual work activities. It defines something that is not in the job description, but if we formalize it as part of the job description, then it loses its specificity. However, researches shown that this theoretical construct has its empirical confirmation (Coleman & Borman, 2000). Factors linked to the job task, as well as, contextual ones, independently, contribute to the work outcomes (Barrick & Mount, 2005). Also, it was found that personal variables are in higher correlation with contextual activities (Pulakos, Broman & Hough, 1988).

Recognition of the existence of contextual work behaviour, not strongly tied with formal work goal, jet essential for organizational performance, requires some methodologically valid approach of measuring its contribution. Here is an endeavour to include in the scales of measuring job performance contextual aspects and to develop an instrument that could be used in variety of settings by mixing different theoretical concepts.

3. MEASURING WORK BEHAVIOUR

3.1. Theoretical and methodological considerations

It is not uncommon to assess job performance based on one narrow specific aspect of work activity based on outcome. However, the idea of perceiving job performance as a "*property of multiple, discrete behaviours that occur over some span of time*" (Motowidlo, 2003, 39) is very popular. As a matter of fact, the whole domain of practice, that envelops processes of defining, measuring, assessing and giving feedback with the objective to improve performance, exists. Defining a work process in behavioural terms enables accessing and measuring it. As *Nelson and Quick* (2006) posted, *measuring the work outcome is an activity of appraising appropriateness and effectiveness of someone`s work activities in specific context.*

Consequently, different conceptions of measuring work behaviour exist. Borman and Motowidlo (1993) are among the first scholars to claim that there are two sorts of work activities both of particular importance for

task achievement: operative and contextual ones. Further, authors distinguish five types of those, so called, contextual activities: (1) readiness to voluntarily complete tasks that are not part of the formal job demands, (2) persistence with additional enthusiasm and effort that is necessary for successfully accomplish working goals, (3) supportative actions toward colleagues and cooperation, (4) obeying organizational rules and procedures even when it does not go in one`s behalf, (5) acceptance, support and protect of organizational goals. Coleman and Borman (2000) observe this concept from the empirical point of view and parse it on 27 items from which they extract 3 factors: (1) interpersonal support, (2) organizational support and (3) consciousness and initiative related to work tasks.

Those behaviours that are not strongly tied with the formal work goal and often called contextual became an inspiration for many researchers. For example, in case that those actions are not part of the formal system of appraisal and compensation, if they are rather optional and result of employee`s initiative, then it is often seen as the phenomenon of Organizational citizenship behaviour (OCB). It is first introduced by Organ in 1977 to define those *behaviours that are not part of the formal job description and that are not prescribed by work role*, but rather "*self-initiative behaviour that contributes organizational effectiveness and benefit and that are not directly and explicitly rewarded*" (Organ, 1988, 4). Also, some distinctions are made between OCB directed toward the colleagues (for example, expressing altruism) and toward the organization (consciousness and loyalty).

Nevertheless, operationally defining work behaviour is not an easy task. The main problems are its inherent multidimensionality and its dependency on different factors. Therefore, it is necessary to clearly define the subject, the criteria and purpose of appraisal and methods for systematically observing targeted subjects and their behaviour on work. Also, potential predictors, conditions facilitating or aggravating work process, and epistemological problems of assessment (accuracy, reliability and validity), should be considered.

Job behaviour is assessed: (1) to determine if a person is suitable for some job (selection), and (2) to determine if a person perform it well (evaluation). Appraisal could be theoretical, informal or highly formalized with significant consequences on compensation, promotion, retribution, dismissing, selection, training, and so on. According to the purpose we chose criteria, methods and sources of assessment. Studies show that there are significant differences in evaluation results in function of measures that are taken as criteria, job that are evaluated, and also of purpose of evaluation (Nelson & Quick, 2006).

Although almost 95% of all appraisals in work context are based on evaluations of superiors, it is believed that when evaluating OCB and similar concepts, more relevant evaluators are subordinates and clients. Also, in theoretically inspired researches, self-appraisal is acceptable (Cardona & Espejo, 2002). The question of accuracy is highly dependent not only on criteria but also on the appraiser. On the other hand, reliability depends on phenomenon`s stability which is not the case. It is believed that past work behaviour is a good predictor of future work behaviour but it relies on the factor of experience. So, the concept of dynamic criteria should be introduced, considering the obvious fact that the work behaviour is changing over time. It is also one of the reasons why correlation of two measures of job performance decreases in function of time and it produces the, so called, problem of work behaviour temporal instability (Sturman, Cheramie & Cashen, 2005).

3.2. Empirical objectives and procedures

The main objective of this paper was to develop an instrument for measuring work behaviour that is strongly rooted in theory and then verify its practical value and metric features through application. This instrument was conceived as five degree Likert type scale with 27 items. Appraisal of work behaviour is left on performers themselves. It is justified with theoretical goals of the study with no practical implications on subjects what so ever.

Inspired by theoretical ideas and methodological experience of other researchers (Slemp, 2013; Kahya, 2007; Coleman & Borman, 2000), we decided to develop an instrument for measuring work behaviour postulated as a wider concept of job performance, based not only on its effects but according to the idea of contextual relevancy. It was expected that it would be able to measure the excellence of work behaviour in totality and in its complexity. The additive nature and capability of instrument to give one single measure is going to be examined by alpha coefficient of internal reliability of the scale.

On the other hand, there is also an assumed structure of operationally defined concept that distinguishes at least two categories representing the work behaviour domains. First one considers activities associated with

main working processes and therefore items should describe the manner of accomplishing professional tasks. Second indicator should refer to the behaviours only indirectly associated with job tasks. In this

context, interaction with colleagues and attitudes toward organization should be taken into account. It is important because it was found that performance is very much dependent on those qualities. The question of how many varieties of contextual activities exist remains open. This postulated structure of work behaviour concept was tested using Factor analysis, precisely, method of Principal components that extracts from original set of items, components that share common variance (Kovačić, 1998).

The procedure of testing the instrument was conducted on 100 employees from five Belgrade IT companies. Respondents are all with similar educational background and they are working on tasks of similar complexity and content. Actually, they are engineers employed on positions of IT managers, system administrators and software developers. Gender structure is slightly biased, with 62% of males and 38% of females.

3.3. Defining scale`s rationales

Work behaviour self-assessment scale is based on previously mentioned Borman and Motowidlo`s concept of work behaviour (1993), as well as on Coleman and Boreman`s empirical verification (2000). Some items are inspired with popular Organ`s concept of citizenship behaviour (Organ, 1988).

Finally, five degree Likert type scale measures work behaviour taking into account: (I) behaviours related to the final job result, although it depends on majority of mentioned factors and as well as on factors we did not include. Here, (2) quality of work is equally important (2 items) as (3) quantity of accomplished tasks (2 items). Further, there are evaluations of episodes of behaviour that are called (II) contextual, explaining the approach to work (manner in which work has been done), implicitly describing employees' attitudes toward job, colleagues and organization. Here, we distinguish between (3) behaviours expressed during the task accomplishment - directly connected with performing working tasks (core activities) (9 items), (4) behaviours referred to the psycho-social (contextual activities) (7 items) and (5) organizational aspects of work (contextual activities) (7 items).

Indicators of work behaviour that are directly attached to the job performance refers to the employee`s persistence with enthusiasm, when additional effort is necessary to accomplish the task, regardless the work conditions. It includes taking an initiative to do whatever is necessary to achieve goals even if they are not a part of the regular duties. There are also tendencies to find extra tasks after fulfilling regular obligations, developing individual knowledge and skills by one's own means and resources. Also, accuracy, reliability and goal oriented qualities should be mentioned. Accordingly, we could mention motivational aspects in this context.

Psycho-social domain of work behaviour encompasses questions of providing help to co-workers by coaching, advising, replacing and doing some part of their tasks, adjusting to their schedules, offering emotional support, as well as cooperation, courtesy, timely informing, expressing consideration, generating motivation, respect and trust. Finally, it could be seen as related to the organizational citizenship behaviour conception, especially that aspect that is directed toward the one concrete employee (colleague), opposite to the indicators of organizational work side. Behaviours associated with organization contribute to the whole organization by representing organization with good image, voluntary organizational promotion, loyalty even in crisis, consciously supporting organizational mission and goals, willingly obeying organizational rules and procedures.

5. TESTING A WORK BEHAVIOUR SELF-ASSESMENT SCALE (WBSAS)

Distribution of scores on scale is normal. One sample Kolmogorov-Smirnov test showed that we could retain null hypothesis due to the fact that there is no statistically significant deviance from normal distribution (AS=99.81; SD=11.47; N=100; p=.43). Internal consistency for 27 items given in the Likert type scale, was Cronbach`s alpha =.79. It represents the measure of homogeneity and internal reliability (low level of obtained measurement error). This measure could represent the level of excellence of someone`s work behaviour as it is seen by him. This measure could be used in studies as an indicator of work behaviour and it could be associated with other psychological variables, as it is the case with one recent study where it is correlated with satisfaction (Kovačević, Čizmić, 2012). Nevertheless, it is possible to approach to the instrument as it is a composite of different dimensions that describe the content of the concept.

Principal component analysis is mostly used for constructive validation, i.e. comprehension of the structure of operationally defined notion. Intercorellations between manifest variables (27 original items of Work behaviour scale) imply lesser number of latent variables that are extracted *with retaining the maximum possible variability at the same time* (Kovačić, 1998, 187). Based on Guttman-Kaisser reliability criteria, eight orthogonal components were extracted (varimax rotation). They give approximation of variation structure of original variables. Total explained variance is slightly above 64 %, which is rather satisfactory. Except first

component that explains about 10% of total variance, components have almost the same amount of explained sample differences. Percentages of possible variances are given in the Table 1.

Table 1: Percentage of explained variance

Component	Percentage (%)
I	10.16
II	8.76
III	8.14
IV	8.12
V	7.81
VI	7.29
VII	7.02
VIII	6.72
Total	64.03

Componential saturation with the scale`s item is given in the Table 2 and it provide us with the information how this components should be comprehended, as well as how real structure of theoretically conceived composition of scale looks like.

First component that explains about 10% of total variance is saturated with items which classification in theoretically defined indicators is rather heterogeneous. Here, we have an item of work quality that overcome the expectations of superiors and work persistence despite the obstacles, but also a high saturation with items provoking enjoyment in informal interactions with colleagues and effort to protect colleagues from personal dissatisfaction, which seems to be mistakenly categorized in organizational aspects. Also, there is a relatively expressed saturation with items that describe a manner of performing task and willingness for professional development. Due to its multiplicity, we named this category **(I) The general work behaviour indicator** (items: 21, 5, 2, 12, 13, 19).

Second component is explained with four items that mainly refer to the relations with colleagues – collegiality and punctuation (meeting deadlines). So, this component is called **(II) Collegiality and devotion** (items: 16, 6, 15, 11) in contrast with third component that is saturated by items with negative connotation of collegiality and psycho-social aspects: distrust and conflicts with colleagues and unwillingness to help. So it is called **(III) Uncooperativeness** (items: 18, 17, 14). Fourth component is strictly defined with organizational aspects of work behaviour, expressing positive attitude toward organization and readiness to protect its image and interest. Thus, it is called **(IV) Organizational loyalty** (items: 24, 25, 26, 27). These items could be incorporated with the organizational aspect of the concept of organizational citizenship behaviour.

Fifth indicator is highly saturated with two items referring to the quality and quantity of work done, so we named it as **(V) Efficiency and effectiveness indicator** (items: 1, 4). It is almost opposite to the component defined by items indicating tendency toward absenteeism that is labelled as **(VI) Skiving indicator** (items: 10, 9, 20). Seventh factor is not consistent. There is an item articulating indifference and lack of information toward the organization and organizational public representation and an item about the quantity of work done that goes beyond average. We called this factor **(VII) Organizational indifference** (items: 22, 3, 23). At the end, eighth component is characterized by willingness to work overtime and undertaking tasks that goes beyond one`s responsibility. So, it is a question of **(VIII) Personal conscientiousness indicator** (items: 8, 7).

Table 2: WBSAS`s components` saturation with items

Items/components	I	II	III	IV	V	VI	VII	VIII
1. I have better results than my colleagues	.01	-.13	.16	.07	**.85**	0	.01	.12
2. Quality of work that I`ve done usually goes beyond superiors `expectations	**-.6**	.05	.25	0	-.42	-.13	.28	.21
3. I usually complete more tasks than average	.08	-.19	.36	-.04	-.45	.01	**.53**	-.08
4. In my business hours I overcome organizational norms	0	.14	-.12	-.11	**.83**	-.19	-.01	.02
5. I try to complete job despite the obstacles	**.63**	.15	-.04	-.09	.03	0	-.06	.11
6. It is important to me to finish job within expected deadline	.2	**.69**	-.01	.09	.1	-.28	-.25	.23
7. I usually avoid to take more tasks than it is required	.02	-.11	.10	-.1	-.06	.1	-.02	**-.69**
8. It is not hard for me to work overtime just to finish work adequately	.18	.08	-.1	.12	.08	.16	-.08	**.73**
9. Sometimes I come late at work	.04	.03	-.03	-.19	-.13	**.69**	-.09	.2
10. Sometimes I can`t continue to work unless I spend more time on break	.08	-.04	.28	-.06	-.05	**.70**	.29	-.15
11. If I finish my job before the end of the work time, I usually find myself some extra tasks	-.11	**.48**	-.06	.15	.32	.34	.14	.16
12. I never stay after work, unless it is explicitly requested by superiors	**-.58**	.15	.09	-.01	0	-.21	.11	-.54
13. I am willing to attend some extra course If I find it useful for my professional development	**.57**	.41	.16	.05	.05	.31	-.05	.08
14. It is not hard for me to help a colleague if I realize that he has too much to do	.29	.35	**-.38**	.17	-.16	.30	-.28	.14
15. I always share information with my colleagues	.24	**.62**	-.29	.09	-.09	-.06	.02	-.13
16. If any of my colleague have some problem I am willing to help	.21	**.72**	-.27	.11	-.03	.11	-.25	.1
17. Experience taught me not to believe my colleagues	.05	-.18	**.75**	-.05	-.13	.14	-.07	-.11
18. I often have conflicts with my colleagues	-.21	-.16	**.76**	-.05	.03	.09	.06	-.14
19. I try to protect colleagues from my bad temper	**.54**	.09	-.29	-.13	-.14	.01	.35	-.26
20. I am not eager to change my plans in order to coordinate with co-workers	-.27	.04	.5	-.24	.17	**-.36**	.32	0
21. I enjoy casual activities that company organize	**.67**	.23	-.07	.08	-.15	-.13	-.05	.22
22. I often overlook some important information in media about the company I work for	-.09	-.10	-.03	.07	.07	.12	**.78**	-.08
23. It seems that my acquaintances know better than me what is happening in my company	-.39	-.21	.1	-.17	-.15	-.32	**.47**	.17
24. When I speak about my organization with people outside the organization, I mention only positive things	-.10	.14	-.1	**.79**	.08	-.04	-.04	.03
25. It bothers me when people criticize what we do in our organization	-.01	.14	.04	**.72**	-.14	.12	.13	.20
26. I do not know what should happen so that I decide to leave the organization	.05	-.19	-.15	**.70**	0	-.38	.01	.10
27. Even when I do not agree with organizational procedures and rules I strive to obey them	.09	.28	-.04	**.51**	.05	-.08	-.33	-.05

6. DISCUSSION AND CONCLUSION

Learnt componential structure of instrument could be improved by analysing the saturations of components with representative items, expecting to, by removing or replacing some items attain higher internal consistency and better explanation of the concept. As a matter of fact, this operational definition of work behaviour could give a good insight to the real content of the notion. It indicates that it is a subject of complex composition that integrate some personal aspects as conscientiousness trait (VIII), attitude toward

organization (IV, VII), motivation and inclination to counterproductive behaviour (VI, III), as well as organizational citizenship like behaviours (II, IV). Also, there is a measure of efficiency and efficacy as the description of finial result (V). There is also a general factor of job performance with the highest impact on work behaviour`s variance and on evaluation (I). This general factor could be seen as if it expresses the manner how the work is done. It explains mainly contextual activities.

Finally, we might see this operationally defined work behaviour concept in the theoretical framework of Borman and Motowidlo (1993) where there is an distinction between task and contextual behaviours, with the conception of Borman and colleagues (2001) who categorized job performance into a personal, organizational support and conscientious initiative. Consciousness is also a predictor of job performance in Barrick an Mount`s (2005) model of performance. We should not forget the Organ`s (1988) concept of organizational citizenship behaviour and Coleman and Boreman`s (2000) methodological endeavours. Afterwards, there is an idea for further researches based on this conception trying to conduct a confirmatory factor analysis using structural equation modelling similar to the existing contemporary attempts where the idea of proactive approach to job is considered (Slemp, Vella-Brodrick, 2013). As a matter of fact, those researchers distinguish three domains of crafting: task, cognitive and relational, with the idea to introduce three factorial concept of job performance and correlate them with relevant variables. Similarly, Kahya (2007) proposed a concept of following dimensions: task performance, interpersonal and organizational citizenship and job dedication, associated with criteria of physical effort, environmental conditions and hazards.

Although scale could be considered applicable according to the fact that its structure relatively coincides with expected theoretical structure of the concept, the question of its final composition remains open. As a matter of fact, validity of the concept is not yet systematically analysed and due to the fact that it considers multiple correlations with different related instruments and real behaviour observations, we left this important metric aspect for future researches. Also, objectivity issue could be examined by correlating the results gained by self-assessment and assessments from other sources. There is also a potential for gender issue to take into consideration and the question of different job characteristics.

REFERENCES

Arvey, D.R., & Murphy, R.K. (1998). Performance evaluation in work settings. Annual Review of Psychology, 49, 141-168.

Barrik, M. R. & Mount, M. K. (2005). Yes, personality matters: Moving on more important matters. Human Performance, 18, 359-372. doi:10.1207/s15327043hup1804_3

Bialek, H., Zapf, D., & McGuire, W. (1977). Personnel Turbulence and Time Utilization in an Infantry Division. Report #FR-WD-CA 77-11. Alexandria, Va.: Human Resources Research Organization.

Borman, W. C., Buck, D. E., Hanson, M. A., Motowidlo, S. J., Stark, S. & Drasgow, F. (2001). An examination of the comparative reliability, validity, and accuracy of performance ratings made using computerized adaptive rating scales. Journal of Applied Psychology, 86(5), 965-973. doi: 10.1037/0021-9010.86.5.965

Borman, W. C. & Motowidlo, S. J. (1993). Expanding the criterion domain to include elements of contextual performance. In: N. Schmitt & W. C. Borman (Eds.), Personnel selection in organizations (71-98). San Francisco: Jossey-Bass.

Campbell, J. P. (1990). Modelling the performance prediction problem in industrial and organizational psychology. In: M. D. Dunnette & L. M. Hough (Eds), Handbook of industrial and organizational psychology, vol. 1 (687-732). Palo Alto, CA: Consulting Psychologists Press.

Cardona, P. & Espejo, A. (2002). The Effect of the Rating Source in Organizational Citizenship Behavior: A Multitrait-Multimethod Analysis. Research Paper no. 474, October, 2002. University of Navarra. Retrieved from: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=443438

Coleman, V. I. & Borman, W. C. (2000). Investigating the underlying structure of the citizenship performance domain. Human Resource Management Review 10(1), 25-44. doi: 10.1016/S1053-4822(99)00037-6

Jex, S.M., &Britt, T.W. (2008). Organizational Psychology: A scientist-practitioner approach. New Jersey: John Wiley & Sons.

Kahya, E. (2007). The effects of job characteristics and working conditions on job performance. International Journal of Industrial Ergonomics 37, 515-523. doi: 10.1016/j.ergon.2007.02.006

Kovačević, I., & Čizmić, S. (2012). Workspace satisfaction and work behaviour of computer systems managers. Psihološka istraživanja, *15*(1), 5-21.

Kovačić, Z. (1998). Multivarijaciona analiza. Beograd: Ekonomski fakultet.

Motowidlo, S. J. (2003). Job performance. In: W. C., Borman, D. R. Ilgen & R. J. Klimoski (Eds), Handbook of Psychology, vol. 12: Industrial and organizational psychology (39-64). New Jersey: John Wiley & Sons.

Murphy, K. R. (2004). Assessment in work settings. In: S. N. Haynes & E. M. Heiby (Eds.), Comprehensive handbook of psychological assessment, vol. 3: Behavioural Assessment (346-364). Hobroken, New Jersey: Wiley Publishers.

Nelson, L.D., Quick, J.C. (2006). Organizational Behavior: Foundations, Realities & Challenges, 5th ed., Ohio: Thomson.

Organ, D. W. (1988). Organizational citizenship behaviour: The good soldier syndrome. Lexington, MA: Lexington Books.

Pulakos, E. D., Broman, W. C. & Hough, L. M. (1988). Test validation for scientific understanding: Two demonstrations of an approach to studying predictor-criterion linkages. Personnel Psychology 41, 703-716

Slemp, G. R., & Vella-Brodrick, D. A., (2013). The job crafting questionnaire: A new scale to measure the extent to which employees engage in job crafting. International Journal of Wellbeing, *3*(2), 126-146. doi:10.5502/ijw.v3i2.1

Sturman, M. C., Cheramie, R. A. & Cashen, L. H. (2005). The impact of job complexity and performance measurement on temporal consistency, stability, and test-retest reliability of employee job performance ratings. Journal of Applied Psychology, 90, 269-283. doi:

Van Scotter,, J. R. & Motowidlo, S. J. (1996). Interpersonal facilitation and job dedication as separate facets of contextual performance. Journal of Applied Psychology, 81, 525-531.

Waldman, D. A., Spangler, W. D. (1989). Putting together the pieces: A closer look at the determinants of job performance. Human Performance 2, 29-59. doi:

PSYCHOLOGICAL CHARACTERISTICS OF LEADERS

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Abstract: *Leadership, as a new style of management, implies changes in a number of psychological characteristics of a leader, his knowledge and behavior. This paper discusses the psychological characteristics of leaders as carriers of positive change and new values, as well as the bearers of a complex process of leadership, which refers to a change that starts from the definition of the current and existing, towards the vision of the possible.*

Keywords: *leaders, psychological characteristics, leadership.*

1. INTRODUCTION

Leadership is a process that captures the attention of many years. According to Bennis and Nanus (1985), there are over 350 different definitions of leadership, as a result of hundreds of studies conducted in the twentieth century. Being a complex managerial activity, leadership can be defined as a process of creating positive change and new values (Grubić-Nešić, 2008), as well as a process of influencing others to work in order to achieve the organization's objectives. Leadership is considered to be a shaping process of individual and group behavior, system of designing and directing teamwork, way of human behavior motivation, communication and negotiation system. Being a change agent, a leader alters the company culture. The change agent should recognize disproportion between the organization size and age, new conditions and organizational culture model. The leader should develop his technical expertise through education and experience, and initiate and monitor organizational changes. For example, organizational culture change implies the leader's activities towards destruction of the old culture elements and promotion of new elements that will form the basis for the new behavior.

2. PERSONAL CHARACTERISTICS

The correlation between personal characteristics and leadership marked theoretical approaches to leadership in the early twentieth century by the theory of the Great Man, which evolved into the trait theory of leadership. The term trait is widely used to emphasize human attributes, including ability, motives or behavioral patterns. The trait theory of leadership does not make assumptions about whether leadership traits are inherited or acquired. It simply asserts that leaders' characteristics are different from non-leaders' ones. At the beginning of the twentieth century, psychological study, and later there were numerous discussions on trait approach, including Cowley's (1931), which summarized the views of trait theorists in the leadership approaches. The trait-based approach was challenged in the middle of the last century when, after a thorough examination of literature, a prominent theorist Ralph Stogdill concluded that a person could not become a leader by possessing a combination of traits. Trying to discover the character traits of leaders, the researchers within this theory group (Stogdill, 1948) used the two approaches, namely: comparison of the personality traits of leaders and non-leaders, and of successful leaders and unsuccessful ones.

According to the first approach, studies have shown that, as a social group, leaders are generally smarter, more open and more self-confident than non-leaders. However, there are some divergences because there are people who possess all of these psychological traits, yet never become leaders. Stogdill believed this because the research showed that no traits were universally associated with effective leadership, whereas situational factors were also influential. It has been shown that the traits are of great significance. Six traits on which leaders differ from non-leaders are the following: drive, desire to lead, honesty and integrity, self-confidence, cognitive ability and business knowledge.

Despite a series of good assumptions defining the trait theory of leadership, the research results related to the personal qualities and leadership were inconsistent and often disappointing. The literature review leads to the conclusion that the trait approach has been abandoned among leadership researchers. Zaccaro, Foti, and Kenny (1991) noted that trait explanations of leader emergence were generally regarded with little esteem by leadership theorists.

The primary source of skepticism towards the trait approach is often associated with Stogdill's (1948) influential statements. Although Stogdill detected consistent relationships, he concluded that leadership was not a matter of passive status or mere possession of certain combinations of traits. As Bass (1985) noted, after Stogdill's examination, the analysis of the specific situations was a dominant factor. Indeed, Hughes, Ginnett and Curphy (1996), commented that any trait effect on the leadership behaviour would depend on the situation. Even today, with a renewed interest in various explanations of attitudes and behaviour, there remains pessimism about the relationship between trait variables and leadership. House & Aditya (1997) concluded that there were few traits associated with the effective leadership.

Reviewing the literature on theories of personality traits, Bass (1985) noticed two distinct questions: which traits distinguish leaders from other people and what is the magnitude of those differences? Despite the considerable research on this topic in the past century and previous meta-analytic views, (Lord et al., 1986), surprisingly little consensus has emerged to respond the two questions raised by Bass.

Leaders must gather, merge, and interpret large amounts of information. These requirements are higher today than ever because of rapid technological change. Therefore, it is not surprising that leaders must be intelligent enough to design appropriate strategies, solve problems and make correct decisions. Charisma, creativity, originality and flexibility are qualities with a little less clear evidence of the leadership importance. Effective leaders may be charismatic, but this feature may be important only for political leaders. Effective leaders can be more creative than others as well, but there is no consistent research that proves it. Flexibility and adaptability may be important features in the present turbulent environment. Leaders must be able to make decisions and solve problems quickly, and initiate rapid changes.

Effective leaders are proactive. They make choices and implement actions that lead to change, rather than just react to changes and wait for things to happen, they show a high level of initiative. Instead of sitting and waiting in vain for fate to smile upon them, leaders should challenge the process. Leaders are oriented towards achievements; they are ambitious, energetic, persistent and proactive. They have a relatively strong desire for achievement, which becomes the motive for further engagement because it draws satisfaction from the successful performance of ongoing tasks, excellence standard achievements and development of better ways to get things done. To maintain a high drive for achievement and progress, leaders must have a lot of energy. Achievement motivation is caused by a range of mutually conditioned factors, like personal characteristics (attitudes, needs, interests, aspirations, abilities, personality traits, internal motives), but also the job type and characteristics (type of work, degree of self-control, responsibility, autonomy, complexity of work, creativity). Working long, intense work weeks for years requires an individual to have a psychological, mental and emotional vitality. Leaders, as opposed to non-leaders, have much more strength and endurance, and generally are active, vital and constantly in motion. Leaders possessing willpower and persistence are better at overcoming obstacles than the others.

Research shows that leaders have a strong desire to lead. Leadership motivation includes a desire to influence others and is often equated with the need for power. People with high leadership motivation think a lot about influencing other people, winning arguments and being a greater authority. They prefer a leadership rather than a subordinate role. Willingness to take responsibility, which coincides with leadership motivation, is another trait that can be seen in leaders. The psychologist Jon Bentz (in Kirkpatrik & Locke,1991) describes successful leaders as those who have a powerful competitive drive for the position, authority, and need to be recognized as people of influence. Effective leaders empower others to increase their own power. They do not see power as something that is competed for but rather as something that can be created and distributed to followers without diminishing their own power. Successful leaders should be ready to implement power over subordinates, tell them what to do and appropriately use positive and negative sanctions.

Leader with a personal power motive seeks power as a target in itself. These individuals have little self-control, are often impulsive and focused on collecting evidence of personal prestige. Gaining power only for the purpose of dominating others may be based on self-doubt.

A leader of a socialized power motive uses power as a means to achieve desired goals or a vision. Its use is expressed as the ability to develop networks and coalitions, gain cooperation with others and resolve conflicts in a constructive way.

Individuals with a socialized power motive are more mature than those with a personalized power motive. They exercise power more for the benefit of the whole organization and are less likely to use it for manipulation. These leaders are also less defensive, more willing to take advice from the experts and have a

longer-range view. They use their power to build up the organizations and make them successful. The socialized power motive takes into account the followers' needs and results in empowered, independent followers.

Self-confidence plays an important role in decision-making and gaining the trust of others. Obviously, if the leader is not sure of what decision to make, or expresses a high degree of doubt, then his followers are less likely to trust him and be committed to the vision. Not only matters the leader's self-confidence, but its perception in others. Often, leaders engage in impression management to maximize their image of competence; by projecting self-confidence they enhance the confidence of the followers. Self-confident leaders are more assertive and determined, which gains the confidence of others in decision-making. This is essential for the effective decision implementation. Even when decisions turn out to be incorrect, the self-confident leader admits the mistake and uses it as an opportunity to learn, often by building confidence in the process.

In order affect employee motivation, the leader must be intrinsically motivated, and know how to motivate others by rewards and punishments, based on a good distribution system of earnings, applied consistently and relied on the results of performance appraisals.

3.BIG FIVE AND LEADERSHIP

Overall, the results of meta-analysis show that Extraversion, Conscientiousness, Openness, Agreeableness and Neuroticism are useful traits or characteristics in relation to leadership. Collectively, the results support the importance of the five-factor model in the study of leadership. Previous studies do not withstand the test of time, but there is an idea of not only which traits are relevant, but also why that is so. Is Neuroticism negatively related to leadership, since the neurotic individuals are less likely to be found in leadership positions, because they are less inspired, or because they have lower expectations of themselves or others? Similarly, Extroverts may be related to leadership because they are more willing to talk, while talk and garrulity are strictly related to leadership emergence. Alternatively, it may be that others implicitly expect leaders to be extraverted. Implicit views of leaders expect them to be sociable (outgoing) and assertive (forceful, aggressive, aspiring). Extraverts could be better leaders due to their expressive nature or the contagion of their positive emotionality. The authors used the five-factor model as an organizing framework and meta-analyzed 222 correlations from 73 samples. Overall, the correlations with leadership were Neuroticism, Extraversion, and Openness to Experience, Agreeableness, and Conscientiousness. Results indicated that the relations of Neuroticism, Extraversion, Openness to Experience, and Conscientiousness with leadership generalized in that more than 90% of the individual correlations were greater than 0. Extraversion was the most consistent correlate of leadership across study settings and leadership criteria: leader emergence and leadership effectiveness (Judge, Bono, Ilies, Gerhardt, 2002). Open individuals may be better leaders because they are more creative and are divergent thinkers, because they are more willing to take risks, while their tendencies for esoteric thinking and fantasy (McCrae, 1996) make them more likely to be visionary leaders. Agreeableness may be weakly correlated with leadership because agreeable individuals tend to be passive and compliant (Graziano & Eisenberg, 1997) but can also be helpful. Conscientiousness is correlated to leadership because conscientious individuals have integrity and engender trust so they excel at process aspects of leadership, such as setting goals (Hogan et al., 1994).

Communication of a leader is a balanced, harmonized communication, first with itself, with its own emotions, and then with other people. Most psychological theories agree that it is impossible to build adequate communication with others, if own dilemmas are not, before that, recognized, clarified and established. And, on the other hand, it is important to avoid reluctance to admit those dilemmas in front of others and constantly look for solutions which can be achieved. The high level of successful communication with oneself means accepting yourself, not worshiping oneself, but realistically accept oneself and it implies a willingness to work on oneself, self-confidence, self-esteem, self-control...

Personal integrity is a consolidated functional activity of a number of traits, skills, and abilities that make up a harmonized whole. The integrity is manifested in the behavior in which the words do not differ substantially from the work and thoughts of conduct. The value system that people of integrity have is stable and based on sincere beliefs that were adopted without calculated needs. Work on oneselves integrity means working to unify different image of oneself, such as the ones that our family, friends, acquaintances or enemies have.

4.CONCLUSION

In the process of leadership, the relationship between leaders and employees is established through work and action, i.e. through action and results, and not through command and control or hierarchical dominance and subordination, which are related to the traditional leadership model. In modern societies with advanced technical and technological bases, organizational structures and cultures permeated by psycho-sociological aspects, the phenomenon of leadership is very important. Most of leadership theories unreservedly accept the attitude that performance and satisfaction of followers are the outcomes of the leader's actions. The important feature of attributive approach is to warn us of the possibility that leadership is only an illusion, or, perhaps, a mere belief. Companies need leaders who do not try to anticipate the future so much as create it. New organizations require different management and a new employee. Perspectives on leadership development is on learning leadership and developing of employee.

5.REFERENCES

Bass, B.M. (1985). Leadership: Good, better, best. Organizational Dynamics 13(3): 26-40.

Bennis, W., & Nanus, B. (1985). Leadership: The strategies for taking charge. New York, NY: Harper & Row.

Cowley, W. H. (1931). The traits of face-to-face leaders. The Journal of Abnormal and Social Psychology 26(3): 304-313.

Graziano, W. G., & Eisenberg, N. H. (1997). Agreeableness: A dimension of personality. In R. Hogan, J. Johnson, & S. Briggs (Eds.),Handbook of personality psychology. 795–824

Grubić-Nešić, L., (2008). Znati biti lider. Novi Sad: AB print.

Hogan, R., Curphy, G., Hogan, J., (1994).What we know about leadership: Effectiveness and personality. American Psychologist 49(6): 493-504.

House, R.,& Aditya, R.(1997) The Social Scientific Study of Leadership:Quo Vadis? Journal of Management 23(3):409-473.

Hughes, RL, Ginnet, RC & Curphy, J.,(2012). Leadership: Enhancing the Lessons of Experience 7thedn, New York: McGraw-Hill/Irwin.

Judge, T., Bono, J., Ilies, R., Gerhardt, M., (2002) Personality and Leadership: A Qualitative and Quantitative Review. Journal of Applied Psychology 87, No. 4, 765–780.

Kirkpatrick, S.,& Locke, E., (1991). Leadership:Do Traits Matter? Academy of Management Executive 5. (2): 48-60.

Lord, R., Vader, C., Alliger, G., (1986). A meta-analysis of the relation between personality traits and leadership perceptions: An application of validity generalization procedures. Journal of Applied Psychology 71(3): 402-410.

McCrae, R. (1996). Social consequences of experiential openness. Psychological Bulletin120(3): 323-337.

River, New Jersey, 2003., page 259.

Stogdill, R. (1948). Personal Factors Associated with Leadership: A Survey of the Literature. The Journal of Psychology: Interdisciplinary and Applied25 (1): 35-71.

Zaccaro, S., Foti,R., Kenny, D. (1991) Self-monitoring and trait-based variance in leadership: An investigation of leader flexibility across multiple group situations. Journal of Applied Psychology 76(2): 308-315.

MOTIVATION, LOYALTY AND VIRTUAL ITEM PURCHASE IN ONLINE GAMES

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Abstract: *In recent years, online games are becoming increasingly popular as a way of entertainment. Many of these games offer the option of purchasing items within the game with real-life money. Since they gather a large number of players, these games are a substantial source of profit. The goal of the present study is examining the factors related to the players' choice to purchase virtual items or not. The factors studied were motivation for playing online games and loyalty level. The sample consisted of 1000 online game players. Chi-square analysis and ANOVA were conducted on the data. Significant differences were found between the players who buy virtual items and those who do not regarding the motivation type and loyalty level. The players who are primarily motivated by leisure are significantly less likely to buy virtual items. Furthermore, it was shown that the players who purchase these items are significantly more loyal than those who do not. We discussed the results in the context of previous findings and offered possible directions for further study.*

Keywords*: online games, virtual items, motivation, loyalty*

1. INTRODUCTION

The Internet has become a part of everyday life and with time it is becoming a necessity in the life of every individual. The Internet is used for a wide variety of purposes: providing information, communication, socialising, business transactions, education and entertainment. It facilitates the interaction between geographically distant individuals, which has contributed to the creation of enormous interactive networks which do not represent only sets of users but settings within which various social activities occur in the virtual environment. An increasing number of online video games have emerged especially on popular social networks which, apart from impressive graphical and technical features, offer the possibility of playing the game in the real time accompanied by the interaction with other players. Internet users visit sites with online games more frequently and stay there longer than on any other web pages (Beak et al., 2004). The data suggest that only in the USA and Great Britain, 120 million people play an online game at least once a week, of which 81 million people play them daily and that the trend increases annually (ISG, 2011). The access to the games is significantly facilitated and encouraged by the development of mobile technologies and the availability of telephones which have the capacity to support the use of wide variety of web applications.

Online games in the most general sense represent a virtual environment with an Internet connection and a large number of players. In other words, they are computer games in which the interactions of Internet users are processed by an Internet connection (Ho & Wu, 2012). In the context of social networks such as Facebook, online games mostly represent simple applications easy to use and understand which lay emphasis on mutual cooperation and communication between players and are frequently called social games (Chang & Chin, 2011). Since online game market steadily increases, its economic potential has become obvious. Until recently, online games used to generate income only by advertisements on their pages. However, due to their growing popularity a possibility of direct profit has arisen (Beak et al., 2004). Certain games sell online accounts and take prepayment for participating on monthly or multi-monthly bases (Oh & Ryu, 2007). However, another mode of profit is becoming more frequent. It is made on the games which are essentially free and which are found on social networks. Users do not have any obligation to pay for participation, yet, within the game, they are offered a possibility to purchase various virtual items with real money. Virtual items refer to various types of objects, such as avatars, decorative articles (furniture, clothes, backgrounds, music) or virtual currencies which exist within the game (Lehdonvirta, 2009). Their purpose is the enhancement of the user's profile as well as the improvement of the performance during the game. They usually cost between several cents and several dollars (Kim et al., 2009). This way of charging has proven to be more profitable, due to the fact that it is not obligatory and that free games attract a greater number of users who, on the other hand, are more inclined to spend small amounts of money to buy a certain item within the game if it occurs periodically. Furthermore, it has been indicated that more frequent payments of small amounts of money are related to the extended game usage with respect to paying a long-term

subscription which implies spending a large amount of money at once (Nojima, 2007). This way the game attracts a great number of users and establishes a community with a great total paying capacity. Accordingly, a higher profit is earned and the game gains popularity. Numerous Internet companies earn more than 100 million per year in this way (Kim et al., 2009; Oh & Ryu, 2007).

The most frequently purchased item is virtual money i.e. currency which is valid within the game and can be used to buy virtual items (Oh & Ryu, 2007). Approximately 50% of users of Facebook, the most popular social network, play social games, of which 2-6% purchase virtual items. Although this percentage is low in relation to the total number of players, the profits of Internet companies are high. Social games industry earned 3, 65 billion dollars in 2010 of which 60% originated from the purchase of virtual items (Crowdpark, 2012). The number of people who buy virtual items has increased in comparison to the period of few years ago and there are indications that the increase will continue in future (ISG, 2011).

It is clear that virtual item sales in games have a great financial significance, and most researches which dealt with this topic were focused on marketing and economic aspects (Guo & Barnes, 2009). Customer preferences were examined, most frequently regarding the attributes of virtual items aiming to improve the design, develop the game which will be enticing and position it well in relation to its competitors. So far, a small number of researches have dealt with the purchase of virtual items from a psychological perspective and there is still a lack of explanatory models and adequate measurement instruments in this field (Guo & Barnes, 2009; Lehdonvirta, 2009). There are few data about the psychological factors which underlie the purchase of virtual items with real money. Therefore, the aim of this research is to examine psychological factors related to this phenomenon.

Most frequent reasons for playing social games are challenge and leisure. People play games because the process itself is attractive and demands engagement (Prensky, 2002). The games are designed in a way that they tempt users do be engaged in them actively and continuously, provide the feeling of engagement and improvement, ensure a quick and constant feedback, and set goals which are challenging enough to keep the interest but not too difficult to detract users. All of that occurs in a friendly but competitive social environment where users can share their success with friends, call attention to their accomplishment on the leaderboards and thus improve their social status in the virtual community. Considering the social aspect of these games, efficacy at problem solving serves as a criterion for comparison with other players and it is related to the individual's self-esteem. Individuals will participate in the game as long as they perceive that they are able to overcome the obstacles and achieve goals which the game sets. Players will tend to maximise their achievement in the game in relation to others (Voreder et al., 2003).

Different researchers suggested categorisations of motives which initiate users into playing online games, based on empirical research. Wood and associates (Wood et al., 2004) distinguish pleasure and relaxation, challenge and excitement as well as social contacts and acquaintance as the most frequent reasons for playing online games. Yee divides motives for playing into three basic categories: achievement, social motive and escapism (Yee, 2006a, 2006b). A similar typology of motives is offered by Wu and associates, who distinguish overcoming the challenge, making friends, killing time and leisure (Wu et al., 2008). One of the latest and most comprehensive classifications was suggested by Li who distinguishes seven motivation categories for playing games: applying knowledge and skills, identification with the theme of the game, fantasising, competition, leisure, social interaction and escape from reality (Li, 2012).

Perceiving a certain product as useful, valuable in emotional or social sense is assumed to have a great influence on users' decision to purchase some virtual item. In other words, key factors on which the purchase decision depends are the product functionality in the sense of practicality, the emotional reaction which the product enhances and an estimate that it will contribute to the status in the virtual social group (Kim et al., 2009). Certain authors distinguish decorative and functional items: decorative mostly stay in permanent possession and have only aesthetic value, while functional items serve for progression in the game and easier goal accomplishment but they are consumable, which means that the players have to repurchase them (Lehdonvirta, 2009). It is established that the value of a certain item will be evaluated differently depending on the motivation which initiates the individual into participating in the game (Kim et al., 2009). For example, the need for achievement and exploration is positively related to the perceived functional value of the virtual item, which leads to the purchase (Li, 2012). Players mostly want to perform the tasks and goals in the game and they are prepared to pay to accomplish that (Crowdpark, 2012). It is established that the players are actuated to purchase virtual items by advancement in the hierarchy within the game and positioning in relation to playmates, exploration of new content and and adjusting the game to one's own preferences (Kim et al., 2009). Similar findings were also obtained in the study of a popular game – World of Warcraft - which indicate that the main virtual items purchase motivators are customisation and accomplishment (Guo & Barnes, 2012). In one of rare comprehensive studies of a large number of online games, it was established that there are certain differences between the users who purchase virtual items

and those who do not in two of four examined game motivation categories. In fact, those who purchase virtual items more often play in need of competition while those who do not purchase them more often play for leisure. It was revealed that there is no difference between users who play for mental exercise or social interaction (ISG, 2011).

Even though they are a significant factor, it was established that mere examination of preferences and motivation cannot entirely explain the variations in recurring purchases by the same user. From a business standpoint, the literature and research recognise the significance of user loyalty for generating profit and positioning in relation to competition (Cheng & Chou, 2011). A survey of different website users confirmed that the largest number of Internet users exhibit a tendency towards loyalty to certain web technologies. Loyalty in the context of business on the Internet is defined as a user's preference for a certain web technology and its continuous use. It was established that loyalty is positively related to the probability of repeated purchase (Anderson & Srinivasan, 2003). Since users can choose between various competitive offers which exist on the Internet and can satisfy their needs, loyalty represents a significant factor in generating profit (Cheng & Chou, 2011; Reichhfeld & Schefter, 2000). It was revealed that the active and constant users of a certain game purchase virtual items with real money more often than the ones who are not (Guo & Barnes, 2009; ISG, 2011). On the other hand, there are findings that players who have the need for novelty and who are not committed to a particular game are not inclined to participate in the same online games for long and spend money on them (Nojima, 2007).

This study deals with examining the association of virtual item purchase and motivation and loyalty of the players. We attempted to consolidate the findings of previous researches as well as a psychological and IT approach in the perception of this phenomenon. Knowing relevant psychological factors and their effect would facilitate developing online games which would be enticing to users and thereby more profitable. Moreover, regarding the lack of research on this topic in our region, this study has the potential to record all feasible peculiarities of the Serbian sample concerning this phenomenon. Relying on the existent findings, we assumed that there would be significant differences in the type of primary motivation for playing between players who purchase virtual items with real-life money and those who do not. At the same time, we expected that the participants who purchase virtual items would more often be motivated by competition and winning than the ones who do not and that the ones who do not purchase them would more often be motivated by relaxation and entertainment. In view of the lack of clearly formulated theoretical models in this field as well as adequate empirical findings, there were no presupposed specific connections between purchase and other types of motivation for playing. Furthermore, we assumed that there would be significant differences in the level of loyalty to online games between the players who purchase virtual items and those who do not. Specifically, we expected that the participants who buy virtual items would be significantly more loyal.

2. METHOD

The research sample consisted of 1000 participants (N= 1000), users of online games. The games involved were two popular online games. By type, they are knowledge quizzes and also include elements of social interaction. After accessing the game, a pop-up window appeared inviting the players to participate in the research. The research was in the form of a short questionnaire with multiple choice closed-ended questions. As recompense for research participation, the participants received a certain amount of virtual currency which is used in the two games. In order to control giving random answers, the participants who completed the questionnaire faster than two seconds per question on average were excluded from the analysis.

Given that there are numerous various types of motivation for playing in the literature, in order to establish which types of motivation are the most prevalent among the users of this type of games, a pilot research was conducted on a random sample of 50 users. The participants were asked open-ended questions which demanded that they specify the main reasons why they play online quizzes. By content analysis, the answers were classified into four categories which could comprise the largest number of answers. Those categories are: 1) competition; 2) intellectual motive; 3) social motive; and 4) leisure. Competition includes motives which are related to pleasure in competing with other people, achieving victory and accomplishing a

high ranking with regard to other players. Intellectual motive is related to desire for knowledge acquisition and improvement as well as for practising cognitive functions such as attention, memory, deduction and similar. Social motive comprises desire for meeting new people and socialising with acquaintances and friends by playing the games. Leisure relates to the desire for boredom elimination, relaxation and entertainment. After we described these four types of motivation, we asked the participants to select among them their primary motive for playing the games.

Subsequently, the participants were asked to complete a short questionnaire specially designed for the purpose of this research which examined their level of loyalty to the game. The questionnaire consisted of Likert items where the total score was taken as a loyalty measure.
Purchase was operationalised as a dichotomous variable. Information about whether each of the participants uses real-life money for virtual item purchase within the game is automatically registered from the administrators' database of the games included in the research. Given that, according to different researches (Crowdpark, 2012; ISG, 2011), players who purchase represent a very small part of the total population of players, the sample is composed of an equal number of players who purchase and players who do not in order to facilitate comparison of these two groups.

Chi-square analysis and analysis of variance were conducted on the data in the statistical program SPSS for Windows.

3. RESULTS

Contingency table analysis for the purchase and motivation variables confirmed that there are significant differences in primary motivation for playing between users who purchase virtual items with real-life money and those who do not, χ^2 (3) = 9.85, p< .05. Table 1 shows frequencies of motivation types indicated by the users who purchase and the ones who do not purchase and Table 2 shows values of χ^2-statistics for each type of motivation in relation to categories of purchase variable.

Table 1: Frequencies of motivation types among players who purchase and who do not purchase

	Primary motivation					
		Competition	Social motive	Intellectual motive	Leisure	Total
Purchase	Do	163	7	201	129	500
	Do not	146	9	172	173	500
	Total	309	16	373	302	1000

Table 2: Values of χ^2-statistics, degrees of freedom and p-values for each type of motivation in relation to purchase

Motivation	χ^2	df	p
Competition	0.94	1	ns
Social motive	0.25	1	ns
Intellectual motive	2.26	1	ns
Leisure	6,41	1	< .01

When examining Table 2, one can see that significant differences between the players who purchase and the ones who do not purchase exist only when considering the leisure motive. Namely, there are significantly more participants who do not pay for virtual items with real-life money among the ones who indicated leisure as their primary motive for playing.

In order to test the hypothesis that there are differences in loyalty between users who purchase virtual items and the ones who do not, analysis of variance was conducted on the data (ANOVA). By Levene's test, it was established that the homogeneity of variance condition of the dependant variable (loyalty) was satisfied, W (1, 998) = 0.45, p>0.05. The analysis of variance results indicate that there is a significant association of the examined variables, F (1, 998) = 14.68, p< .001. The participants who purchase virtual items achieved a significantly higher score on the loyalty scale than the ones who do not purchase them.

4. DISCUSSION AND CONCLUSION

The obtained results support the hypothesis that the users who do not purchase virtual items are more often primarily motivated by leisure than the users who purchase them. This finding, as well as the absence of significant differences when the intellectual and social motives are considered, is consistent with the results of the ISG research (2011). Moreover, the results support the hypothesis that the players who pay are more loyal. As opposed to that, the results did not confirm the expectation of significantly more frequent presence of competition as a primary motive among players who purchase virtual items.

One of the possible reasons for the absence of the expected outcome is the type of the games included in the research. Both games are knowledge quizzes and competitive element is inevitably present during every playing. The players aim to give the correct answer or accomplish a task before the other player who is playing simultaneously. At the end of each segment, the achieved results are compared, and at the end of the whole game one of the players is declared the winner. Since the games of this format are almost impossible to play without an element of competition, it is likely that they attract competitive users more than

the other games in which this element is possible to avoid. In that case, variations in decision to purchase virtual items couldn't be explained by competitiveness but other factors, such as, for example, loyalty or users' financial capability.
The finding that users who pay are more loyal is consistent with the results of previous research (Guo & Barnes, 2009; ISG, 2011; Reichhfeld & Schefter, 2000). Prensky postulates the existence of a two-way association between these variables: the players who invest money in the game will not tend to give up their investment. Continuing the game, the players will be able to ascertain the progress after a certain time and gain the impression that the invested money has paid off, which will encourage them to keep spending and investing in the game (Prensky, 2002).

Further research which would deal with this topic should consider the type of the game when examining the association of motivation and paying. Previous research established the association of paying with competitive and leisure motive (ISG, 2011). While every game can represent leisure to people who play it, the same does not apply to competition. In some games competition is inevitable (quizzes, card games and other games in which there are an unambiguous winner and loser), in some it represents a matter of choice (the games in which interaction with other players is optional) while in others this element is minimal or non-existent (real life simulation games in which there is not an outcome to achieve, but the emphasis is on expressing individuality and creativity). It would be interesting to examine which variables best explain the variations in paying in games which are at the ending points of this continuum, i.e. in cases when the variability of the competitive motive is reduced to minimum (almost inevitable in one and almost non-existent in the other case). Furthermore, in future research, more salient information could be obtained if the participants are not asked to decide on their primary motive but allowed to estimate the degree of presence of different types of motives. In that way, we would have an insight into possible influences of different combinations of motives on virtual item purchase.

Moreover, we could obtain additional insights by checking whether there is an association between loyalty and a certain type of motivation for playing, i.e. whether the players primarily led by one type of motives are more loyal than the players led by different motives. This finding can have implications for further development of online game industry. Since users' loyalty is one of the key factors in generating profit (Cheng & Chou, 2011; Reichhfeld & Schefter, 2000), it is expected that the developers of online games will attempt to make their products attractive for a large number of people. Possible revelation of the association of loyalty and motivation type could influence the design of future games and lay emphasis on the elements within the game which can satisfy a certain type of motivation.

REFERENCES

Anderson, R. E., & Srinivasan, S. S. (2003). E-Satisfaction and E-Loyalty: A Contingency Framework. *Psychology & Marketing, 20(2),* 123-138.

Beak, S., Song, Y. S., & Seo, J. K. (2004, December). *Exploring Customers' Preferences for Online Games.* Paper presented at Proceedings of the Third Annual Workshop on HCI Research in MIS, Washington, D.C.

Chang, C. C., & Chin, Y. C. (2011, January). *Predicting The Usage Intention of Social Network Games: An Intrinsic-Extrinsic Motivation Theory Perspective.* Paper presented at Annual Conference on Innovations in Business & Management, London, UK.

Chang, S. C. & Chou, C. M. (2011). Factors affecting user's online shopping behavior: Integrating the constraint-based and dedication-based relationship perspectives. *African Journal of Business Management, 5(2),* 370-382.

Crowdpark (2012). *The State of the Social Games Industry: Gambling to Social Gaming, Social Gaming to Gambling.* Taken from http://www.gappfest.com/gambling-to-social-gaming-social-gaming-to-gambling/.

Guo, Y., & Barnes, S. J. (2009, June). *Why do people buy virtual items in virtual worlds? An empirical test of a conceptual model.* Paper presented at 17th European Conference on Information Systems, Verona.

Guo, Y., & Barnes, S. J. (2012). Explaining Purchasing Behavior within World of Warcraft. *Journal of Computer Information Systems, 52(3),* 18-30.

Ho, C. H., & Wu, T. Y. (2012). Factors Affecting Intent to Purchase Virtual Goods in Online Games. *International Journal of Electronic Business Management, 10(3),* 204-212.

Information Solutions Group (2011). *PopCap Games Social Gaming Research.* Taken from http://www.infosolutionsgroup.com/pdfs/2011_PopCap_Social_Gaming_Research_Results.pdf.

Kim, H. W., Kooh, J., & Lee, H. L. (2009, July). *Investigating The Intention of Purchasing Digital Items in Virtual Communities.* Paper presented at Pacific Asia Conference on Information Systems, Hyderabad, India.

Li, N. (2012). Motivation of Virtual Goods Transactions Based on the Theory of Gaming Motivations. *Journal of Theoretical & Applied Information Technology, 43(2),* 254-260.

Lehdonvirta, V. (2009). Virtual Item Sales as a Revenue Model: Identifying Attributes that Drive Purchase Decisions. *Electronic Commerce Research, 9(1),* 97-113.

Nojima, M. (2007, September). *Pricing Models and Motivations for MMO Play.* Paper presented at Proceedings of DiGRA 2007 Conference: Situated Play, Tokyo, Japan.

Oh, G., & Ryu, T. (2007, September). *Game Design on Item-selling Based Payment Model in Korean Online Games.* Paper presented at Proceedings of DiGRA 2007 Conference: Situated Play, Tokyo, Japan.

Prensky, M. (2002). The Motivation of Gameplay. *On the Horizon, 10(1),* 1-14.

Reichhfeld, F. F., & Schefter, P. (2000). E-Loyalty: Your Secret Weapon on the Web. *Harvard Buisness Review, 78(4),* 105-113.

Voreder, P., Hartman, T. & Klimmt, C. (2003). *Explaining the enjoyment of playing video games: the role of competition.* Paper presented at ICEC '03 Proceedings of the second international conference on Entertainment computing, Pittsburgh.

Wood, R. T. A., Gupta, R., Derevensky, J. L., & Griffiths, M. (2004). Video Game Playing and Gambling in Adolescents: Common Risk Factors. *Journal of Child & Adolescent Substance Abuse, 14(1),* 77-100.

Wu, J., Li, P., & Rao, S. (2008). Why They Enjoy Virtual Game Worlds? An Empirical Investigation. *Journal of Elecrtonic Commerce Research, 9(3),* 219-230.

Yee, N. (2006a). Motivations for Play in Online Games. *CyberPsychology & Behavior, 9(6),* 772-775.

Yee, N. (2006b). The Psychology of MMORPGs: Emotional Investment, Motivation, Relationship Formations, and Problematic Usage. In R. Schroeder & A. Axelsson (Eds.), *Avatars at Work and Play: Collaboration and Interaction in Shared Virtual Environments* (pp. 187-207). London: Springer-Verlag.

INFLUENCE OF PERSONAL FACTORS ON CAREER DEVELOPMENT OF EMPLOYEES

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Abstract: *Complex organizational changes involve different approaches and different ways of thinking and behaving of employees, such as greater responsibility for personal career and greater importance given to human capital in work processes. The key to successful business is not found only in work and creative potential of employees, but in their personal engagement as well, which is related to the process of career development. As a highly complex and dynamic concept which is based on needs, aspirations and preferences of employees, the development of career differs with respect to personal characteristics of employees and their positions within the organization. It is of utmost importance to be aware of employees' personal characteristics (such as the locus of control, work styles, degree of self-esteem), importance of organization to the employee, development goals of the organization, and social environment. Successful development of employees is possible with the analysis of development plans and understanding of employees' needs. To attract, retain and motivate employees, as well as to enable their personal development, is a challenge for an organization which growth depends on the characteristics of people who make that organization.*
In this paper, main characteristics of the process of development of employees' careers is studied from the aspect of personal indicators in order to identify which personal factors set the direction of career development which contributes to more successful personal and professional development.

Keywords*: Personality, personal characteristics, career development, employees, organization*

1. INTRODUCTION

One of the most important characteristics of modern business is that without competent people neither society nor organization can be healthy, so the development of employees is a permanent process and investment in the future of many organizations.

In an era of knowledge where strong international competition prevails, Blustein (2006) noticed that the career development which aims at acquiring new knowledge and skills becomes increasingly important as a link between an individual and organization; it becomes the determining degree to which employees are attached to an organization. In order to be successful in the achievement of goals and development, the organization should be focused more on individual goals and interests of its employees, and on arranging, planning and achieving growth by developing its employees.

Today, career is a complex concept that modern management is facing. The need to follow worldwide trends because of the globalization poses challenge to employees to care for their education, creativity, and productivity with the aim of positioning themselves in the organization.

2. CAREER DEVELOPMENT

According to Arturu and Rouseu (1996), the traditional career considered only from the aspect of hierarchical advancement is fading and disappearing because contemporary organizations tend to be more flexible in modern business, more dynamic, and economically efficient in an uncertain and unpredictable future. Casto (2000) claims that career should be viewed as permanent development of personal competences in order to secure employment opportunities and remain satisfied with the job, as well as to be prepared for making decisions and taking responsibility during one's career.

Arnold (2001) sees employees as the capital which must be constantly encouraged, directed, and provided with opportunities for growth; he points out that training given at work place is one of the most popular forms of management development. Bacanli (2006) claims that the organizations which learn and overcome the obstacles in the process of learning create conditions for development and engagement of all individuals.

Development of career in modern business is a big challenge for individuals because there are no standards but just a few regulations that can be regarded as guidelines. Individuals primarily take responsibility for

career development, education and training. This leads to interest in education and professional development of employees because it is necessary to constantly encourage employees by creating individual feeling of self-actualization and actual purpose of participation in business collaboration.

The focus is given to employees who create portfolios with their achievements, competences, self-evaluation and building of social network.

2.1. Professional development of employees

Professional development refers to advancement in the business life of an individual. A continuous professional development means work experience which is logically organized in time and planned in such a way to broaden the knowledge and improve the skills of employees (Hicks-Clarke & Iles, 2000). Professional development is a process which needs active participation and investment of the employee as well as the organization that this employee works for. On the other hand, the purpose of this process is professional acknowledgment and employee's feeling of accomplishment, but also improvement of organization and increased employee's contribution to the achievement of organizational goals by means of professional development (career development, education in company, professional orientation, and system of advancement).

The need for professional development can be recognized in the fact that person always seeks for improvement and strives for changes which will have positive effect on that person's professional development. If the key factors for professional development exist, then the organization generates motivation, pleasure, efficiency and equal development. In order to ensure successful process of professional development there should be fair expert choice of candidates which involves proposition of candidates, evaluation of their characteristics, decision making and monitoring of career development.

2.2. Career planning from the aspect of an individual

The importance of career lies in the fact that career is the strongest and most obvious link which joins individual and organizational goals and interests. Career planning is a process which enables an individual to identify and implement the steps and actions necessary for achievement of career goals. Career development involves career planning, development of possible career paths, activities related to training and development, promotion, promotion criteria, assessment, consulting and encouragement of mentoring which is designed based on personal characteristics of employees. By planning the career, employee takes responsibility for his/her own development by identifying and taking necessary steps and actions for achievement of professional goals. By encouraging the planning and development of career, the organization shows that it cares about its employees, which is a strong motivation for their development.

Career planning helps individuals to understand their personal goals and aspirations and their own identity, to make decisions based on information, to be committed to what they do and to control the changes in their career, both planned and unplanned changes. Thus, it is important to consider a synthesis of biological (hereditary) and social (acquired) characteristics of a person because they build physical, mental, sensor, psychomotor and other biological properties, knowledge, skills, habits and social characteristics (Palmer,2004).

Career has both subjective and objective dimension. Subjective dimension is related to attitudes, interests and motives of individuals, and objective dimension is related to the conditions provided by organization, workplace structure and advancement criteria.

3. INFLUENCE OF PERSONAL FACTORS ON PROFESSIONAL DEVELOPMENT OF EMPLOYEES

Every organization, regardless of the nature of its business, is composed of members of that organization – individuals. The employee is expected to take an active role in the organization in order to control his/her career and its development successfully. It is the individual who should draw the organization's attention to his/her needs and aspirations, and who should be active in looking for the ways to fulfill them. Career development of an individual is not necessarily connected to a single organization. According to Spencer and Harris-Bowlsbey (2014), every employee in an organization is the instrument that organization uses for achievement of its goals. Likewise, employees should see the organization as their instrument to achieve the goals related to their professional development and advancement. The best way to achieve mutual goal is when personal professional goals are similar to those of the organization. In order to analyze the organizational processes and functioning of an organization, the behavior of individuals who work in that

organization should be analyzed first. By observing the behavior of each individual, certain characteristics that this person exhibits in community can be seen. People behave differently inside an organization, and those differences are mainly due to differences in their personalities. That is why it is of utmost importance for the management to define and be aware of the characters of all employees. Apart from understanding the behavior of someone, it is also important for the management to accept the fact that everyone is different, and to match the job with person as much as it is possible. Also, it is necessary to recognize person's characteristics and dimensions which will influence the development of employees and use the potential of other employees. When planning career development, the basis for that plan is person's characteristics. In the beginning, both employee and organization need to familiarize themselves with the strengths and weaknesses so that they could adjust the development to those strengths and weaknesses. Behavior and profile of an organization are the result of relation between personalities and behavior of its members.

3.1. Personality and personal characteristics

Personality is commonly defined as a unique combination of characteristics of a person, seen from this person's behavior and communication with other people. The most important fact is that it is a combination of characteristics which single this person out from other people in his/her surrounding. Also, another important fact is that the person's character is formed and expressed during the interaction with other people. Those interactions in someone's life create this person's character but they also serve us for evaluation of someone's personal characteristics. Judge, Higgins, Thoresen, Barick (1999) noticed two basic factors of personality are inheritance and environment where person is maturing, as well as the situations this person has experienced.

- Inheritance includes factors which influence personality by birth. Those are physical qualities, gender, temper, energy level, biorhythm, etc. Genetic inheritance is an important factor in this group.
- Environment includes several factors which influence the personality. This group includes those influences that occur during one person's growth and development. Those are family (as the most important factor shaping one's personality), belonging to certain social group (social class, profession), and belonging to a nation and national culture.
- Situation is not as important as inheritance and environment but sometimes it can be of huge importance to person's development. The influence of a situation is more of a correction type because it can rarely create a characteristic if a person does not already have it, but it can emphasize some hidden characteristic that this person has not been aware of.

Most personality research has been focused on discovering characteristics and personality traits. Personality traits are permanent characteristics which describe the behavior of a person. The Big Five Model gives the most significant classification of personality traits and characteristics according to John & Srivastava (1999). After a long research of several thousands of characteristics, five basic dimensions were selected based on which all characters can be distinguished.

1. Extrovert-introvert (sociality or openness) - degree to which person is sociable and satisfied with relationship with other people. Extrovert people are sociable and open, communicative and friendly towards other people. Introvert persons, are unsociable and closed people, and they are less willing to take part in social interactions.

2. Amiability – this dimension refers to: cooperativeness, warmness and trust, but on the other hand it is also marked with antagonism, coldness, doubt. This trait shows tendency of a person to be agreeable and keep good relationship with others.

3. Consciousness- this dimension shows reliability and trust, but on the other hand it also shows disloyalty and distrust. This trait describes a person who is careful, scrupulous and persistent.

4. Neuroticism – this dimension, on the one hand, shows emotional stability, safety and calmness, and on the other hand it shows nervousness, uncertainty, depression. People who are adjusted or emotionally stable are calm, stable, relaxed and feel safe.

5. Openness- this dimension of personality shows creativity, originality, curiosity, openness to new experiences, imagination, and un-conventionalism and risk proneness. At the other end of this dimension, there is closeness, conventional person, conservatism, lack of imagination, aversion towards risk.

One of the well known classifications of personality types is the one defined by Judge et al.,(1999). They observed dimensions of personalities in the context of their development. He determined that every person's

personality was developed from immature to mature based on certain dimensions. Schermerhorn, Hunt, and Osborn (2005) determined that this development occurred in cycles and not continuously, and he set the hypothesis about those cycles: up to the age of 18, from the age of 18 to 30, from 30 to 45, and from 45 onwards. Dimensions of mature and immature personality can be seen in the following table:

Table 1: Dimensions of mature personality (Schermerhorn, Hunt, Osborn 2005)

Mature personality	Immature personality
Active	Passive
Independent	Dependent
Different modes of conduct	Single mode of conduct
Deeper interests	Minor interests
Long-term perspective	Short-term perspective
Executive position	Subordinate position
Self awareness and control	Lack of self awareness and control

3.2. Matching of personality and job

According to the description and dimensions of personality, it can be concluded that people are different and that individuals cannot be categorized as being better or worse for some jobs (Judge & Bono, 2001). The fact is that all people are different. However, we cannot say that employees' characteristics are not important for an organization. According to Holland's theory, although all characteristics of people are legitimate, they have to be adjusted to the work that employees do. Although all personality traits are equal they are not equally good for all positions. Matching of personality traits to job requirements increases both productivity and job satisfaction. In case that a manager forces an employee to do the job which requires personality that is totally opposite of the personality of that employee, the employee will be dissatisfied and frustrated regardless of the fact that this type of job can be attractive to someone else. According to Holland's theory, there are 6 main personalities which have corresponding jobs.

Realistic – prefers to work in the field of civil engineering, agriculture, architecture; *Investigative* – prefers the following jobs: biologist, chemist, dentist, vet, programmer; *Artistic* – prefers the jobs of: artist, musician, poet, interior designer, writer; *Social* – prefers jobs of: social worker, counselor, police officer; *Conventional* – prefers jobs of: teller, clerk, typist, data input; *Enterprising* – prefers jobs: lawyer, business director, politician, TV producer.

3.3. Career and working styles

1. Perfection – people who set goal to work perfectly and to be perfect must not make mistakes and in that way they renounce their right to be average. This person strives for perfection in one aspect of life which is important for him/her or in more aspects. The person devotes a lot of energy to these aspects, which is why it is difficult for him/her to perform other activities. Perfection can be comparative, which means that an individual wants to be better than the others, or non-comparative, when an individual does not compare himself/herself with the others but tends to be the best at what he/she does. Perfectionists are not productive because they waste considerable time irrationally on achieving good results for something that is not necessary. These people can suffer from obsessive disorder or depressive disorder. They need help in order to be able to develop the personality which they can use to distinguish between optimum and maximum.

2. Strong personality – these people tend to show their strengths and not weaknesses, they are proud of their persistence, strength and resolution. This type of behavior is common in our country where life has been cruel to people and they are exposed to danger of not being able to ever lead better lives. These people prepare themselves for cruel life and in that way they renounce the right to enjoy. They often develop antisocial personalities; they have paranoid tendencies and suffer from psychosomatic disorders.

3. Arduous work – these people work constantly regardless of the fact whether their work is visible or not to other people and in that way they pose limitations on going on holidays and having fun. People often choose this type of work when they want to avoid pessimistic mood, loneliness and boredom. These people are afraid of being rejected and do not allow themselves to have rest. They often suffer from chronic fatigue, heart attack due to being extremely tired, spine problems, depression (Katic et al.,2013).

4. Pleasing– these people stick to the principle that they should not oppose the others and have to fulfill their wishes. There are two extremities: according to the first extremity, the imperative is to please the other people and according to the second extremity, the imperative is to please them. This type of person is narrow minded and often looses social power, avoids conflicts by withdrawing from a conversation with other people and remains separated from her/his wishes. Due to their behavior, these people are often in danger of suffering from depression and psychosomatic disorder. These people should be persuaded to realize that they are not responsible for the other people‘s feelings and that their wishes are very important. The model of assertiveness training can influence on the changes.

5. Speed – the imperative of speed is of particular importance in urban western societies. An individual is extremely fast and effective in everything he/she does, but he/she can easily become bored. These people believe that normal and low work rates are undesirable. The basis here is productivity and efficiency. These people are limited because they have problems with handling all social situations where things are performed at normal or low work rates. These people choose professions which require speed such as journalism, television, stock market, medicine. They are constantly exposed to stress and there is an increased risk of suffering from hypomania, psychosomatic disorder and cardiovascular diseases. The most important for these employees is the fact that they have to behave in accordance with their nature because in that way they will feel better and have right attitude about themselves and the environment around them.

3.4. Personal values

Personal values represent beliefs that certain modes of conduct or existential conditions are desirable from personal or social aspects in comparison to the opposite modes of conduct or conditions. Therefore, values represent an ideal condition or mode of conduct which we are striving for. Values show what people believe is good and what is bad. Every value has content and intensity. Content of value shows the things that people believe are good and important, and intensity shows how good and important those things are. An individual system of values is developed when individual’s values are ranked based on importance and then connected. The value system shows the values which are important for individuals and the values which individuals believe are good and which are bad, as well as which values are important, less important and the relationship between them. As such, individual value system is the best in showing predisposition of an individual to behave in a certain way. Values develop in early childhood and they are set early in people’s lives. Family is a factor which has the largest influence on the development of values in every person. Apart from the family, environment also affects development of values. Hollander (1971) noticed values are rather stable and difficult to change. The reasons for this are: they are set in early childhood which makes them resistant to changes, and, over the time, they are placed into sub consciousness and people keep them even when they are not aware of that; alteration of values requires radical change of people’s attitudes about the world, which is rare and difficult.

3.5. Locus of control

It defines the extent to which people believe they can control their own destiny. People are different with respect to the feeling of control that they have over their lives. Some people believe that they are affected by their actions and that they build their own lives. They have internal locus of control because they believe that they have the control. On the other hand, some people believe they do not have the control over their lives and they are affected by activities of the other people or destiny. They have external locus of control because they feel that their lives are beyond their control. In organizations according Blau (2011), those who have external locus of control are, as a rule, less satisfied with job, more absent from work, less dedicated to work and have strong tendency to obey orders and authority. People with internal locus of control have better performances at more complex jobs such as job of a manager and all expert jobs.

3.6. Self esteem

Self-esteem is the extent to which an individual respects and appreciates himself/herself and his/her abilities. Self esteem is related to self efficacy which shows an extent to which an individual believes in his/ her individual abilities. People with high self-efficacy greatly appreciate their abilities and according to that they can have high self esteem. People with high self esteem believe that they are able to perform difficult tasks. This is why they are highly motivated, prone to take risks and they are more satisfied with their jobs (Judge & Bono, 2001). If some difficult and risky job has to be done in an organization, people with high self esteem and self-efficacy should be chosen. People with low self-efficacy and self esteem will show tendency to be dependent upon other people and they will be less satisfied.

3.7. Self-observation

Self-observation is the extent to which an individual is aware of his/her characteristics and abilities to adjust his/her characteristics and mode of conduct to the situation. People with greater extent of self-observation are more aware of themselves and their environment. These people pay more attention to the behavior of other people in the organization. Therefore, they are more aware of the situation around them. However, even if they have higher ability to adjust to the environment, these people are promoted and change workplace more often.

3.8. Abilities

Abilities are defined as mental or physical capacity of an individual to perform certain tasks or jobs. People's abilities are of particular importance for understanding of behavior in an organization because they affect the individuals' performances and organizations as well.Judge and Bono (2001) indicated abilities can be divided into two main groups:

- Intellectual abilities are part of general intelligence and they include the following abilities: verbal, numerical, reasoning abilities, abilities to deduce, to notice relations, to remember, to manage in space and ability to perceive.
- Physical abilities comprise two groups of abilities: motor and physical abilities. Motor abilities represent abilities to physically manipulate things in the surrounding and they include the following: reaction, speed of the arms… Physical abilities represent an individual physical shape and strength such as: static strength – ability to lift certain weight.

3.9. Employees' attitudes

When entering an organization, employees do not renounce their old, previously acquired characteristics, but they change, adjust and improve them partially (Driver,1982). Employees have influence on organization and its aims and organization and management have influence on employees, their interests, development and behavior. Employees' attitudes to work and organization are of particular importance for management. Attitudes have three components:

- Emotional component,
- Cognitive component,
- Behavioral component.

Attitudes can be defined as relatively stable group of feelings, beliefs and behavioral predispositions towards some certain object.

4. CONCLUSION

Career advancement means that individuals analyze their weaknesses and strengths, learn about the ways to develop or overcome them by analyzing aspects of internal motivation for set goals in careers. People, their needs, preferences, motivation and satisfaction become the center of attention in business, considering the fact that we have come to the conclusion that human capital represents major tool of the competitors' abilities and advantages on the global market. Personality represents complex psychological structure which requires knowledge in personality psychology so that their career development could be affected. Accordingly, this paper focuses on the analysis of psychological traits of employees that affect their careers.

Assessment of personality by using five-factor model of personality provides information on significant personality indicators that affect job performance. Adopted attitudes of employees, that are seen through locus of control, attitudes, working styles, self-esteem, self-observation, and employees' expectations are conditioned by personality traits, which further leads to assuming the responsibility for career management. Strengthening of organizational culture and climate, in order to establish criteria, is necessary, as well as establishing the criteria for employees' development so that employees could build portfolios of their own achievements and abilities. Business reason for the mentioned concept lies in the productivity of employees which is the result of more realistic dedication of employees to the career development.

REFERENCES

Arthur, M.B., & D.M. Rousseau. (1996). A career lexicon for the 21st century. Academy of Management Executive 10(4): 28–39.

Arnold, J. (2001). Careers and career management. In N. Anderson, D. S. Ones, H. K. Sinangil, & C. Viswesvaran (Eds.), Handbook of Industrial, work and organizational psychology, vol. 2. (pp. 115−132)London: Sage.

Bacanli,F. (2006). Personality Characteristics as Predictors of Personal Indecisiveness. Journal of Career Development 32. (4): 320-332.

Blau, G. (2011). Testing the relationship of locus of control to different performance dimensions, Journal of Occupational and Organizational psychology, 66:125-138.

Blustein, D.(2006). The psychology of working: a new perspective for career development, counseling, and public policy, Routledge.

Casto, M.L. (2000). Get Smart! About Modern Career Development: A Personal Guide to Creating Your Life's Work, Biblio Distribution.

Driver, M.(1982), Career concepts- a new approach in HR., Enlewood Cliffs, NJ:Prentice-Hall.

Hollander, E. P. (1971). Leadership, innovation and influence: an overview. In E. P. Hollander and G. Hunt. Current perspectives in social psychology. New York. Oxford University Press. 495-505.

Hicks-Clarke, D., & Iles, P.(2000). Climate for diversity and its effects on career and organizational attitudes and perceptions, Personnel Review, Vol. 29 Iss: 3, pp.324 – 345.

John, O. P., & Srivastava, S. (1999). The Big-Five trait taxonomy: History, measurement, and theoretical perspectives. In L. A. Pervin & O. P. John (Eds.), Handbook of personality: Theory and research (Vol. 2, pp. 102–138). New York: Guilford Press.

Judge, T., Higgins, C., Thoresen, C., Barrick , J. (1999). The big five personality traits, general mental ability, and career success across the life span. Personnel Psychology 52. (3): 621-652.

Judge, T.A.,& Bono, J.E. (2001). Relationship of core self-evaluations traits: self-esteem, generalized self-efficacy, locus of control, and emotional stability-with job satisfaction and job performance, Journal of Applied Psychology, 86.

Katić,I. Grubić-Nešić,L., Mihailović,D.,& Lalić,D. (2013) Overworking as a threat to modern business**,** ISSN: 1840-1503, Technics Technologies Education Management, Vol.8.No.1. 2/3.

Palmer, J.,Finney ,M.(2004). The Human Resource Professionals' Career Guide: Building a Position of Strength, John Wiley and Sons.

Spencer G.N.,&Harris-Bowlsbey.(2014). Career Development Interventions in the 21st Century, Prentice Hall.

Schermerhorn, J., Hunt, J., &Osborn, R. (2005).Organizational Behaviour, New York: John Wiley &Sons

RESEARCH INTO ATTITUDES ABOUT SOCIAL CHANGE AND GLOBAL MODELS OF GOVERNANCE[1]

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Abstract: *This paper presents the results of the empirical research "Cultural orientation of actors/students, interethnic relations, national identity and the culture of peace in the Balkans" performed within the macro project "Tradition, modernization and national identity in Serbia and the Balkans in the EU integration process" (179074). They are related to attitudes about democracy, social change and global management. The key issue of the research is how people perceive functionality of democracy and whether they are satisfied with the situation and do they support the democratic process and democratic institutions. From the findings we can see that the authoritarian legacy consciences burden the citizens of Serbia greatly, and in particular the examined population - university students. Confirmation of this was seen in the finding that the majority of respondents believe that the best global management model is technocracy. This leads us to the conclusion that our society still does not have a fully developed and mature political culture since the people are still inclined to accept (personalized) authorities that are ultimately reflected in the state and the holders of state power rather than citizens and their associations.*

Keywords*: change, democracy, technocracy, authoritarianism*

1. INTRODUCTION

The beginning of XXI century can be considered as the period of the third wave of democratization (Huntington, 1991), the period characterized by accelerated breaking up with authoritarian systems and the consolidation of democracy at the global level. The third wave was initiated in 1974 with the democratic changes in Portugal and continues to this day. The process has been accelerating since the second half of the eighties. Authoritarian regimes transit to a democratic form and parliamentary elections are becoming freer and more open. The number of countries in which democratic electoral system is evolving (multi-party parliamentary democracy) has more than doubled in the last three decades. It seems, at least when it comes to the beginning of the XXI century, that this is the age when democracy is, at least nominally, becoming a global political norm rather than one of the possible choice. But in the new democracies, as it is the case with us, it appears, as a general problem, that they still retain an authoritarian heritage since the democratic norms, values and practices are still a great uncertainty for many actors of social change, starting with political and economic leaders, political parties, civil` associations and to the ordinary citizens. It takes time for people to adapt and accept democracy as a form of global management and government of the state and society. So in order for democratic systems to be functional it is important how the citizens themselves perceive their functionality among other things, e.g. if they are satisfied with the situation and whether they support democratic process and democratic institutions. Therefore, it is nothing strange that the new democratic society has a lot of problems in the way of democratization.

The aim of this paper is to determine the extent Serbian citizens support the democratic system and democratic institutions, e.g. to what extent do people experience democracy as the optimal form of global management. Therefore, we conducted a survey of social attitudes of citizens relating to the acceptance of democracy as a system of global management, relationship to social changes and issues if the social subject should be managed by the state.

A variety of factors affect citizens' satisfaction with the democratic process (McAllister, 2008). One of them relates to the institutional aspects of democracy. This is especially true when it comes to whether the elections can provide representation in the establishment of their will, and whether that can ensure the quality of the electoral process, which will be reflected to the effects of the election activities of citizens. Second, support for the democratic system takes into account a responsibility and performance of the system, i.e. whether the system is effective in providing good management, as well. It should be taken into account whether the occasional and temporary convergence of political parties in order to create coalitions

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limits the choice to citizens. Third, the consequences of political participation and political involvement of the citizens to political efficacy are important.

Here will be analyzed the results of the empirical research "Cultural Orientation of Actors/Students, Interethnic Relations, National Identity and the Culture of Peace in the Balkans" performed within the macro project "Tradition, Modernization and National Identity in Serbia and the Balkans in the EU Integration Process" (179074) in the implementation of the Centre for Sociological Research, Faculty of Philosophy, University of Niš, which is financially supported by the Ministry of Education and Science of the Republic of Serbia. The study was a survey type and realized in the area of South and Southeastern Serbia (summer 2013) on a sample of 818 students of the University of Niš. The sample is proportional to the composition of students and includes three groups of students: (1) students of social sciences and humanities, (2) students of technical and technological sciences and (3) students of medical and natural sciences and mathematics, by years of study and educational institutions.

2. SURVEY DATA ANALYSIS

Many years even decades-long crisis facing the Serbian society has endangered the stability and functionality of the society to the extent that the issue of fundamental social transformation became a development imperative. Of course, there may be different types and different political contexts in which transformation may take place. Today, the broader public often raises the question whether it is better for our society to establish a democratic or an authoritarian form of political organization. Of course, this is a false dilemma considering that the current social practice has shown that democracy has many advantages over other forms of political organization. Every form of authoritarian government favors particular social subjects to the detriment of some others while democracy strives to articulate different interests. Of course, democracy may have specific problems and go through developmental difficulties and even "children's diseases" but at the end of the development path however shows socially favorable results which for various forms of authoritarian government generally it cannot be told.

Revisiting the concept of political power often corresponds to the dominant value patterns in the society among which we would emphasize the global type of national culture and within it the issue of organizational and political culture as particularly important. (Mojić, 2010). Unfortunately, in the society of Serbia during recent history dominated patriarchal and traditional cultural patterns within which authoritarianism (Kuzmanović, 1994, 1995) and nationalism (Miladinović, 2006, 2007; Popadić, 2010) played a particularly significant role. This context dictated in many respects the type of organization and political culture and attitude towards work cultivated in our society. It is no coincidence that the personal authorities were easily accepted in these areas and built cults of leaders on the basis of them (Kuzmanović, 2010). Rather than democratic solutions characterized by the free elections and a parliamentary form of government there are often present personal authorities who frequently promoted populism and hid themselves behind the idea of technocracy in a public arena. The essence of a technocratic government, which is supposed to represent the rule of experts, is that they, despite their expertise, they are not politically neutral for general benefit, but they support various authorities and their ideologies and interests clans. Authoritarianism as a value framework and personal power as a political practice are in the firm coupled with the demagogic action that was done in parallel demagogic rhetoric and concrete action designed to satisfy the low passions, and launch the broad masses support (Stojanovic, 2011).

Authoritarianism, cult of leaders and demagogic actions triggered mass as inarticulate subject which is easy to manipulate. In such circumstances, the power of mass gives legitimacy to the leader and theirs will is seen as a general people will. It has long been known that when ideas mastering the masses become the driving force that can fundamentally change the social circumstances. The key problem is that the charismatic leaders with a skillful manipulative rhetoric present their ideas as ideas of the masses and thus get an enormous social power that presents as a legitimate political will of the people and their every move as the fulfillment of the peoples will (Miladinovic, 1994).

The recent political history has shown that every social crisis, whether economic or political, is an introduction to the period in which the leader has grown over the society. The Second World War and the period of revolutionary construction led to the cult of Josip Broz. After his death, the political crisis has led some nationalist leaders in the political arena (Bowman, 2004; Denitch, 1996; Miladinović, 1994):. Ideological turmoil, in the conjunction with the birth of multi-party system, brought to the surface a larger number of potential candidates who play on personal charisma and fought for the position of undisputed leader of the nation. The period after the 2.000 year is a period of temporary calm. It seemed that the leaders go down in history, and vacuum is filled with new social and political patterns. However, the crisis at the end of the first decade was favorable for the fact that citizens of Serbia turned again to personal authorities and give the support to the cult of personality at the beginning of the second decade of the twenty-first century. At this

moment it is a thankless task to predict the outcome of the current social and political turmoil. It can be reliably argued only that there are all necessary conditions to establish the cult of the charismatic leader and his personal power. What will be realized from it depends on a number of political, economic and cultural factors that set the tone of current events.

Table1: To what extent do you agree with the following attitude:

To what extent do you agree with the following attitude:	Strongly Disagree (1)	Tend to disagree (2)	Neither agree nor disagree (3)	Tend to agree (4)	Completely agree (5)	Mean	Std. Deviation	N
Democracy may have its problems, but it is better than any other form of government	12,84%	11,60%	31,73%	28,89%	14,94%	3,21	1,210	806
Undemocratic order is sometimes better and more efficient than democratic	14,88%	15,62%	39,24%	19,19%	11,07%	2,96	1,178	806
Democracy is the same as anarchy	29,19%	24,26%	30,54%	9,85%	6,16%	2,39	1,177	806
For people like me it does not matter what kind of political system they live	47,41%	13,92%	22,41%	8,13%	8,13%	2,16	1,318	806

With the aim to determine the tested population attitudes towards democracy we asked respondents to declare themselves to which extent they agreed with the four statements (Table 1):

1. Democracy may have its problems, but it is better than any other form of government
2. Undemocratic order is sometimes better and more efficient than democratic
3. Democracy is the same as anarchy
4. For people like me it does not matter what kind of political system they live

It turned out that is the highest compliance exists with the first claim. Even 43.83% of respondents believe that democracy is better than any other form of government, although it may have its problems. If we take into consideration dominance of authoritarian patterns in the value structure of the society in Serbia, this finding seems to be very good. However, it does not provide developmental perspective of Serbia. The problem is that one in four does not endorse this attitude and one in three does not have clearly defined opinion on this issue. Even among those who agree with this statement dominate is the caution about the claim that democracy is the best form of governing a society (28.89% tend to agree but only 14.94% completely agree). This answers configuration suggests there is a poor subjective potential for adoption and development of a democratic political ideas and system in Serbia.

The largest numbers of the respondents are not in a state to respond about their own compliance with the claim that the undemocratic order is sometimes better than democratic (39.24%). There is an equal number of respondents who refuse and accept this attitude (about 30%). Within the structure of those who reject this essentially anti-democratic attitude, half of them reject it completely but the other half do it mainly. This configuration of responses indicates that there is very good potential for the acceptance of non-democratic forms of governing a society. This finding is not surprising given that previous studies have shown a very high presence of authoritarianism in the value structure of the population of Serbia (Kuzmanovic, 2010).

If we sharpen the previous attitude and say that democracy is the same as anarchy, then we have a slightly more favorable response configuration. Now willingness to defend democracy shows more than half of the respondents (53.45% of which 29.19% completely) while 30.54% are indecisive. So, there are only 16.01% of those who directly admitted that democracy and anarchy can be equated. In the structure of those who equate democracy and anarchy are 6.16% of those who completely agree this attitude. Ultimately, this is about the potential for acceptance of extremist political organizations and their ideologies. This potential can be extended from the current six percent to a significantly higher number in times of crisis. Moreover, here is a potential core for extremist forces first line support in any context of escalation of social conflicts and their transmission from parliament and factory halls to the streets. This number can grow up in a short time and take on alarming proportions by skillful political manipulation and attempts to establish the cult of the charismatic leader, as it was seen in Serbia and former Yugoslavia in the nineties.

The last statement "for people like me it does not matter what kind of political system they live in" expresses political apathy. Political apathy may be considered as an expression of saturation with political events or dissatisfaction among citizens about social perspective or inadequate party and electoral offer and the entire political elite (Stojiljkovic, 2011) as the "lull before the storm." In our case, only 16.26% of respondents expressed a direct political apathy supporting such attitude. Half of it (8.13%) accepted this attitude completely. It should be added that 22.41% of those who cannot opt which in total are 38.65% of potentially apathetic citizens, i.e. those who might want to take off from any political activity. On the other hand there is the majority of 61.33% of the respondents who do not accept political apathy as a way of his personal relationship with the government of the state and society. An interesting finding is that almost half of the examined population completely rejects this claim. This means there is a great potential for political activism in the Serbian society, and that the citizens are very interested in the politics and political perspectives of the society.

Table 2: Which of the following statements best describes your opinion:

Which of the following statements best describes your opinion:	
The whole organization of our society must be radically changed (in revolutionary action)	25,31%
Our society must be completely changed through a reform	52,21%
Our present society must fight vigorously against any changes	7,74%
I do not know	14,74%

A democratic society is essentially a dynamic society. A dynamic society is a society that is willing and able to change itself quickly and create new forms of social behavior. Of course, it is important to the changing of society that there are no subjective forces that would be carriers of changes. It is common understanding that the younger and more educated, which includes our respondents, are more willing to accept and initiate social change. Therefore, we offered them to choose an attitude that best reflects their relationship to a global social change (Table 2). Offered attitudes exemplify the following orientations: a radical change (radical cut - a revolution), gradual change (reform), resistance to change and the absence of change attitude. The modal response was that the society should completely change through a reform. So, every second respondent accepted reform, gradual changes, as the best solution to the current social problems. On the other hand, one in four respondents thought that the best pattern of social change is a radical revolutionary action. The key difference between these two versions is the duration of the transformation process. While, on the one hand, the reform involves long duration process on the other side revolution implies a relatively short-term action. A revolution brings stormy and very dramatic changes almost as a rule while the reform is not necessarily the case.

It is an interesting finding that even 7.75% of the respondents think that our society must fight vigorously against any changes. They advocate for the status quo, for preserved existing situation of social relations. We need to add 14.74% of those who declare that they cannot opt for any of the available variants.

So almost 85% of students have a clear vision of the pace with which the social transformation is supposed to happen and more than half is for gradually changing social relations.

Table 3: Who in your opinion should manage the state:

Who in your opinion should manage the state:	
A strong leader who is not limited by Parliament and elections	17,04%
Experts who know best what is good for the state	60,49%
Army	3,33%
The government and the parliament elected in free elections	19,14%

Respondents were also given to declare themselves within which global government model changes should happen (Table 3). We asked them the question: "Who should manage the state?" and it was given as standard variants authoritarianism (strong leader who is not limited by Parliament and elections), democracy (the government and parliament elected in free elections), technocracy (experts who know best what is good for the country) and militarism (the army). The answers are surprising. The modal response was based on the idea that the state should be managed by technocracy i.e. experts who know best what is good for the state. Technocracy as the best model of state government adopted by more than half of respondents (60.49%).

The second ranked was the answer that the best model of state management is a democracy that declared one in five respondents (19.14%). Authoritarianism is accepted by 17.04% and militarism by only 3.33%.

Thus, the technocratic model is three times more desirable than the democratic model of state management and government. Here, in our example, we recognize the authoritarian heritage in accepting the authority of experts. The key disadvantage of the technocratic model compared to the democratic is that professionals are given carte blanche confidence to make strategic decisions and the bulk of the population is excluded from the decision-making process. Technocracy is a kind of the minority educated professionals tyranny over the majority of less educated members of society. It should be noted that technocracy does not necessarily produce socially valuable results. It can be linked to any political or economic strength of society and defend its own interests, or simply take care about their own interests primarily. The point is that global politics should be left to the democratically elected government that will be able to articulate the interests of all stakeholders of civil society and ensure the protection of minority interests in the broadest sense of the word. Experts should be left to perform the individual specific tasks that require professional competence and thereby achieve socially valuable effect.

But it seems to be, the much greater problem is that one in five respondents accept authoritarianism either in any form of government of a strong leader who is not limited by Parliament and elections or in the form of militaristic government.

In the next step (Table 4) we crossed questions that show the attitude towards change and attitude that defines the optimal model of change. There is statistically significant relationship ($p = 0.000$) of low intensity between these two variables (Contingency coefficient C=0.23 and Cramer`s V=0.13). Most frequently accepted combination is the one that connects the reformist view of social change with the technocratic model of governance. Concretely, 65.3% of the supporters of reform course accept technocratic model of governance as the best, or 56.4% of the supporters of technocracy accept the reform course. Another cell of the table which contains interesting results is one in which even 58.1% of the supporters of the democratic model of governance accept the reform course of changes. Of course, acceptance is not bidirectional, as only 21.4% of reformists accept democracy as the optimal model of governance. It is also interesting results in the row where intersects supporters of revolutionary change (radical cuts) given that more than half of supporters of radical change (56.4%) also preferred technocratic model of governance, while on the other hand, only about a quarter of supporters of technocracy accept the radical changes. It is interesting that 44.3% of supporters of the status quo accept the government of technocracy.

The table can be viewed either in vertical columns or in horizontal rows only. If we look at the vertical columns, we see that on the one hand one third of the supporters of the authoritarian model of governance advocating the radical course and in the other hand the next third advocating the reform course. It is observed that within this group it is twice more of those who oppose any change (16.2% of supporters of authoritarianism to 7.6% of supporters in the general population. It is observed that within this group, the share of those who oppose any change is twice bigger (16.2% of supporters of authoritarianism to 7.6% of supporters in the general population).

Supporters of technocratic model are mainly directed towards the reform course (56.4%), while a quarter of them (23.6%) accept the radical cut.

A third of the supporter of militaristic model of governance prefer radical cuts (33.3%), a quarter of them prefer reform change (25.9%), while the same number of them are undecided. It is interesting that there are the most of those who do not have a clearly defined attitude toward the preferred dynamic of social change (25.9% compared to 14.9% of the total population) among the supporters of militarism. It seems that the militaristic attitude towards choosing a subject of change occurs as an expression of profound social hopelessness considering that a large number of supporters of this form of government either want quick, radical change or just do not know what would be good for the society, the state and the economy and they found force that can bring order in the society in the army.

It has already been noted that three fifths of the supporters of democratic government model accept technocrats. It should be added that one in five believes that social problems can be solved in the best way applying radical cuts.

Analyzed by horizontal lines we observe that a technocracy is the modal choice of supporters of radical changes (56.4%). In addition to this, almost a quarter of them advocate an authoritarian model of governance. The presence of the acceptance of democracy and militarism in this group is significantly less

Two-thirds of reformist oriented respondents accept the technocratic model of global management and government, while only one-fifth of them accept a democratic model. Other models of governance (authoritarianism and militarism) barely have supporters in this segment of the population

Table 4: Cross tabulation: Who in your opinion should manage the state * Which of the following statements best describes your opinion:

	Who in your opinion should manage the state:				Total
Which of the following statements best describes your opinion:	A strong leader who is not limited by Parliament and elections	Experts who know best what is good for the state	Army	The government and the parliament elected in free elections	
The whole organization of our society must be radically changed (in revolutionary action)	23,5% 35,3%	56,4% 23,6%	4,4% 33,3%	15,7% 20,6%	100,0% 25,3%
Our society must be completely changed through a reform	11,6% 36,0%	65,3% 56,4%	1,7% 25,9%	21,4% 58,1%	100,0% 52,2%
Our present society must fight vigorously against any changes	36,1% 16,2%	44,3% 5,5%	6,6% 14,8%	13,1% 5,2%	100,0% 7,6%
I do not know	14,2% 12,5%	59,2% 14,5%	5,8% 25,9%	20,8% 16,1%	100,0% 14,9%
Total	16,9% 100,0%	60,5% 100,0%	3,3% 100,0%	19,2% 100,0%	100,0% 100,0%
χ^2=42,946	C=0,23	V=0,13	p=0,000		

Slightly less than half of the opponents of social change (44.3%) accept technocratic model as the best model of governance, while more than a third of them (36.1%) support the authoritarian model of governance.

The distribution of those who declare not to know which the model of governance would be optimal is almost identical as in the general population. The only visible difference is related to supporters of militaristic model which are almost twice more than in the total population (5.8%).

4. CONCLUSION

Now we can return to the question how people perceive functionality of democracy and whether they are satisfied with the situation and do they support the democratic process and democratic institutions. From the findings we can see that the authoritarian legacy burden the conscience of citizens of Serbia greatly, and in particular the examined population - university students. Confirmation of this was seen in the finding that the majority of respondents believe that the best global management model is technocracy. This leads us to the conclusion that our society still does not have a fully developed and mature political culture since the people are still inclined to accept (personalized) authorities that are ultimately reflected in the state and the holders of state power rather than citizens and their associations.

Technocratic system can be considered as a transitional form between classical authoritarianism, which may be embodied in personalized authority or in authoritarian institutions such as the army in a very limited context, and democracy which is represented with the government and the parliament elected in free elections. In this case it is masquerading as professional competence of their carriers so that it can be easily uncritically accepted as a system of governance which is better than authoritarian personnel governments or military administration in periods of turbulent social upheaval which also impairs the democratic nature of the social system at the same time. The problem is that a technocratic government is not the same as a democracy. Technocratic government and management of society is just one more model of authoritarian rule. The difference compared to other authoritarian models is that the technocrats hide behind the professional competencies what inspire some confidence, but it does not mean that there is an existential interest of experts to work for the common good. Technocrats are not controlled by numerous mechanisms of broader social control backed by the citizens. Technocrats are controlled by centers of alienated social power and behind them can stand very different authorities.

The expansion of political freedom (democracy) achieves different effects on economic growth (Barro, 1999). The positive thing is that democratic institutions enable control of the government, which limits the potential

of public servants to accumulate personal wealth or to do the unpopular policy. Negative is that more democracy encourages redistribution of income from the rich to the poor, and the growing power of different interest groups. Therefore it can be considered that the net effect of the growth of democracy is uncertain.

On the other hand, practice shows that economic development embodied in the higher standard of living promotes democracy. This relationship is clearly shown when a democracy is presented through the electoral rights and civil liberties and impact, and the living rate through the growth of gross domestic product per capita, access to primary education and reducing the gap in education of male and female population and the growing importance of the middle class etc.

REFERENCES

Barro, R. J. (1999): Determinants of Democracy. Source: Journal of Political Economy, Vol. 107, No. S6 (December 1999), pp. S158-S183.

Bowman, G. (2004): Xenophobia, Fantasy and the Nation: he Logic of Ethnic Violence in Former Yugoslavia in: V. Goddard, J. Llober & C. Shore (Eds.), *Anthropology of Europe: Identity and Boundaries in Conflict*, pp. 143-171. London: Berg.

Denitch, B. D. (1996): *Ethnic nationalism: The tragic death of Yugoslavia*. Minneapolis: University of Minnesota Press.

Huntington, S.H., (1991): The Third Wave: Democratization in the Late Twentieth Century. University of Oklahoma Press, Norman, OK. pp. 13-26.

Kuzmanović, B. (1994): Autoritarity in: Lazić, M.(ed): *Society in crisis,* Beograd: Filip Višnjić;

Kuzmanović, B. (1995): Autoritarnost kao socijalnopsiholška karakteristika, u: *Društveni karakter i društvene promene u svetlu nacionalnih sukoba*, priredili Golubović, Z., Kuzmanović, B. i Vasović, M. Beograd: Institut za Filozofiju i društvenu teoriju i Filip Višnjić

Kuzmanović, B. (2010): Autoritarnost – vapaj za jakim i pouzdanim vođama i disciplinom, u: *Kako građani Srbije vide tranziciju*, priredio Mihailović, S. Beograd: *Friedrich Ebert Stiftung*

McAllister, I (2008): Public Support for Democracy: Results from the Comparative Study of Electoral Systems Project. Electoral Studies 27: 2. pp. 1-.4

Miladinović, S (2007). Stanje nacionalne tolerancije u Srbiji. u Matejić, V. (ur). *Tehnologija, kultura, razvoj.* str.164-173. Beograd: Udruženje „Tehnologija i društvo“ Institut „Mihajlo Pupin“ Centar za istraživanje razvoja nauke i tehnologije.;

Miladinović, S. (1994): Fenomen vođe, Gradina 1-2-3.

Miladinović, S. (2006). Pitanje socijalnih identiteta nacionalnih manjina i evrointegracijski procesi u Srbiji. *Sociološki pregled*, 2: 207-245.

Mojić, D. (2010): Kultura i organizacije: uticaj kulturnih pretpostavki, verovanja i vrednosti na organizacione strukture, sisteme i procese. Beograd : Čigoja štampa : Institut za sociološka istraživanja Filozofskog fakulteta.

Popadić, D. (2010). Put iz bratstva i jedinstva – etnička distanca građana Srbije“, u Mihailović, Srećko (ur). *Kako građani Srbije vide tranziciju, istraživanje javnog mnenja tranzicije*, str. 105-121. Beograd: Friedrich Ebert Stiftung.;

Stojanović, Đ. (2011): Početak „rata harizmi” u ex-Jugoslaviji: od institucionalne ka ličnoj harizmi Slobodana Miloševića. Kultura polisa, god. VIII (2011), br.15, str. 107-128.

Stojiljković, Z. (2011): Politički kapital i kultura (ne)poverenja: slučaj Srbija. u Podunavac, M. (ur): Ustav i demokratija u procesu transformacije, Univerzitet u Beogradu – Fakultet političkih nauka, Udruženje za političke nauke Srbije, Beograd

STORYTELLING AS AN ORGANIZATIONAL CHANGE MANAGEMENT TOOL

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Abstract: *Organizational change is one of the most studied phenomena within the domain of organizational theory. Further, overcoming resistance to change is pointed out as a critical success factor in the successful implementation of an organizational change. Over time, academics and practitioners have developed a variety of tools and methods to cope with the employees' resistance to change. This paper presents one of the contemporary corporate tools that has been successfully deployed for such purposes - storytelling. The advantages and disadvantages of the usage of storytelling during the organizational change process are pointed out and avenues for future research are provided.*

Keywords*: organizational change, resistance to change, storytelling*

1. INTRODUCTION

Although the method of storytelling as a communication strategy is well known among theorists, there is not many documented research endeavours on the application of these methods during the process of organizational change.(Simmons, 2001; Wiggins, 2009; Oreg, 2003.) In this paper I will briefly summarize the scope of contemporary research and relevant publications on the corporate storytelling. By doing so, I aim to demonstrate the ways in which the use of storytelling can be an effective form (and even more effective than some other forms) of communication during organizational change. As such, corporate storytelling should secure the support from the employees, especially when it comes to the implementation of strategic goals. In order to demonstrate its power, storytelling will be put in contrast to the traditionally used internal communication channels during the period of organizational change. Research has shown that employees have a greater affinity for changes because of the application of storytelling, mainly due to the fact that stories can be, and often are in this context, associated with their experience and knowledge.

Due to the importance of this topic, for both business and academic community, as well as the great interest in this topic and broader research area in general, this paper aims to highlight the specificities of the method of storytelling in organizations, with an emphasis on organizations that are going through the process of organizational change.

2. CHANGES AND CHANGE MANAGEMENT IN ORGANIZATIONS

Organizations are nowadays faced with high level of complexity and uncertainty in various fields of business due to the fact that economic and social unrest are changing the game, often more rapidly than one can observe. Unfortunately, many companies are designed to operate in conditions where there is no change, or when operating effectively at "full speed" means consistently keeping up the track on the past actions. In that respect, changes are often seen as something that must be overcome, controlled, as a simple break in the known world, not as a new "norm" that needs to be properly managed.

This new "norm" refers to the fact that organizational agility and flexibility have to be developed; organizations need to be able to constantly adapt and change in order to meet diverse economic and competitive challenges. Truly agile organizations are able to meet these changes and challenges through the implementation of different organizational projects that allow them to adapt, to continually be assessed by an educated and informed leadership, and in a way that is common and normal for all employees (Change Management Institute, 2012). To sum up, companies need to develop and strategically apply sophisticated change management practices.

Change management can be defined as a process of constant renewal of the direction of the organization, its structure and its ability to adapt to the needs of internal and external clients (Moran and Brightman, 2001). According to Burns (2004) changes are always present - existing part of organizational life, both on the operational and strategic level. Therefore, there should not be any doubt about the importance of opportunities to be identified on where the organization needs to be in the future, as well as how to manage changes in a way which will make that happen. Finally, organizational changes cannot be separated from

organizational strategy or the other way around (Burnes 2004; Rieley and Clarkson, 2001). Organizational change is one of the building blocks of the corporate strategy.
Although it is difficult to establish any kind of consensus on the framework for the management of change, there seems to be agreement on two important issues. First of all, it is accepted that the pace of change has never been greater than in the current business environment. Secondly, there is a consensus that changes caused by internal or external factors come in all shapes and sizes and therefore, can potentially affect all organizations in all industries. Hence, the significance and the relevance of the topic get constantly reinforced.

3. RESISTANCE TO ORGANIZATIONAL CHANGE

The basis for the success of organizational change is their acceptance by employees. In the context of his work Kubler-Ross (1973) argues that people faced with loss or change go through five stages of "grief" namely: anger, denial, bargaining, depression and acceptance. This indicates the essential aspects of change management in an organization. Wiggins (2009) uses this model for the purpose of communication and support during the period of change which again indicates that it should be adapted to the stage in which the employees are concerned. For example, after the news about the change have been communicated, employees must be given the information that would oppose their potential (and most likely to happen) rejection. After they receive the information, they experience a sense of anger, negotiating and entering into a state of depression, which actually requires different types of support within each of these phases. At the end of the cycle, once employees start to accept the new situation, they need a vision of the future – the one that can make them dedicated and committed to the new circumstances.

On the contrary, some other researchers advocate a different approach in the research on change governance, arguing that individual reactions are complex, different and unpredictable. One representative of such thinking is Oreg (2003) who suggested that the resistance to change is based on the personality and the context in which the change occurs. In his initial study (Oreg, 2003), the author developed and tested a scale called "The scale of resistance to change (RTC)" which is conceptualized as a stable personality trait. In this study, Oreg came to a positive and significant relationship between the individual RTC results and their affective and behavioural resistance to specific organizational changes with which they are faced.

In addition to personal settings that affect the level of resistance caused by organizational changes, Oreg (2003) also showed that the context variables played a significant role. Trust in management has proven to have a strong effect on cognitive and behavioural resistance, which is pointed to the importance of good governance in a time of change. Similarly, studies have shown that a large amount of information about changes given to individuals resulted in a worse evaluation of changes and increased the ability to act against them. This latest finding has led Oreg (2003) to suggest that there will be an optimal amount of information that can be given, after which the employee will feel satisfied. He also suggests that if the change has a negative impact on the individual, it would not be surprising that more information about the change increases the resistance to it. This study highlights the importance of another management approach in connection with the communication strategy.

On a day-to-day basis, the engagement of an employee relies on the effectiveness of internal communication through the exchange of information between employees and management and employees among themselves. Such an internal communication takes place on three distinct levels: the daily management of employee relations, strategic plan for realisation of the mission of the organization, and project management (Cheney and Christensen, 2001). In the times of change, employers need to successfully shape and manage information throughout these three levels of communication, in order to maintain and support amplifiers of positive employees' attitudes (Gots and Wilson, 2001).

4. THE CONCEPT OF STORYTELLING

Corporate storytelling is the process of transferring messages that form a new angle or reinforce the opinion or behaviour using narratives about people, organizations, past, visions of the future, social cohesion and work in general.

Stories are one of the most important motivational tools known to a man. Useful, anytime and anywhere - from the Bible to contemporary comedians - stories explain, entertain and motivate. Through jokes, tragedy and comparisons, they make us laugh, sadden, or inspire. In business, good communicators use storytelling to sell products, generate ideas, develop and nurture a corporate culture. Kyle and Jacobson (1999) remark that the story can communicate vision and build a sense of common goals as well as create a sense of

community among different people. Certain situations are perfect for storytelling, such as new beginnings or calming employees during crisis.

Kaye and Jacobson (1999) identify a typical three-step sequence that holds the key to the power of storytelling:

- *The story*. One person tells the story while one or more others listen.
- *The understanding.* Both parties begin to gain a deeper understanding of something that was previously known only superficially.
- *The shared meaning.* Groups use the shared meaning of one thing as a metaphor or shorthand for the broader understanding of other things.

Organizations are dependent on effective communication as drivers of success. Storytelling already plays an important role in the world of organizations, businesses and modern politics. Stories can be used internally by the organization in order to motivate people and create a memorable message for employees (Madlock, 2009; Marques, 2010). Traditionally, stories in the workplace have been used to highlight the safety and well-being, and reduce risk. From an employer's perspective, the expansion of the value of corporate storytelling is the potential to persuade, motivate and inspire staff, especially in the period of change, which strengthens the internal loyalty (Simmons, 2006).

The key advantage of using stories as a communication strategy during organizational change lies in the fact that management can use the corresponding narrative in order to understand employees (their wishes, expectations, ambitions, general attitudes and attitudes in relation to a respective organizational change etc.), without compromising the goal of communication (Harrison, 2008). The common opinion is based on the fact that the pure logic between management and employees may be significantly improved through storytelling, thus making it easier for employees to adapt to a change and the new emerging organizational reality.

Another important advantage is the universal need for the use of storytelling in contact with members of the organization who have different interests and learning styles. Many large organizations have a great range of stakeholders. The stories provide a flexible framework for the narrator to present objectives in accordance with interests of certain stakeholders (Dowling, 2006). We can see that storytelling is not only a communication tool aiming at employees but all other relevant internal, and potentially also external stakeholders.

5. STORYTELLING AND CHANGE MANAGEMENT

According to Fleming (2001), the role of the leader is to challenge the cosy and outdated beliefs, selectively discarding them, and providing new insights into the attitudes and existing organizational practices. However, most leaders can confirm that this is easier said than done. The following story confirms these claims to a great extent (James and Minnis, 2004).

> *"The young Presbyterian minister looked out on his congregation with satisfaction as he noted the apparent enthusiasm in their faces. He had expected the subject of his sermon – change - to ruffle some feathers and he had embarked on it this morning with no small degree of consternation. He had just finished outlining his new initiatives for the church and, to his delight and surprise, his established (some would say mulish) congregation looked to be responding enthusiastically. Emboldened, he decided to go a step further than he had planned for the morning by asking his parishioners to signify their individual readiness for the fresh ideas. "If you're with me," he enthused, "get up and move to a different pew and take a look at things from a whole new perspective." The response: no movement, except for some head shaking and even a little vocal refusal. One congregant's declaration captured the sentiment of the group in a nutshell: "I'm all in favor of the church making changes, but that doesn't mean I want to change."*

The lack of commitment of employees is the main reason why a program of organizational change fails. Successful change requires a new general behavior of all members of the organization, but employees usually react in the opposite way, with anger, denial, doubt and anxiety. Theorists generally agree that the key to overcoming this resistance is open communication. The most common barrier to organizational changes is the top management who hold tickets to unto in its hands. The change is frequently experienced emotionally by the employees, and task of the leaders is to spend their followers through uncharted waters. The challenge is to involve employees in the current changes so that they feel as participants and not as

targets. This requires leaders to engage not only the technical but also the human side in an effort to change. They can build consensus with strong relationships instead of using the power that their positions bring. In contrast to positional power, where the results are achieved by emphasizing rank, power relations strengthen new projects through the involvement of leaders and provide information to those who will be affected by the changes.

Further, leaders more often consider human emotion as a potential threat, rather than as a potential opportunity for engagement. As the process of creativity stories can be used as a symbolic tool for persuading others to change their views and consider new beliefs. Aristotle talked about the three pillars of persuasion:

- *logos* - that appeals to the intellect;
- *pathos* - indicating emotions;
- *ethos* - which appeals to the credibility of one who convinces.

Intellect and emotion are strongly related, but not always aligned. Emotions have the ability to affect the intellect. The right time, well directed story, can cause emotions to transform the point of view of the employee and motivate the desired response. Mark Walton (2003) calls the stories that affect the change "strategic narratives". Walton (2003) describes a three-step process to develop a strategic story. The first determines what the desired end is - what we want the audience to take. The second one - establishing strategic story should provide a positive view of the future that the audience should imagine. Thirdly, develop a story line that meets the specific needs of the audience, their desires and goals. Annette Simmons (2001), on the other hand, wrote that the need for a demonstration of the benefits of compliance with the changes should be understood – it is the key aspect of this plot. When listeners believe that their needs are understood, linking actions or commitment to the plan provides multiple and significantly higher chances for success.

6. STORYTELLING AND RESISTANCE TO CHANGE

It is the fact that storytelling is a way for the suppression of organizational change, but not a substitute for changes in policies, programs, budgets, incentives, staff, measurement and other actions that are necessary for prolonged periods during the transformation of a large organization. Storytelling is just a tool that can be used to implement these measures in the first place. It helps inciters of changes to communicate the changes to all levels. Storytelling connects employees and managers in order to support the changes that seem strange and threatening.

There are a number of reasons why stories can be effective to change organizations:

- *Storytelling is natural and easy*. The ability to tell and follow narrative is a capacity that happens at such an early age - around the age of two or three years of age - that one is tempted to call the capability innate, or at least a natural, capacity (Brunner, 1990). By contrast, abstract analysis is not something that we do naturally. It is something that we have to be trained to do, through many years of schooling. For most of us, it emerges as burdensome work. It may be excellent mental exercise and good for self-improvement. But except for a few unusual people, who like living in an inert world of non-living things, the experience makes us tired and weary, as compared to listening to stories which most of us experience as invigorating and refreshing and energizing. We find the telling of stories inherently pleasurable (Weick, 1995). Stories invite the listener to visualize a different world, and in the imagining, to add value to the activity. The shared imagining of the teller and listener creates a common space. As the storyteller watches the reactions of the listeners, he instinctively builds on and emphasizes the elements that are resonating with the listeners, thereby encouraging the phenomenon of co-creation. The audience senses that the storyteller is interacting with them, and they respond to it with more reactions. The phenomenon is natural, spontaneous and pleasurable.

- *Stories show the connections between things*. A good story holds disparate elements together long enough to energize and guide action, plausibly enough to allow people to make retrospective sense of whatever happens, and engagingly enough that others will contribute their own inputs in the interest of sense-making (Weick, 1995).

- *Stories bypass defense mechanisms*. The story is bypassing defense mechanisms. One of the attractions of the story is that people can not immediately see where this story is going to take. People find it difficult to categorize stories, especially if they are unfamiliar. Therefore, the defense mechanisms are normal in storytelling. The mind is not critiquing it, but following it, and projecting on to it. This enables a more participatory spirit towards understanding what is involved in it, than if listeners are hearing an analytic presentation where they have their critical apparatus at the ready, to dissect, analyze and appraise the proposed change. In the case of a story, the listeners are not analyzing it. They are living it. The mindset is fundamentally different. (Brunner,1990.)

- *Stories help cope with complexity.* The world is a complex place. Despite the impression we have often been given in school, simple linear phenomena are rare in our world. Non-linear phenomena are everywhere. It is only in the last several decades that scientists have been discovering this reality. How then has the human race coped with such complexity for thousands of years? One of the early ways of coping was by personifying complex events, so that we expect the same non-linear behavior that we expect with persons. Stories provide a simple way that has been used since time immemorial to communicate the complexity of the world. Modern corporations, and the changes that are needed in them, are complicated entities. People in them can understand and make sense of what is going on by telling stories to each other (Capra, 1996).

- *Stories engage our feelings:* Stories have the inherent capacity to engage our emotions and get to deep meaning, because stories are in their nature about the irregularities in our lives, things that catch our attention as being different from what is expected, and hence arouse our curiosity, or even fear. The regularities in our lives attract little attention. They are boring. They are the background noise of our lives and do not constitute the subject matter for stories, except when we discover a new regularity, which in itself is unexpected and hence irregular. It is the irregularities that attract our attention: they operate as a potential threat to our capacity to stay in control of our lives, as well as an incentive to understand them so as to be able to have a say in our future. As a result, stories, in addition to their cognitive dimension for understanding the irregularities, tend to engage our emotions to the extent that we perceive our well-being and safety to be at risk. (Brunner, 1990.)

7. AN EXAMPLE

Results of an employee satisfaction survey conducted by Ericsson Australian and New Zealand during the global financial crisis period in 2008 indicated poor results, with: senior leaders' motivation rating 52 per cent; leadership communication capability rating 57 per cent; and, strategy awareness rating 66 per cent (Aplin, 2010). Ericsson launched a three-year strategy with programs addressing business challenges and opportunities, focussing on transforming the organisation's culture to becoming more customer-centric. The goal of the program was to help employees understand the organisation's ambitions and feel motivated to contribute. To achieve this, Ericsson recognised the need to build communication competence with senior leaders. The organisation set objectives to improve leadership communication capability and strategy awareness by three points. The senior leadership group (including the CEO) was required to attend two half-day workshops on storytelling, which had been identified as the way to connect, not just communicate, with the staff.

It was identified from these sessions that although the organisation had a story to share with employees, each team had unique challenges that needed to be addressed by the leaders to gain support for the cultural change. Gaining senior leadership 'buy-in' was an important element to making the storytelling strategy a success. Of the Ericsson leaders, although some scepticism was initially detected, 97 per cent rated the workshops as developing relevant skills for their roles as leaders and 91 per cent saying storytelling improved their influence as a leader (Aplin, 2010). The results from educating leaders in the strategy of storytelling to engage with employees indicated a resounding success rate, with employee surveys at the end of 2009 showing leadership communication competency jumping 18 points to 75 per cent, strategy awareness increased by 11 points to 77 per cent, and senior leaders' motivation increasing by 22 points to 74 per cent. Ericsson's customers rated them five points ahead of their competitors in the Customer Satisfaction Index Survey and the company finished the year in a stronger financial position (Aplin, 2010). The 2009 turn-around was due to a range of initiatives, but equipping leaders with storytelling expertise had a real impact (Aplin, 2010).

Even though just a brief summary of how Ericsson uses storytelling to cope with resistance to change, these results show encouraging effects of corporate storytelling in this domain. Such success stories should encourage other practitioners to deploy this tool, but also researchers to study it more thoroughly.

8. CONCLUSIONS

In this paper I presented the importance of the implementation of corporate storytelling as an internal communication strategy that facilitates the understanding of management decisions. Using the story by the leaders is an interesting way to build loyalty in times of organizational change, and doing so by strengthening the support and communication between employees. References included in this paper strongly support the concept of corporate storytelling as a powerful mean for building stronger engagement and create greater loyalty to employees. The needs of employees include both cognitive and emotional domains, especially during periods of change. Therefore, corporate stories can address these requirements through a deeper and more personal communications medium. A carefully planned narrative delivered through the story, meets employees on a more individual level, strongly enhancing the potential of understanding, memory and commitment to corporate interests. On the basis of the above-mentioned, it can be concluded that the corporate storytelling is an effective medium of communication for the purpose of increasing engagement and building loyalty to employees.

Will the storytelling be more than temporary managerial trend? It is possible, if it is perceived as some kind of drug. But actually, communicative leader who had a positive experience to applying storytelling can choose to keep this as a strong advantage in managing organizational change. The stories represent and shape the organizational culture. They have a role in clarifying ambiguities and provide meaning. The stories also work to change the beliefs and behaviours through cognitive and emotional processes. Once leaders seize the transformational power of language to motivate and inspire, they would undoubtedly conclude that organizational storytelling makes sense. Taking this into consideration, further research should address narratives and corporate storytelling as one of the pillars of the organizational culture. Finally, the development of information-communication technologies has opened a whole new horizon of the possibilities for digital and online storytelling. Examples can already be found both in practice and within the research streams of academics.

REFERENCES

Aplin, S. (2010). Storytelling in practice at Ericsson Australia & New Zealand. Strategic Communication Management, 14 (5), 16-19.

Brightman, B. K. &, B. Moran, J. W. (2001). Leading organizational change, Career Development International, 6(2), pp. 111–118

Brunner J. (1990). Culture and Human Development: A New Look in Human development volume 33: pp. 344-355.

Burnes, B. (2004). Managing Change: A Strategic Approach to Organisational Dynamics, (4th Edition), Harlow:Prentice Hall

Capra, F. (1996). The Web of Life, Fontana, London.

Change Management Institute (2012). Organisational Change Management Maturity

Cheney, G. & Christensen, L. (2001). Organisational identity linkages between internal and external communication, in Jablin, F. and Putnam, L. (Eds), The New Handbook of Organisational Communication. Thousand Oaks, California: Sage

Clarkson, I. & Rieley, J. B. (2001). The impact of change on performance, Journal of Change Management, 2(2), pp. 160–172.

Dowling, G.R. (2006). Communicating corporate reputation through stories. California Management Review, 49 (1), 82–100.

Fleming, D. (2001). Narrative leadership: Using the power of stories. Strategy and Leadership

Gotsi, M. & Wilson, A. (2001). Corporate Reputation: seeking a definition. Corporate Communication: An International Journal, l6 (1), 24-30

Harrison, K. (2007). Strategic Public Relations, a practical guide to success (4th Ed.). Perth: Century Consulting.

Jacobson, B. & Beverly, K. (1999). True tales and tall tales: The power of organizational storytelling. Training and Development 53/3 , 44-50.

James, C. & Minnis, W. (2004). Organisational storytelling - It makes sense, Business Horizons 47/4, pp. 23-32

Kübler-Ross, *E.* (1997). *On Death and Dying,* Routledge

Madlock, P.E. (2008). The link between leadership style, communicator competetence, and employee satisfaction. Journal of Business Communication, 45 (1), 61-78.

Oreg, S. (2003). Resistance to change: Developing an individual differences measure, Journal of Applied Psychology, 88, 4, pp. 587-604

Simmons, A. (2001). The story factor: Inspiration, influence, and persuasion through the art of storytelling. New York: Perseus.

Simmons, A. (2006). The Story Factor. New York: Basic Books.

Walton, Mark S. (2003). Generating buy-in. New York: AMACOM. 203

Wiggins, L. (2009). Managing the ups and downs of change communication, Strategic Communication Management, 13, 1, pp20-23

WHAT MAKES AN EFFECTIVE TEAM MEMBER?

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Abstract: *Teamwork is a widely recognized form of doing business today. Many organizations implement this form of groups in order to improve their competitive advantage and overall performances. Since performances are affected by inputs, it is important to consider people as the most important input in teamwork and analyze their individual characteristics that might or might not affect the final results. This paper presents a literature review on individual characteristics of team members that contribute to team effectiveness. Most important characteristics are: knowledge, skills and abilities, personality traits, attitudes and diversity.*

Keywords*: team member effectiveness, individual characteristics*

1. INTRODUCTION

Emergence and diffusion of teams – a particular form of groups brought many novelties upon modern organizations. Although a team is a type of group, it has certain distinctions which need to be taken into consideration when analyzing team effectiveness, as no other form of „group work“ matches with it perfectly (Jex & Britt, 2008). Vast number of organizations creates teams for different work assignments and there is a widely popular opinion that teams should be a foundation on which organizations build up and develop in the future (Guzzo & Shea, 1992; Kozlowski & Bell, 2003).

Considering prevalence of teams in business world, it is important to define criteria of successful teamwork. For more than half a century scientists from different disciplines make efforts to understand and measure that success and effectiveness. Dominant approach in literature regarding team effectiveness is explicit or implicit input – process – output sequence, or some sort of modification of this sequence introduces by McGrath 50 years ago (Guzzo & Shea, 1992). Different combination of inputs initiate team processes (interaction) directed at task accomplishment. Researchers considered many inputs of team effectiveness in the past and got to numerous and often contradictory results. Inputs can be described as factors that enable or shape interaction in teams (Mathieu J. , Maynard, Rapp, & Gilson, 2008), and usually include knowledge, status, personality traits, abilities, experience and demographics. Some authors modified definition of input and added certain organizational (rewards, interdependence, task design, etc) (Gladstein, 1984; Guzzo & Shea, 1992) or contextual factors that influence effectiveness directly (Campion, Papper, & Medsker, 1996; Cohen & Bailey, 1997).

Team structure or composition is incorporated element of team effectiveness for more than 50 years (Mann, 1959), and is mostly explored in terms of job related attributes (Webber & Donahue, 2001) and general and specific attributes (Harrison, Price, & Bell, 1998). Research in the field of team structure or individual characteristics of team members are focused on team members' attributes and effects of those attributes on processes, emerging states and outputs. Most common individual characteristics in previous research are: (1) knowledge, skills and abilities; (2) personality traits; (3) attitudes; and (4) diversity. These are explained further in the text based on extensive literature review with the aim to answer the question: “What makes an effective team member?”

2. KNOWLEDGE, SKILLS AND ABILLITIES

Knowledge, skills and abilities necessary for effective performances in teamwork differ from those required for accomplishing individual tasks. (Morgeson, Reider, & Campion, 2005). Interaction in team environment imposes the need for unique set of competencies (Stevens & Campion, 1994) with empirical

confirmation of their influence on performances (Cooke, Kiekel, Salas, Stout, & Bowers, 2003; Hirschfeld, Jordan, Feild, Giles, & Armenakis, 2005; McClough & Rogelberg, 2003). Knowledge of the

task is extremely important for teams working on assignment for a long period of time. Teams with high level of knowledge of the task not only have better performances but go through transition processes much easier (Mathieu & Schulze, 2006).

Average team cognitive ability is a good predictor of performances. Teams with high average cognitive ability acquire new knowledge much easier when there is an equal work overload among members. (Ellis, Hollenbeck, Ilgen, Porter, West, & Moon, 2003). Team performances are influenced by structure with highly interdependent tasks (Tziner & Eden, 1985). In meta analysis of 17 studies considering relationship between cognitive ability and team performances on student population, Devine and Philips (2001) concluded that „functional sum of cognitive abilities in team may affect team performances in different types of teams". According to them, effects are largest in teams working on intellectual tasks or teams involved in decision making process, unlike teams working on tasks with dominant physical component. They also concluded that relationship between cognitive ability and effectiveness is stronger when teams work on unfamiliar task (Devine & Philips, 2001). This conclusion is consistent with literature analyzing individual performances which also proved interdependence between cognitive ability and performances (Jex & Britt, 2008).

Interesting discovery in team effectiveness literature is the fact that team composed of highly skilled individuals is more effective than teams composed of individuals with lower level of absolute skills (Hackman, 1987; Guzzo & Shea, 1992). Although team members' skills and abilities have positive correlation with effectiveness, it doesn't mean organizations only need talented individuals to create effective teams. Another consistent conclusion in literature is although absolute level of individual skills and abilities is necessary in teams; organizations must consider the total sum of skills and abilities in teams (Campion, Papper, & Medsker, 1996). For example, successful basketball team must have pointers to achieve points during game. On the other hand, important players are those who can jump or play defense. It was proven that team member diversity has positive correlation with team performances (Guzzo & Shea, 1992), and teams with diverse knowledge and skills grade their own effectiveness much higher (Magjuka & Baldwin, 1991).

3. PERSONALITY TRAITS

Despite the significance of skills and abilities, in practice situations where teams with high-quality individuals are ineffective are often. Beside cognitive ability, personality traits are a good predictor of performances. Most reliable predictor is team consciousness that reflects as reliability and regularity in performing task related activities (Barrick & Mount, 2005). Van Vianen and De Dreau (2001) found that harmony and consciousness in teams are related to performances. Same conclusions produced meta analysis of other authors (Peeters, Van Tuijl, Rutte, & Reymen, 2006). Interesting conclusion of these authors is that changes in harmony and consciousness have negative impact on team performance.

Researchers analyzed influence of personality traits on team performances in respect with type of task given to team members. LePine, Colquitt i Erez (2000) found negative correlation between consciousness and effective decision making when decision making rules demand the need to adjust (Le Pine, Colquitt, & Erez, 2000). Adjustment to modified conditions is difficult for individuals with need for stability. Other authors came to the conclusion that effect of personality traits varies upon task as well (English, Griffith, & Steelman, 2004). Another argument why personality is important is it's' influence on team climate. George concluded that teams differ on affective tone determined upon individual personalities (George, 1990). The fact that personality influence team climate is not surprising considering the fact that personality traits of all individuals affect organizational climate (Schneider, 1987).

Specific combination of personalities in team has a great influence on team performances. There could be conflicting personalities in team environment, and it is also possible that one individual has a bad influence on team performances just because he/she possesses certain personality trait. Barrick et al.,

(1998) found that teams with emotionally unstable members have lower values in cohesion, flexibility, communication, conflicts and division of labor, in comparison to teams without that type of member. However, one emotionally unstable team member does not influence performances in negative manner (Barrick, Stewart, Neubert, & Mount, 1998).

Bell conducted meta analysis of relationship between personality traits and performances. Her results indicate the fact that average team consciousness, cooperation, extraversion, emotional stability and openness to experience have positive correlation to performances (Bell, 2007). Likewise, teams consisting of highly conscious members who cooperate achieve higher performances (Halfhill, Sundstrom, Lahner, Calderone, & Niels, 2005). At the same time, teams with members who have low need for cooperation are not skilled in acquiring new knowledge (Mathieu, Maynard, Rapp, & Gilson, 2008).

Spectrum of personality traits analyzed in relation to team performances is extremely wide and surpasses the most popular model in the field - Big Five model, that considers neuroticism, extraversion, openness, agreeableness and consciousness (Costa & McCrae, 1995). Many authors include orientation to achievement and dependability (LePine J. A., 2003), assertiveness (Pearsall & Elis, 2006), and locus of control (Boone, Van Olffen, Van Witteloostuijn, & De Brabander, 2004) as significant personality traits in teamwork and team effectiveness.

4. ATTITUDES

Effects of attitudes on team effectiveness can manifest in one of two ways. Campion defined direct effect as „preferences towards teamwork“ that reflect desire of team members to be in team environment (Campion, Medsker, & Higgs, 1993). Irrespective of team presence in organizations, not everyone likes to work in teams and certain employees prefer individual work. Teamwork may bring frustrations due to social loafing, conflicts and other problems. Campion et al., (1993) concluded that teams are less effective in general, looking at several criteria, when members have low preferences towards teamwork (Campion, Medsker, & Higgs, 1993). Other authors came to the same conclusion that preferences towards teamwork increase effectiveness (Bell, 2007; Jung & Sosik, 1999; Watson, Johnson, & Merritt, 1998), quality of teamwork (Eby & Dobbins, 1997; Harris & Barnes-Farrell, 1997) and team sustainability (Harris & Barnes-Farrell, 1997).

Second way of influence attitudes have on effectiveness is through similarities in them. Taking into consideration the findings of social psychologists that people like people similar to themselves (Byrne, Clore, & Smeaton, 1986), teams function better when there is moderate similarity of attitudes on significant matters like team leader effectiveness or organizational support (Bliese & Britt, 2001). Despite potential value of similarities, there are considerable dangers in situations where team members are much alike. When team members agree on every issue, necessary debate in work activities lacks and team members become resilient to changes. Janis (1982) defined such dynamics as group thinking and described it as „model of thinking individuals adopt in cohesive groups in situation when team unity has prevalence over realistic consideration of alternative ways of action... Group thinking is related to deterioration of mental efficiency, reality checks and moral judgment as a result of group pressure“ (Leana, 1985).

5. DIVERSITY

Diversity domain has developed over the last decades and covers a wide range of different phenomena. The term diversity is used in this paper to describe the distribution of different characteristics among interdependent team members that may affect effectiveness, and as a representation of the influence of heterogeneity in teams on processes and outputs.

There is an old dilemma about „homogeneity and heterogeneity“. This a problem of increasing diversity for the purpose of multiplying available set of skills and perspectives necessary for problem solving, but making work and cooperation harder at the same time among significantly different team members (Schermerhorn, Hunt, & Osborn, 2005). Relatively homogenous teams in age, gender, ethnicity, race, experience and culture have quality interpersonal relationships and interact easily during teamwork. On the other hand, homogenous membership may limit the team due to shortage of ideas, creativity, and same views on the problem at hand (Schermerhorn, Hunt, & Osborn, 2005). Certain differences among team members are inevitable, some are even desirable (Mihailović & Ristić, 2005).

Heterogeneous team, with members that vary in demographics, life style, experience and culture, also bring potential advantages to teamwork. Diversity is a rich source of information, talents and different perspectives that can advance problem solving in teams and increase creativity, especially with complex and demanding tasks. Research has shown that team diversity may be the cause of bad

performances, especially in early phases of team development. Problems occur as interpersonal stress or conflict due to diversity. Solving these problems may slow down team development and interfere with interpersonal relations (Schermerhorn, Hunt, & Osborn, 2005), but heterogeneous team have an excellent position for utilizing positive aspects of diversity in achieving high performances after handling difficulties at work. Although it takes more time and effort to create great teamwork based on diversity, long-term benefits in terms of creativity and performances make the investment worthwhile. Full potential of heterogeneous teams is one of great strengths in high performing organizations.

Personal characteristics significant from the diversity aspect can be classified in several ways, as: clearly visible characteristics (e.g. race, gender, age), characteristics evident after introduction (e.g. personality traits, knowledge, values), and characteristics in between two extremes on a transparency continuum (e.g. education, years of employment). Some of them have direct (e.g. education), and others indirect (e.g. age) effect on work results (Jackson, Joshi, & Erhardt, 2003). Jackson et al., (1995) also defined taxonomy of job related attributes and interpersonal related attributes, and grouped them as superficial and essential. Race, age and gender can shape interpersonal relationships, but don't usually affect performances. Differences in knowledge, skills and abilities (e.g. position, education, permanent job), do have a direct impact on performances.

Research shows that diversity is a complex input and findings of different researchers are often conflicting. Some believe that influence of diversity on processes, emerging states and outputs is positive, negative or non-existent (Webber & Donahue, 2001). For example, Campion et al., (1993) looked at heterogeneity in service sector and found no connection with productivity and satisfaction (Campion, Medsker, & Higgs, 1993). Additionally, studies have shown that diversity is in interaction with time (Harrison, Price, & Bell, 1998), task (Pelled, Eisenhardt, & Xin, 1999) and organizational culture (Brickson, 2000; Ely & Thomas, 2001). Though there is a vast literature in the field of diversity and several comprehensive literature reviews (Jackson, Joshi, & Erhardt, 2003; Milliken & Martins, 1996; Williams & O'Reilly, 1998), focus of this paper is on several individual characteristics of team members: demography, functional diversity, personality traits and status.

Demography. Webber and Donahue conducted meta analysis with the aim to find the influence of demographic diversity, and did not manage to prove the relationship with cohesion or team performances (Webber & Donahue, 2001). Several other researchers found diversity in age (Kilduff, Angelmar, & Mehra, 2000) and years of employment (Jehn & Bezrukova, 2004) to have influence on performances. It was shown that ethnicity, gender, age, years of employment and education (Jackson, Joshi, & Erhardt, 2003; Kirkman, Tesluk, & Rosen, 2001; Leonard, Levine, & Joshi, 2004; Li & Hambrick, 2005; Mohammed & Angell, 2003; Simons, Pelled, & Smith, 1999) have negative impact on processes (e.g. managing conflict), emerging states (e.g. empowering employees, commitment to organization) and performances (Townsend & Scott, 2001; Watson, Johnson, & Merritt, 1998). But, if time aspect is taken into consideration, findings change. Harrison et al., (1998) noted that differences in age stop having influence on performance when team members spend significant amount of time working. It can be concluded that effects of diversity vary depending on team task, culture and climate in organization (Jackson, Joshi, & Erhardt, 2003).

Functional diversity. Functional diversity is defined as degree to which team members differ among each other in terms of functional career (Bunderson & Sutcljffe, 2003). This aspect of heterogeneity isn't always

related to increased performances (Carpenter, 2002; Jehn & Bezrukova, 2004; Pelled, Eisenhardt, & Xin, 1999; Pitcher & Smith, 2001) and it was found that it can limit the processes and effectiveness due to numerous appearances of conflict (Knight, et al., 1999; Pelled, Eisenhardt, & Xin, 1999), bad information exchange (Ancona & Caldwell, 1992) and slow response time to set demands (Hambrick, Cho, & Chen, 1996). Despite this fact, different theoretical and practical approaches emerged lately regarding functional diversity. Bunderson and Sutcliffe (2002) found that different conceptualization of functional diversity may influence processes and performance. They introduced the term interpersonal diversity (e.g. degree in which team members posses highly specialized or wide spread of knowledge in certain fields) and concluded that interpersonal functional diversity (among several team members) has a negative impact, while intrapersonal diversity (heterogeneity inside the individual) has a positive impact on data processing inside team and on performances (Bunderson & Sutcljffe, 2003).

Differences in personality traits. Personality traits as individual predispositions to react in a similar manner in different situations (Mihailović, 2010), brought the array of various conclusions in the literature. Authors found that diversity in extraversion (Mohammed & Angell, 2003; Neuman, Wagner, & Christiansen, 1999) and emotional stability (Neuman, Wagner, & Christiansen, 1999) has positive impact on performances. Also, this type of diversity has negative impact on processes (Mohammed & Angell, 2004), while diversity in agreeableness and neuroticism has negative influence on performances (Halfhill, Sundstrom, Lahner, Calderone, & Niels, 2005; Mohammed & Angell, 2003). Besides Big Five personality traits, diversity in perception of urgency has a positive correlation with resolving conflict in teams (Mohammed & Angell, 2004; Landy, Rastegary, Thayer, & Colvin, 1991).

Integration of different personalities is an important aspect of teamwork. FIRO-B theory identifies differences in relationships between individuals in groups upon their needs for love, participation and control. These three groups of needs are the key in work environment and determine behavior of each individual. Schultz, the author FIRO-B theory, believes that groups with compatible members are more successful than groups in which members do not share the same needs. Symptoms of incompatibility may be members' withdrawal, open hostility, fight for control and domination of few. If managers don't pay attention to members' compatibility in times of forming teams, a vase amount of time is lost on resolving interpersonal conflicts (Schultz, 1958).

Status. Another source of diversity is status – rank, prestige or position of team members. Team member's status is influenced by several factors: age, years of employment in organization, profession, education or performances. Status congruence occurs when position of the tem member is equivalent to status outside the team. Problems occur with status inconsistencies, such as if a younger team member takes on leader's role in the team with senior and more experienced workers (Schermerhorn, Hunt, & Osborn, 2005).

6. CONCLUSION

There are many individual characteristics of team members that influence team effectiveness. Most important characteristics, which were in detail explained in this paper, are: knowledge, skills and abilities, personality traits, attitudes and diversity. Looking at knowledge, skills and abilities most important is knowledge of task, average cognitive ability, and absolute level of skill. Personality traits of all individuals affect team climate and specific combination of personalities in team has a great influence on team performances When it comes to attitudes, preferences towards teamwork bring high performances and last, but not least, diversity is a complex input and findings of different researchers are often conflicting. The main dilemma is about „homogeneity and heterogeneity", of team members and the influences of both approaches. Each of individual characteristics may have a positive, neutral or negative impact on overall performances depending on different organizational, situational or contextual factors.

REFERENCES

Ancona, D. G., & Caldwell, D. F. (1992). Demography and Design: Predictors of New Product Team Performance. Organization Science , 3 (3), 321-341.

Barrick, M. R., & Mount, M. K. (2005). Yes, Personality Matters: Moving on to More Important Matters. Human Performance , 18 (4), 359-372.

Barrick, M. R., Stewart, G. L., Neubert, M. J., & Mount, M. K. (1998). Relating Member Ability and Personality to Work-Team Processes and Team Effectiveness. Journal of Applied Psychology , 83 (3), 377-391.

Bell, S. T. (2007). Deep-Level Composition Variables as Predictors of Team Performance: A Meta-Analysis. Journal of Applied Psychology , 92 (3), 595-615.

Bliese, P. D., & Britt, T. W. (2001). Social Support, Group Consensus and Stressor-Strain Relationships: Social Context Matters. Journal of Organizational Behavior , 22 (4), 425-436.
Boone, C., Van Olffen, W., Van Witteloostuijn, A., & De Brabander, B. (2004). The Genesis of Top Management Team Diversity: Selective Turnover Among Top Management Teams in Dutch Newspaper Publishing, 1970-94. Academy of Management Journal , 47 (5), 633-656.
Brickson, S. (2000). The Impact of Identity Orientation on Individual and Organizational Outcomes in Demographically Diverse Settings. Academy of Management Review , 25 (1), 82-101.
Bunderson, J. S., & Sutcljffe, K. M. (2003). Management Team Learning Orientation and Business Unit Performance. Journal of Applied Psychology , 88 (3), 552-560.
Byrne, D., Clore, G. L., & Smeaton, G. (1986). The Attraction Hypothesis: Do Similar Attitudes Affect Anything? *Journal of Personality and Social Psychology , 51* (6), 1167-1170.
Campion, M. A., Medsker, G. J., & Higgs, C. A. (1993). Relations between Work Group Characteristics and Effectiveness: Implications for Designing Effective Work Groups. Personnel Psychology , 46, 823-847.
Campion, M. A., Papper, E. M., & Medsker, G. J. (1996). Relationship between Work Team Characteristics and Effectiveness: Replication and Extension. Personnel Psychology , 49 (2), 429-452.
Carpenter, M. A. (2002). The Implications of Strategy and Social Context for the Relationship between Top Management Team Heterogeneity and Firm Performance. Strategic Management Journal , 23 (3), 275-284.
Cohen, S. G., & Bailey, D. E. (1997). What Makes Teams Work: Group Effectiveness Research from the Shop Floor to the Executive Suite. Journal of Management , 23 (3), 239-290.
Cooke, N. J., Kiekel, P. A., Salas, E., Stout, R., & Bowers, C. (2003). Measuring Team Knowledge: A Window to the Cognitive Underpinnings of Team Performance. Group Dynamics: Theory, Research, and Practice , 7 (3), 179-199.
Costa, P. T., & McCrae, R. R. (1995). Domains and Facets: Hierarchical Personality Assessment Using the Revised NEO Personality Inventory. Journal of personality Assesment , 64 (1), 21-50.
Devine, D. J., & Philips, J. L. (2001). Do Smarter Teams Do Better : A Meta-Analysis of Cognitive Ability and Team Performance. Small Group Research , 32 (5), 507-532.
Eby, L. T., & Dobbins, G. H. (1997). Collectivistic Orientation in Teams: An Individual and Group-Level Analysis. Journal of Organizational Behavior , 18 (3), 275-295.
Ellis, A. P., Hollenbeck, J. R., Ilgen, D. R., Porter, C. O., West, B. J., & Moon, H. (2003). Team Learning: Collectively Connecting the Dots. Journal of Applied Psychology , 88 (5), 821-835.
Ely, R. J., & Thomas, D. A. (2001). Cultural Diversity at Work: The Effects of Diversity Perspectives on Work Group Processes and Outcomes. Administrative Science Quarterly , 46 (2), 229-273.
English, A., Griffith, R. L., & Steelman, L. A. (2004). eam Performance: The Effect of Team Conscientiousness and Task Type. Small Group Research , 35 (6), 643-665.
George, J. M. (1990). Personality, Affect, and Behavior in Groups. Journal of Applied Psychology , 75 (2), 107-116.
Gladstein, D. L. (1984). Groups in Context: A Model of Task Group Effectiveness. Administrative Science Quarterly , 29 (4), 499-517.
Guzzo, R. A., & Shea, G. P. (1992). Group Performance and Intergroup Relations in Organizations. In M. D. Dunnette, & L. M. Hough (Eds.), Handbook of Industrial and Organizational Psychology (pp. 269-313). Palo Alto, CA: Consulting Psychologists Press.
Hackman. (1987). The Design of Work Teams. In J. W. Lorsch (Ed.), Handbook of Organizational Behavior (pp. 315-342). Englewood Cliffs: New York, Prentice-Hall.
Halfhill, T., Sundstrom, E., Lahner, J., Calderone, W., & Niels, T. M. (2005). Group Personality Composition and Group Effectiveness: An Integrative Review of Empirical Research. Small Group Research , 36 (1), 83-105.
Hambrick, D. C., Cho, T. S., & Chen, M.-J. (1996). The Influence of Top Management Team Heterogeneity on Firms' Competitive Moves. Administrative Science Quarterly , 41 (4), 659-684.
Harris, T. C., & Barnes-Farrell, J. L. (1997). Components of Teamwork: Impact on Evaluations of Contributions to Work Team Effectiveness. Journal of Applied Social Psychology , 27 (19), 1694–1715.
Harrison, D. A., Price, K. H., & Bell, M. P. (1998). Beyond Relational Demography: Time and the Effects of Surface- and Deep-Level Diversity on Work Group Cohesion. Academy of Management Journal , 41 (1), 96-107.
Hirschfeld, R. R., Jordan, M. H., Feild, H. S., Giles, W. F., & Armenakis, A. A. (2005). Teams' Female Representation and Perceived Potency as Inputs to Team Outcomes in a Predominantly Male Field Setting. Personnel Psychology , 58 (4), 893-924.

Jackson, S. E., Joshi, A., & Erhardt, N. L. (2003). Recent Research on Team and Organizational Diversity: SWOT Analysis and Implications. Journal of Management , 29 (6), 801-830.
Jehn, K. A., & Bezrukova, K. (2004). A Field Study of Group Diversity, Workgroup Context, and Performance. Journal of Organizational Behavior , 25 (6), 703-729.
Jex, S. M., & Britt, T. W. (2008). Organizational Psychology: A Scientist - Practitioner Approach (2nd ed.) (2nd ed.). Hoboken, New Jersey: John Wiley & Sons, Inc.
Jung, D. I., & Sosik, J. J. (1999). Effects of Group Characteristics on Work Group Performance: A Longitudinal Investigation. Group Dynamics: Theory, Research, and Practice , 3 (4), 279-290.
Kilduff, M., Angelmar, R., & Mehra, A. (2000). Top Management-Team Diversity and Firm Performance: Examining the Role of Cognitions. Organization Science , 11 (1), 21-34.
Kirkman, B. L., Tesluk, P. E., & Rosen, B. (2001). Assessing the Incremental Validity of Team Consensus Ratings over Aggregation of Individual-Level Data in Predicting Team Effectiveness. Personnel Psychology , 54 (1), 645-667.
Knight, D., Pearce, C. L., Smith, K. G., Olian, J. D., Sims, H. P., Smith, K. A., et al. (1999). Top Management Team Diversity, Group Process, and Strategic Consensus. Strategic Management Journal , 20 (5), 445-465.
Kozlowski, S. W., & Bell, B. S. (2003). Work Groups and Teams in Organization. In W. C. Borman, D. R. Ilgen, & R. J. Klimoski (Eds.), Handbook of Psychology: Industrial and Organizational Psychology (pp. 333-375). Hoboken:NJ: Wiley.
Kozlowski, S. W., & Klein, K. J. (2000). A Multilevel Approach to Theory and Research in Organizations: Contextual, Temporal, and Emergent Processes. In K. J. Klein, & S. W. Kozlowski (Eds.), Multilevel Theory, Research, and Methods in Organizations: Foundations, Extensions, and New Directions (pp. 3-90). San Francisco: Jossey-Bass.
Landy, F. J., Rastegary, H., Thayer, J., & Colvin, C. (1991). Time Urgency: The Construct and Its Measurement. Journal of Applied Psychology , 76 (5), 644-657.
Le Pine, J. A., Colquitt, J. A., & Erez, A. (2000). Adaptability and Changing Task Contexts: Effects of General Cognitive Ability, Conscientiuosness, and Openness to Experience. Personnel Psychology , 53 (3), 563-593.
Leana, C. R. (1985). A Partial test of Janis' Groupthink Model: Effects of Group Cohesiveness and Leader Behavior on Deffective Decision Making. Journal of Management , 11 (1), 5-18.
Leonard, J. S., Levine, D. I., & Joshi, A. (2004). Do Birds of a Feather Shop Together? The Effects on Performance of Employees' Similarity with One Another and with Customers. Journal of Organizational Behavior , 25 (6), 731-754.
LePine, J. A. (2003). Team Adaptation and Postchange Performance: Effects of Team Composition in Terms of Members' Cognitive Ability and Personality. Journal of Applied Psychology , 88 (1), 27-39.
Li, J., & Hambrick, D. C. (2005). Factional Groups: A New Vantage on Demographic Faultlines, Conflict, and Disintegration in Work Teams. Academy of Management Journal , 48 (5), 794-813.
Magjuka, R. J., & Baldwin, T. T. (1991). Team-Based Employee Involvement Programs: Effects of Design and Administration. Personnel Psychology , 44 (4), 793-812.
Mann, R. D. (1959). A Review of the Relationships between Personality and Performance in Small Groups. Psychological Bulletin , 56 (4), 241-270.
Mathieu, J. E., & Schulze, W. (2006). The Influence of Team Knowledge and Formal Plans on Episodic Team Process-Performance Relationships. Academy of Management Journal , 49 (3), 605-619.
Mathieu, J., Maynard, T. M., Rapp, T., & Gilson, L. (2008). Team Effectiveness: 1997-2007: A Review of Recent Advancements and a Glimpse Into the Future. Journal of Management , 34 (3), 410-443.
McClough, A. C., & Rogelberg, S. G. (2003). Selection in Teams: An Exploration of the Teamwork Knowledge, Skills, and Ability Test. International Journal of Selection & Assessment , 11 (1), 56-66.
Mihailović, D. (2010). Psihologija rada i organizacije. Beograd: Fakultet organizacionih nauka.
Mihailović, D., & Ristić, S. (2005). Timski rad i radni apsentizam. Beograd: Viša železnička škola.
Milliken, F. J., & Martins, L. L. (1996). Searching for Common Threads: Understanding the Multiple Effects of Diversity in Organizational Groups. Academy of Management Review , 21 (2), 402-433.
Mohammed, S., & Angell, L. C. (2003). Personality Heterogeneity in Teams: Which Differences Make a Difference for Team Performance? Small Group Research , 34 (6), 651-677.

Mohammed, S., & Angell, L. C. (2004). Surface- and Deep-Level Diversity in Workgroups: Examining the Moderating Effects of Team Orientation and Team Process on Relationship Conflict. Journal of Organizational Behavior , 25 (8), 1015-1039.
Morgeson, F. P., Reider, M. H., & Campion, M. A. (2005). Selecting Individuals in Team Settings: The Importance of Social Skills, Personality Characteristics, and Teamwork Knowledge. Personnel Psychology , 58 (3), 583-611.
Neuman, G. A., Wagner, S. H., & Christiansen, N. D. (1999). The Relationship Between Work-Team Personality Composition and the Job Performance of Teams. Group & Organization Management , 24 (1), 28-45.
Pearsall, M. J., & Elis, A. P. (2006). The Effects of Critical Team Member Assertiveness on Team Performance and Satisfaction. Journal of Management , 32 (4), 575-594.
Peeters, M. A., Van Tuijl, H. F., Rutte, C. G., & Reymen, I. M. (2006). Personality and Team Performance: A Meta-Analysis. European Journal of Personality , 20 (5), 377–396.
Pelled, L. H., Eisenhardt, K. M., & Xin, K. R. (1999). Exploring the Black Box: An Analysis of Work Group Diversity, Conflict, and Performance. Administrative Science Quarterly , 44 (1), 1-28.
Pitcher, P., & Smith, A. D. (2001). Top Management Team Heterogeneity: Personality, Power, and Proxies. Organization Science , 12 (1), 1-18.
Schermerhorn, J. R., Hunt, J. G., & Osborn, R. N. (2005). Organizational Behavior (Ninth ed.). Hoboken, NJ: John Wiley & Sons, Inc.
Schneider, B. (1987). People make the Place. Personnel Psychology , 40 (3), 437-453.
Schultz, W. C. (1958). Interpersonal Underworld. Harvard Business Review , 36 (4), 123-135.
Simons, T., Pelled, L. H., & Smith, K. A. (1999). Making Use of Difference: Diversity, Debate, and Decision Comprehensiveness in Top Management Teams. Academy of Management Journal , 42 (6), 652-661.
Stevens, M. J., & Campion, M. A. (1994). The Knowledge, Skill, and Ability Requirements for Teamwork: Implications for Human Resource Management. Journal of Management , 20 (2), 503-530.
Townsend, A. M., & Scott, K. D. (2001). Team Racial Composition, Member Attitudes, and Performance: A Field Study. Industrial Relations , 40 (2), 317-337.
Tziner, A., & Eden, D. (1985). Effects of Crew Composition on Crew Performance: Does the Whole Equal the Sum of Its Parts? Journal of Applied Psychology , 70 (1), 85-93.
Van Vianen, A. E., & De Dreu, C. K. (2001). Personality in Teams: Its Relationship to Social Cohesion, Task Cohesion, and Team Performance. European Journal of Work and Organizational Psychology , 10 (2), 97-120.
Watson, W. E., Johnson, L., & Merritt, D. (1998). Team Orientation, Self-Orientation, and Diversity in Task Groups. Group & Organization Management , 23 (2), 161-188.
Webber, S. S., & Donahue, L. M. (2001). Impact of Highly and Less Job-Related Diversity on Work Group Cohesion and Performance: A Meta-Analysis. Journal of Management , 27 (2), 141-162.
Williams, K. Y., & O'Reilly, C. A. (1998). Demography and Diversity in Organizations: A Review of 40 Years of Research. *Research In Organizational Behavior , 20* (20), 77-140.

INTERPERSONAL RELATIONSHIPS AS DETERMINANT OF FACULTY JOB SATISFACTION

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Abstract:*The purpose of this paper is to present the review of the current research conducted in the area of job satisfaction in the university settings, with the specific emphasize on interpersonal and collegial relationships. Job satisfaction is one of the most important variables in the field of the business psychology, sociology of work, and organizational behavior. According to the body of literature, interpersonal relationships have a strong impact on job satisfaction; social support and good interpersonal relationships at the workplace were even found to have a mediating effect on job dissatisfaction rooted in other aspects of the job (Morison, 2004). Interpersonal and collegial relationships within department were found to be the influential factor of the job satisfaction for the faculty members.The relationship with the department head wasfound to influence job satisfaction, with a better relationship with the department head predicting a higher job satisfaction (Drakich et al., 2012).However, all aspects of the impact of the interpersonal relationships on the job satisfaction of the faculty employees have not been that well researched so far as the job satisfaction in the other professions, and literature review indicated that some of the factors that are influential in other professions might not be that influential with the faculty members.*

Keywords*: business psychology, job satisfaction, interpersonal relationships, literature review*

1. INTRODUCTION

The concept of employee job satisfaction has been the topic of interest for the several disciplines –business psychology, sociology of work, and organizational behavior. Employee job satisfaction is a multifaceted construct, influenced by a number of different intertwined external and internal factors. There are several definitions of job satisfaction that can be found in the literature. Locke (1976, as cited in Saari and Judge, 2004) defined job satisfaction as a "pleasurable and positive emotional state, resulting from the appraisal of one's job or job experiences" (page 1304). Brief (1998, as cited in Weiss, 2002) defined job satisfaction from the viewpoint of the positive or negative attitude toward job, and Spector (1997) argued that there are two factors influencing job satisfaction: personal characteristics of an individual and overall job environment.

Why is the study of employee job satisfaction important? According to Landy and Conte (2010) job satisfaction is directly related to productivity level, job performance, job turnover, absenteeism, both organizational citizenship behavior and counterproductive behaviours and a number of other different job related outcomes. The existing body of literature indicates that number of different factors can influence employee job satisfaction.

Job satisfaction has been theoretically explained within several different theoretical conceptual frameworks: process theories, situational theories and content theories. All three groups of theories explain job satisfaction from the different viewpoints. Process theories such as Porter and Lawler model, look at the values and expectations that influence job satisfaction; the greater the disproportion is between some elements of the work that the individual values (e.g. high wages, opportunities for promotion) and the possibility of achieving this goal, the greater will be the dissatisfaction with the work and vice versa.

Situational theories look at the organizational culture and person-organization fit. According to situational theories an individual will adapt his or her behavior to the change in the external environment. Quarstein,McAffee and Glassman (1992) conducted a study in order to test the situational occurrences theory of job satisfaction. The results of the study indicated that a number of situational characteristics and occurrences influenced an individual's job satisfaction. Herzberg's dual factor theory (1957) also looked at the job satisfaction According to this theory satisfaction in the work setting is determined by two separate variables satisfaction and dissatisfaction, which are influenced with the wide range factors. He differentiated

two sets of factors – motivators that directly influence job satisfaction and hygiene factors that do not have a direct influence on job satisfaction but their absence results in increase in job dissatisfaction.

The content theories take a dispositional approach to the job satisfaction, looking at the wide range of personality variables and how they relate to the job satisfaction. Maslow theory of needs with the need for individual growth and self-actualization viewed as the factor influencing job satisfaction, is an example of an dispositional approach to job satisfaction (Landy and Conte, 2010).

A number of different factors influencing job satisfaction in various settings have been researched. All researchers recognized that people and their mutual interaction and synergy are one of the indispensable factors of any institution and organization, strongly influencing the levels of an individual's job satisfaction. Job dissatisfaction has been found to be one of the most important factors influencing employee turnover. However, according to Morison (2004), social support and cohesiveness at the workplace can have a mediating effect on job satisfaction, even when employees are dissatisfied with some other aspects of the job.

2. INTERPERSONAL RELATIONSHIPS

A number of different studies has been undertaken in order to determine influence that interpersonal relationships at the workplace have on overall job satisfaction. Romig, O'Sullivan, and Denmark (2011) and Birx, Lasalla, and Wagstaff, (2011), confirmed interpersonal relationships with coworkers to be one of the main factors influencing job satisfaction of the faculty members. Research has shown that group cohesion and positive interpersonal relationships at the workplace have direct effect on employee job satisfaction and on individual's overall well-being. Inadequate social support and negative interpersonal relationships at the workplace are related to counterproductive work behaviours, negative attitudes toward the job, and a decreased level of overall job satisfaction (Landy& Conte, 2010).

The basic premise of many of these researches was that both interpersonal relationships with coworkers and managers have certain impact on job satisfaction. As mentioned before, collegial relationships are found to be based on two types of relationships: leader-member relationship (exchange) and coworker's interactions (Sherony and Green, 2002). A study conducted by Harmer and Findlay (2005) also indicated that overall job satisfaction of young workers is highly correlated with both the interpersonal relationship with the supervisor /manager and the interpersonal relationships that an individual has with his or her coworkers.

Chiok (2001) explored how job satisfaction is influenced by leadership behaviours. He found significant correlations between five different leadership behaviours and employee job satisfaction; 29% of the overall job satisfaction was explained by leadership behaviours indicating that leadership behaviours are indeed one of the factors that can strongly influence employee job satisfaction.

Birx, Lasalla&Wagstaff (2011) found out that interpersonal relationships at work can be influenced with the intervention programs. In their study they explored influence of a team building retreat on overall job satisfaction and group cohesion. Team building intervention was conducted with a group of participants. The intervention was found to be an effective way to increase faculty cohesion, satisfaction with coworkers and overall job satisfaction. There were statistically significant differences between pretest (before the team building retreat) and posttest (after the team building retreat) on the JDI questionnaire; scores on JDI were higher after the team building intervention indicating that participants' job satisfaction increased after the intervention. However, when the same survey was conducted at the end of semester, several months after the team building retreat, scores on JDI went back to the pretest level, indicating that the positive changes stimulated by the retreat were not maintained over the course of the semester. This indicates that follow up team building activities needs to be conducted on a regular basis in order to preserve positive effects of the team building intervention.

3. FACULTY JOB SATISFACTION

Job satisfaction is one of the most important variables in the field of business psychology, sociology of work, and organizational behavior.As noted before, the number of different factors may influence an individual's level of job satisfaction. The existing body of literature related to the specific factors influencing job satisfaction of the faculty members, and influence of the interpersonal and collegial relationships on job satisfaction will be further reviewed.

Tack and Patitu (1992,as cited in Okpara, Squilace and Erondu, 2005) highlighted the importance of conducting specific research on the faculty job satisfaction. They argued that lower level of job satisfaction of faculty members have a direct impact on quality of both educational and research-related activities that university professors conduct. They also noted that some of the factors that might influence job satisfaction in different environments may not be good predictors of the faculty members' job satisfaction, having in mind the specific characteristics of the university jobs.

Bozeman and Gaughan (2011) wanted to find out if job satisfaction of the university faculty members is determined by the same factors as other workers' job satisfaction, and to explore if there are some specific aspects of the academic faculty job determining job satisfaction. In their research they have found three main determinants of faculty job satisfaction: demographic characteristics, colleague interactions, and pay motivation. However, they have found recognition of the faculty member's research by his or her peers to be the strongest predictor of job satisfaction. Gender was also predictor of job satisfaction; male faculty members were more satisfied with their jobs from their female colleagues. Additionally, perception that they are rewarded accordingly to their qualifications was also a predictor of job satisfaction.

Oshagbemi (1994) conducted the study in order to explore potential differences in the levels of job satisfaction of faculty members and their managers (department heads, deans, etc.). A range of demographic characteristic and differences between faculty members at managerial positions and other academics were explored: age, gender, seniority and rank. Significant differences were found between academic managers and other faculty members on five out of eight explored aspects of the job satisfaction. Faculty members at managerial positions were found to be more satisfied in following aspects: teaching, promotions, supervisor behavior, co-workers behavior, and physical conditions/working facilities. Moreover, some of the demographic characteristics were found to be related to the levels of job satisfaction. Age, seniority and rank were positively related to the job satisfaction; older faculty members, with more years of experience and higher ranks were overall more satisfied with their jobs. Gender was, however, not found to be related to the job satisfaction in this particular study.

In addition to the primary research, the secondary sources have been also analyzed in order to explore the influence that different facets of job have on faculty job satisfaction. For example, Sabharval and Corley (2009) conducted secondary data analysis from the data from the 2003 Survey of Doctorate Recipients funded by the National Science Foundation in USA in order to explore the levels of job satisfaction of faculty members, with special emphasize on how job satisfaction differ by gender and discipline. The main findings were that across all scientific disciplines men were found to have significantly higher levels of overall job satisfaction. Moreover, research productivity was found to be correlated to job satisfaction in a variety of ways in different disciplines. The highest job satisfaction for women was in health, science, social science and, lastly, engineering whereas the highest job satisfaction for men was in the fields of social sciences, engineering, and health and the lowest in the scientific disciplines.

Rosser (2004) analyzed data from the National Study of Postsecondary Faculty. The results of the analysis indicated that quality of faculty work life had a direct impact on both job satisfaction and decision to stay at the particular university. The influence of each component of the quality of faculty work life was explored. Utilization of technologies was found to be the important part of the overall work life of the faculty members. Since all faculty members are expected to quickly adopt and utilize modern technologies; for some faculty members this continuous update of skills related to the use of technologies was found to be a somewhat demanding component of the work life. Committee and service work was found to be the source for dissatisfaction mostly for the junior faculty ranks; some of them perceived those duties as a barrier to earning tenure and promotion. Professional development was another strong contributor to the overall work life of faculty members in this study; travel, conferences, trainings, release time, and sabbatical leave, have been shown to be important factors in the retention of faculty members.

Cultural factors were also found to have impact on faculty job satisfaction. Sabharval (2011) explored the job satisfaction of the foreign-born faculty members in order to find out how their job satisfaction compares with native-born citizens. She analyzed secondary data available from the Survey of Doctorate Recipients funded by the National Science Foundation in USA (2003). Main findings of her study were that all categories of foreign-born university faculty members (naturalized citizens, permanent, and temporary residents) showed significantly lower level of job satisfaction compared with native-born faculty members. Moreover, foreign-born faculty members were found to occupy less leadership positions then native born faculty members did, which according to Sabharval (2011) might also have influenced their level of job satisfaction.

Crothers at al. (2010) explored gender differences in promotion and salary negotiation practices of female and male university faculty members in psychology departments, and its influence on job satisfaction. They have found job satisfaction and salary to be positively correlated for male faculty members, but not for the

female faculty members; for female participants job satisfaction was found to be negatively correlated with the perception of negative repercussions for undertaking promotion and salary negotiations. The results of their study also indicated that the level of job satisfaction for women faculty members is related to the interpersonal relationships and overall departmental climate.

Horton (2006) explored differences and similarities between faculty and staff job satisfaction, looking specifically to look at the relationship between job satisfaction and career aspirations of the university employees. According to the results of this study, faculty members had lower job satisfaction from the university staff. Majority of negative responses of the faculty members were related to issues of workload, work/life balance and university policies. Majority of the faculty members also responded that they would not choose again to work at the same institution. Additionally, faculty members also gave more negative responses related to their satisfaction with supervision, management support and communication than staff members did. This findings relate to the body of literature related to job aspirations, indicating that employee satisfaction also depends on career aspirations (higher aspirations of faculty members is related to lower level of job satisfaction).

Romig (2011) conducted a literature review with an aim of examining the various factors that influence job satisfaction, especially by allied health faculty, in institutions of higher education in the U.S. Compensation, advancement opportunities, the quality of supervision and social and collegial relationships were identified as main factors influencing job satisfaction of the allied faculty members. Literature on work experience and job satisfaction was found to be limited; however, according to the literature presented in the article, years of experience did not have influence on job satisfaction. On the other hand, work experience did influence the faculty turnover with higher turnover being related to fewer years of employment. Additionally, job satisfaction seemed to be related with decision making and locus of control for some of the program directors and department heads and with the specific commitment to the department.

A research conducted at the University of Windsor (Drakich et al, 2012) indicated that the relationship with the department head influenced job satisfaction of the faculty members, with a better relationship with the department head predicting a higher job satisfaction. Gender, rank and faculty positions did not significantly influence quality or satisfaction with collegial relationships in this particular study.

Based on the presented literature review we can conclude that interpersonal and collegial relationships within department are found to be the influential factor of the job satisfaction for the faculty members.

4. CONCLUSION

According to the literature, job satisfaction has been found to be the significant factor for the wide area of other job-related issues such as job performance, productivity, organizational citizenship behavior and a number of counterproductive behaviours and turnover (Landy and Conte, 2010). The influence that job satisfaction may have on all these different aspects of job, explains the importance of the research related to the job satisfaction. Since some studies (Birx, Lasalla&Wagstaff, 2011) have shown that employee job satisfaction can be influenced and improved by the intervention programs, this opens the possibility for other work-related aspects to be influenced through increasing the job satisfaction.

Replication of the presented studiescould be attempted in future studies in order to analyze what are the main factors that influence job satisfaction of the faculty members at Serbian Universities, how interpersonal and collegial relationships influence their overall job satisfaction, and to compare these findings with similar research conducted so far in other countries. Overall, the presented literature review indicated that the specific area of faculty job satisfaction has not been that well researched so far as the job satisfaction in the other professions, and that some of the factors that are influential in other professions might not be that influential with the faculty members.

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REFERENCES

Birx, E., Lasalla, B., Wagstaff, M. (2011).Evaluation of a team-building retreat to promote nursing faculty cohesion and job satisfaction.*Journal of Professional Nursing, 27 (3),*174–178.

Bozeman, B &Gaughan, M.(2011). Job satisfaction among university faculty: Individual, work, and institutional determinants. *The Journal of Higher Education,* 82(2), 154-186.

Chiok, F.L (2001).Leadership behaviours: effects on job satisfaction, productivity and organizational commitment. *Journal of Nursing Management,* 9(4), 1365-2834.

Common University Data Ontario (CUDO), Report 2011, University of Windsor.Retreived on November 15th from http://web2.uwindsor.ca/general/cds/2011/htmlSectionH.html.

Crothers, L. M.,. Hughes, T., Schmitt, A.R., Theodore, L., Lipinski, J., Bloomquist A.J., Altman C. (2010). Has equity been achieved? Salary and promotion negotiation practices of a national sample of school psychology university faculty. *The Psychologist-Manager Journal*, 13 (1), 40-59.

Drakich, J., Maticka –Tyndale, E., Ali Farooqi, A., Fiki, C., Gaspard, A., Hutchings, K., Jayeoba, O., Ljepava, N., Kasem, A., McLellan, C., Mungwete, R., Selimos, E., Suner, S.,Yhang, A., (2012) Faculty work life and job satisfaction Retreived on May 1st from http://web4.uwindsor.ca/units/...nsf/.../FINAL%20REPORT%2008-31.docx

Harmer, R. & Findlay, B. (2005).*The effect of workplace relationships on employee job satisfaction for 25 to 35 year olds.* Paper presented at the 5th Annual Conference of the APS on the Psychology of Relationships Interest Group.

Horton, S. (2006). High aspirations: Differences in employee satisfaction between university faculty and staff. *Applied Research in Quality of Life,* 1 (3-4), 315-322.

Landy, F.J. & Conte, J.M. (2007). Work in the 21st century: An introduction to industrial-organizational psychology (2nd ed.). Malden, MA: Blackwell Publishing

Morrison, R. (2004). Informal relationships in the workplace: Associations with job satisfaction, organisational commitment and turnover intentions. *New Zealand Journal of Psychology, 33*, 114-129.

Oshagbemi, T (1997). Academics and their managers: A comparative study in job satisfaction. Personnel Review 28 (1/2), 108-123.

Okpara, J.O, Squilace, M. Erondu, E. (2005).Gender differences and job satisfaction: a study of university teachers in the United States. *Women in Management Review*, 20(3),177 – 190.

Quarstein, V. A., McAfee, R. B., & Glassman, M. (1992).The situational occurrences theory of job satisfaction.*Human Relations*, 45, 859-873.

Romig, B., & O'Sullivan M.J., Denmark, R. M. (2011). Factors affecting allied health faculty job satisfaction: a literature review. *Journal of Allied Health,* 40,3-14.

Rosser, V. (2004). Faculty member's intentions to leave: A national study on their worklife and satisfaction. Research in Higher Education, 45 (3), 285-309.

Saari, L.M. & Judge, T. (2004).Employee attitudes and job satisfaction. Human Resource Management, 43(4),395-407.

Sabharwal, M., Corley, E. (2009).Faculty job satisfaction across gender and discipline.*The Social Science Journal 46 (3),* 539-556

Sabharwal, M. (2011). High-skilled immigrants: How satisfied are foreign-born scientists and engineers employed at American universities? *Review of Public Personnel Administration 31 (2),* 143-170.

Sherony, K. M., & Green, S. G. (2002). Coworker exchange: relationships between coworkers, leader-member exchange, and work attitudes. *Journal of Applied Psychology,* 87, 542−548.

Weiss HM, Nicholas JP, Daus CS. (1999). An examination of the joint effects of affective experiences and job beliefs on job satisfaction and variations in affective experiences over time.*Organizational Behavior and Human Decision Processes*, 78, 1-24.

APPLYING PERSONALITY TESTS IN SELECTION OF EMPLOYEES-THE PROBLEM OF CRITERION VALIDATION

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Abstract: *For decades, there has been a leading scientific debate on the justification of the personality tests use in the selection of employees. Cognitive tests have found their place in the selection of employees issues, but personality tests are constantly reviewed. Reflections of authors are very different and the analysis of the relation of personality and job performance shows increasing complexity. Personality tests are still used in selection procedures and organizational and industrial psychology continues to deal with the issue - whether and when to use personality tests to enable successful prediction of job success. The research results of personality tests can range from extremely optimistic to extremely pessimistic. The problem can not be easily solved and a solution could be to include the impact of different methodologies and different factors on the relation between personality dimensions and job performance. The job analysis is one of these factors. Summarizing research done by different authors, in fact, creates new problems.*

Key words: *organizational and industrial psychology, selection, personality tests, personality dimensions, job performance, job analysis*

1.INTRODUCTION

At the Conference of the Society for Industrial and Organizational Psychology, held in 2004 in Chicago, the panel discussion on "Usability (utility) of personality tests in the selection situation“ was opened. Participants in the panel discussion were the editors of the journals "Personnel Psychology" and "Journal of Applied Psychology", who are the recognized experts in the field of industrial and organizational psychology.

Although the main focus of these discussions was the problem of counterfeiting (giving false answers) of the personality tests' item, the subject was quickly transformed into the problem of criterion validation. The discussants noted that distortion of responses is to be expected and probably can not be avoided, and that its impact on the criterion validation of personality tests is negligible (Morgeson et al., 2007). Murphy said: "The problem with personality tests is not the falsification of responses, but the validity of the criterion variable which is disappointingly low" (Morgeson et al., 2007). Since the predictive value of personality tests is low in the selection context, they should be avoided and not used in a selection of employees (Morgeson et al., 2007).

This view of the low criterion validation of personality tests has been met with the response of other experts in the field of industrial and organizational psychology. The Ones and Christiansen find that the coefficients of validation can be corrective, and that such corrections suggest that personality tests are significant predictors of job performance (Tett & Christansen, 2007). Likewise, Tett find that compared personality-job success need to respect individual moderators, because, for example, using confirmative study (versus explorative) and application of the personality-oriented job analysis contribute to improving the odds of criterion validation of personality tests (Tett & Christansen, 2007).

Regardless of the criticism of two groups of authors, Morgeson and colleagues maintain their claims and point out that an adequate replacement in the selection should be found for the personality tests.

2. PREDICITVE VALUE OF PERSONALITY TESTS IN SELECTION OF EMPLOYEES

In 1965, Guion and Gottier based on the assessment of criterion validation of personality tests, which was 0.09, concluded that it is difficult to justify the use of the above tests in situations that are the basis for making decisions on hiring candidates (Guion & Gottier, 1965). The conclusion of the mentioned authors prevailed for 25 years in industrial and organizational psychology, until the appearance of two meta-analytic studies have determined that criterion validation of personality tests in the selection context is still significant and meaningful (Barrick & Mount, 1991). The optimistic view of the value of personality tests in predicting job performance, was essentially a phenomenon initiated by a five-factor model of personality and meta-analytic

innovation (Rothstein & Goffin, 2006). In this regard, Barrick and Mount, in their meta-analytic study find that the rights of the correlation dimension of the five-factor model of personality and job performance range from 0.04 for Openness to 0.22 for Conscientiousness [1](Barrick & Mount, 1991; Rothstein & Goffin, 2006).

Mentioned results of meta-analytic studies, although overpriced and under-impressive as it is considered by Murphy (Morgeson et al., 2007), represent a real incentive for the use of personality tests in the selection of employees. In addition to that, research conducted back in 2003 estimated that 30% of U.S. companies use personality tests in the selection of employees (Heller, 2005 by Rothstein & Goffin, 2006).

Despite the "revolution" in the application of personality tests in the areas of organizational and industrial psychology, Schmitt still asks: "Why now all of a sudden we look at personality tests as valid predictors of job performance when the validity over time was not significantly changed and remains equal to zero" (Morgeson et al., 2007)? In support of the aforesaid, Murphy stated that the results of the revolutionary meta-analytic studies are impressive, as the correlation between the Big Five dimensions and job performance is only 0.13 (Morgeson et al., 2007).

Using the median as a measure of central tendency, Campion shows that the middle coefficient of validation, in appraising training, is 0.10 with interquartale range (50% of our core measures) from 0.05 to 0.17 (Morgeson et al., 2007). It is possible to assess that their criterion validity is low, in relation to cognitive tests (Morgeson et al., 2007).

Barrick found a few years ago that the personality test, taking into consideration that it is fully corrected, can explain about 15% of the variance, which is impressive, because simple cognitive tests can assess 25% of the variance (Morgeson et al., 2007). Also, personality tests are not good predictors of success in training, as cognitive ones (Morgeson et al., 2007).However, it is certain that there is a potential for incremental validation of personality tests in relation to the applied cognitive tests, but it should be taken into account that they do not say much about who does work well and who does it badly (Morgenson et al., 2007). On the other hand, Campion considers that incremental validation of personality tests is insignificant if the cognitive battery of tests is applied in selection of employees (Morgeson et al., 2007).

Ones and colleagues agree with the statement that cognitive ability, regardless of the type of job and profession, predict overall job performance well, which is not the case with personality tests (Ones et al., 2007). The predictive power of personality tests is that some of the five-factor model of personality dimensions have predictive value in certain types of jobs, for example, diligence in business sales, conscientiousness, emotional stability, and friendly demeanor in police duties, in management of extraversion and conscientiousness. (Ones et al., 2007).

Also, Ones and colleagues believe that the assessment of criterion validation of personality tests based on observed (unadjusted) meta-analytic data is not reliable (Ones et al., 2007). The observed data on meta-analytic studies are biased because the fact that such data influenced by statistical artifacts (restrictions rank and criterion unreliability) were not taken into consideration. If the correction of data on meta-analytical studies was done, as some scholars have done, data on the criterion variable validation of personality tests would be different and suggested that the predictive value in assessing the performance appraisal was low (Ones et al., 2007). In this regard, Ones and colleagues published corrected data amount of meta-analytic study and determined that the predictive validity of the Big Five was 0.27, as opposed to the non-adjusted, which was 0.13 (Ones et al., 2007).

In the opinion of Morgeson and colleagues, correction data for rank restriction and criterion unreliability is justified, while other adjustments overstate the criterion validation of personality tests (Morgeson et al., 2007). Some meta-analytic studies, in addition to the above corrections, corrected data also because of the predictory unreliability and the constructive invalidity (Morgeson et al., 2007). Correction of predictor of uncertainty and constructive invalidity overestimates validation and it shows in research[2] (Barrick, Mount & Stewart, 1998 by Morgeson et al., 2007).

[1] Five-factor model includes five dimensions of personality: Extraversion, Openness to Experience, Conscientiousness, Emotional Stability and Agreeableness.

[2] Barrick, Mount and Stewart have shown that when the validation corrected only for rank restrictions and criterion unreliability, it was 0.23, and when I make a correction for predictor unreliability, validation is 0.26 (Morgeson et al., 2007).

As in previous meta-analytic studies it is not clear how the data was corrected, the only reliable information is observed (uncorrected) (Morgeson et al., 2007). It should be considered that if the scores are corrected, the correction of the rank restriction is possible only if the data suggest this phenomenon, while correction for criterion unreliability is usually small (Morgeson et al., 2007). Still, regardless of the capabilities of correction, it is well known that organizations in the selection process use personality tests without correcting scores (Morgeson et al., 2007). So, Morgeson and colleagues believe that regardless of the impact of statistical artifacts, the only "real" results are uncorrected scores obtained in the research studies (Morgeson et al., 2007). In addition, they make several claims. Firstly, none of the organizations, which in its selection process used personality tests, adjusted score (Morgeson et al., 2007). Secondly, the correction of the scores, the predictor unreliability and constructive disability, which are in meta-analytic studies used by some authors, usually overestimate the validity coefficients (Morgeson et al., 2007).Thirdly, when the correction is performed due to the rank scores of the restrictions, it is only feasible if the information is available to identify it. Fourthly, correction scores for criterion unreliability, although justified, slightly improve the validity coefficients (Morgeson et al., 2007).

On the basis of these four reasons, Morgeson and colleagues conclude that the usefulness of personality tests can only be judged on the basis of unadjusted data, as previous studies have data corrected, for justified and unjustified reasons, and thus overestimated the power of personality tests in predicting job performance (Morgeson et al., 2007).

But either way, not even corrected data, which are published by Ones and colleagues, are impressive in terms of the assessment of corrected validity, which Schidmt and Hunter gave, and which is for the cognitive tests 0.51, 0.54 for the sample of work and for a structured interview 0.51 (Schidmt & Hunter, 1998 by Morgeson et al., 2007).

Tett and Christiansen believe that the correlation predictor (personality traits) and criterion variables (job performance) is not enough data to make a conclusion on the criterion variable validation test figures (Tett & Christiansen, 2007). In addition to measures of correlation obtained in certain samples, one should not lose sight of the population measures of correlation and standard deviation (Tett & Christiansen, 2007). Specifically, based on the value of correlation obtained by meta-analysis, it is possible to make a conclusion about population measures (parameters) of correlations and standard deviations (Tett & Christiansen, 2007). Confidence intervals, which are defined on the basis of meta-adjusted correlation and the analysis of the population of the standard deviation, indicating that 80% of the population correlation is expected in the range from 0 to 0.54, with an average value of 0.30 (Tett & Christansen, 2007). Even in some cases 10% parametric measure of correlation will be above and below the confidence interval (Tett & Christansen, 2007). The key measure is the population standard deviation, whose variability is not the result of statistical artifacts, but of situational specificity (Tett & Christansen, 2007). Namely, the range of the population correlation indicates bi-directive relation of personality and job performance and the related mean value of the correlation test of personality and job performance, which Morgeson and colleagues presented, understates the potential value of personality tests, ignoring the variability in strength and population directorate validation coefficients (Tett & Christansen, 2007). So, bi-direction of the person-job success relations indicate that the validity of personality tests under certain conditions can reach significant levels (Tett & Christansen, 2007). The attention should be drawn to the conditions that create stronger, more positive relation of personality tests and job performance (Tett & Christansen, 2007).

The relation between personality dimensions and job performance is dependent primarily on a number of moderators and their effects (Tett & Christiansen, 2007). For example, as the personality tests, including the Big Five model, are multi-dimensional, it is necessary to extract the subscales that were positively associated with job success rate. Unlike explorative strategies that take all scales (personality traits) into account, even those that are irrelevant to success in business, confirmative research strategies first identified scales that are associated with the activities and then focus only on them [3] Through his research, Tett pointed to the fact that the validation coefficients are higher by application of confirmative rather than explorative research strategy and he confirmed through his meta-analytic studies that by the application of confirmative strategy the validity coefficient is twice higher (unadjusted data: 0.20 applying confirmative study 0.10 using the explorative strategies; corrected data: 0.30 confirmative application strategies, 0.16 using the explorative strategies) (Tett et al., 1999; Tett & Christiansen, 2007).

In addition to the choice of research strategy, an important factor in relations person-job success is the analysis of person-oriented work. In his research, Tett comes to the conclusion that, by using person-oriented work, validity coefficients are higher (Tett & Christiansen, 2007). Tett has empirically shown that the

[3] 80% confidence interval measures include the adoption of standard meta-analytic studies (Tett & Christiansen, 2007).

study, which included analysis of the work had higher average correlation coefficients (Tett & Christansen, 2007).

Morgeson and colleagues believe that the conclusions of Tett and Christiansen are significant, but still we have little empirical data about it on how (Morgeson et al., 2007). It is clear that the average of the test validation may underestimate validity, but it should be taken into account that the direction of person-job success relations should be defined a priori, and not after data collection (Morgeson et al., 2007). In addition it is not clear which theoretical explanations are the basis of the choice of certain personality traits in predicting job performance (Morgeson et al., 2007). For example, Christiansen in one of his research shows that only four personality dimensions 16PF (Cattell Personality Inventory) can be extracted in predicting job performance in managerial jobs (Morgeson et al., 2007). Although the four personality dimensions showed the highest predictive power, it is not clear which theoretical models explain the relation of the above personality dimensions and job performance (Morgeson et al., 2007).

3.CONCLUSION

The use of personality tests in the selection context has always been and will be a critical issue in the field of industrial and organizational psychology. This eternal question is undoubtedly increasingly more thorough, because the dilemma remains the same as half a century ago when Gottier and Guion noted that the two major problems of personality tests were forging responses to the items and low criterion validation.

Although at first glance it seems that the discussion of speakers and critics has not progressed much since the positions are unchanged, there is an evident consensus on several important dilemmas that can undoubtedly affect the future status of personality tests in the selection context.

In fact, despite the claims of Morgeson and his colleagues that the observed scores are the only real criterion of validation data, there is no doubt that there is consensus that the meta-analytic data can be justified and it is correct in the case of rank restriction and criterion unrealiability. Also, Morgeson and colleagues acknowledge that the relationship personality – job performance is complex and that it is dependant on the situational specificity.

Also, correspondence with the Ones and Tet still led to a partial withdrawal in the stance of Morgeson and colleagues that for the personality tests in the selection context it is neccessary to look for an adequate replacement, although there are firm and steadfast conclusions for such a position, because nothing has changed in the criterion variable validation personality tests since the conclusion of Gottier and Guion (Morgeson et al., 2007). It is worrying that since the appearance of the "revolutionary" meta-analytic studies, personality tests are widely used in a selection of employees that, according to the available empirical data, there is no real basis for (Moregeson et al., 2007).

Regardless of the presented facts and information, Morgeson and colleagues conclude that it is necessary to continue research and examine why the criterion validation is low (Morgeson et al., 2007). Also, they think that the search for an answer to the question "whether personality tests are useful (helpful) in a selection situation", should be disposed of and replaced, and focus should be given to testing all the dilemmas and conflicting attitudes that provoked this question, and there are many (Morgeson et al., 2007).

REFERENCES

Barrick, M. R. & Mount, M. K. (1991). The Big Five personality dimensions: A metaanalysis, *Personnel Psychology*, 44, 1-26.

Guion, R. M. & Gottier R. F. (1965). Validity Of Personality Measures In Personnel Selection, *Personnel psychology*, 18, 135-164

Morgeson, F. P., Campion, A. M., Dipboye R. L., Hollenbeck R. J., Murphy K. & Schmitt, N. (2007). Are we getting fooled again? Coming to terms with limitations in the use of personality tests for personnel selection, *Personnel psychology,* 60, 1029-1049.

Morgeson, F. P., Campion, A. M., Dipboye R. L., Hollenbeck R. J., Murphy K. & Schmitt, N. (2007). Reconsidering the use of personality tests inpersonnel selection contexts, *Personnel psychology,* 60, 683-729.

Ones, S. D., Dilchert S., Viswesvaran C. & Judge, A. T. (2007). In support to personality assessment in organizational settings, *Personnel psychology, 60, 995-1027*.

Rothstein, G. M. & Goffin, D. R. (2006). The use of personality measures in personnel selection: What does current research support?, *Human resource management review*, 16, 155-180.

Tett, P. R. & Christiansen, D. N. (2007). Personality tests at the crossroads: A responce to Morgeson, Campion, Dipboye, Hollenbeck, Murphy, and Schmitt, *Personnel psychology*, 60, 967-933.

Tett, P.R., Jackson D. N., Rothstein, G. M. & Reddon, J.R. (1999). Meta-Analysis of Bidirectional Relations in Personality-Job Performance Research, *Human Performance*, 12 (1), 1-29

LOCUS OF CONTROL AND LEVEL OF SELF-CONFIDENCE AS PREDICTORS OF STRIVING FOR POWER AMONG MANAGERS

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Abstract: *Power as a skill of imposing influence, capacity to change social behavior of others is a significant tool for managerial population who use their position to empower such influence on their employees. Accordingly, their personal predispositions and key character traits significantly influence managers' behavior. In order to study whether locus of control and level of self-confidence are predictors of strive for power the research was conducted among managers in Mercator Serbia Trade Company. The results show that managers are a population which is dominated by internal locus of control, high level of self-confidence and high level of pursuit for power. We established a predictor connection between levels of self-confidence and levels of pursuit for power but not in the case of locus of control and pursuit for power.*

Keywords*: Managerial population, research, locus of control, level of self-confidence, striving for power, connection predictor...*

1. INTRODUCTION

Management means managing a unique activity in order to achieve targets set by the organization with optimum use of resources. Even though the term management includes managing, planning, organization and control, this paper will focus on managing. Within transactional theory of management (Hollander, 1971), the management is regarded as a two-way, transactional process. A person's manner of managing people is a result of interaction between his/her personality and circumstances defined by hierarchical position within the organizational structure. Based on the theory of roles, a certain management style represents the way a person sees their role in the organization and that role mean strong interaction with other people in the company. The success of entire organization largely depends on management mentality, on their way of thinking about production process issues, on their understanding their own role within the organization, the interpretation of co-workers' behavior...

In this paper, special attention is given to attribution style of managers as a relatively consistent and long lasting way of interpreting causal phenomenon, which plays an important role in the cognitive processing of reality. Within his theory of social study Rotter (1966) defines locus of control as 'personality variable that assigns individuals to the degree to which they accept personal responsibility for what happens to them as opposed to assigning responsibility to forces beyond their control'. Attribution style as a relatively consistent and lasting way of affixing causal phenomenon plays an important role in the cognitive processing of reality and as such, has a great significance in efficient management. Joe (1971) and Lefkart (1976) proved that people with dominant internal locus of control overcome life obstacles more successfully and have better orientation. In accordance with Barnes and Seligman (1991), this research looked at attribution style as a character trait, as a person's relatively permanent tendency to interpret causal phenomenon. Hersch and Scheibe, as stated by Fanelli (1977), find that internally oriented examinees show higher degree of dominance, sociability and intellectual efficiency as opposed to externally oriented ones.

Another important aspect that has been analyzed is self-confidence; a personality trait important to the successful functioning of managers, which Cohen (1968) defines as 'a compatibility degree between the ideal and the actual self perception'. Self-esteem is a significant dimension of a personal integrity.

Position in the organizational structure and the role of the manager necessarily carries a certain degree of latent and manifest power that comes from a given position. Research of power problems within the organization go in several directions. The most common ones are those dealing with problems of efficiency in applying specific types of power in managing people. Based on review of numerous research Podsakoff and associates (Podsakoff, Todor, Grover & Huber,1984) come to conclusion that successful managers base their influence on expert and referent power. There have been only few studies on the topic of connection between need for power and the way of managing. McClelland and Burnham (1976), depending on the function of expressed power on a particular person, differentiate between orientation towards personal power and socialized orientation towards power. People oriented towards personal power have no strong inhibition and self-control, but express their power impulsively. Leaders who use power in order to satisfy personal

needs in the first place (the need for self-confidence and status) try to dominate over their subordinates by creating conditions where those people depend on them. Leaders with socialized orientation towards power are emotionally more mature, less focused on themselves, use power in order to satisfy their personal goals and welfare of others as well. Leaders who exercise their power in a socialized way do so in order to develop and build the success of the organization.

This paper will try to establish whether managers have an increased level of striving for power and if locus of control and level of self-confidence can be observed as predictors of striving for power among managers of different hierarchical level.

2. RESEARCH METHODOLOGY

2.1. Subject and problems of research

This paper analyses one segment of management within a specific type of large groups, such as enterprises, where there is a clear hierarchical structure and formally defined managers' roles. The subject of research is managers' personal traits and their connection as well as different social demographic characteristics. The problem of research will be observed from the points of view of psychology, management psychology, labor psychology and can be determined in the following way: ***What level of self-confidence and locus of control do managers of different hierarchical level have and could these personality aspects be predictors of striving for power?***

2.2. Aims and objectives of research

General theoretical aim of the research is improved by understanding the management process and connection with certain characteristics of managers, and the practical contribution of this paper looked at providing guidelines for improvement of the management of enterprises and for high-quality selection of management. The stated objectives are executed in the following tasks: consider relevant socio-demographic characteristics of managers; determine the managers' level of self-confidence and striving for power, or the domination of locus of control; determine the nature of the relationships between socio-demographic characteristics of managers, or certain aspects of the job and analyzed personality traits, as well as determine the degree of connection predictor between locus of control and level of self-confidence on the one hand and striving for power on the other.

2.3. Hypothesis

The following hypothesis were established during research concept:
H-1. Locus of control of people in managing positions is predominantly internal.
H-2. Managers have a high level of self-confidence.
H-3. Managers strongly strive for power.
H-4. Locus of control and level of self-confidence are predictor connected with strive for power.

2.4. Instruments

In order to collect socio-demographic data an adequate questionnaire was designed. Locus of control (LC) was measured by a scale with 20 items and the results were classified into the following categories: strong external LC, exterior LC, the balance between external and internal LC, internal LC and strong internal LC. Managers' level of self-confidence was measured by a scale created by partially taking over items of S-C inventory, (*Self confidence*) Basavanna, adapted to our population (Djuric, 1980). The instrument has 30 items and responses are given on a six-level Likert scale (reliability– Alpha 0.80). Measuring of striving for power was conducted with the test of directive attitude (DA), by Bastina (1972), which is used for diagnostic evaluation of directivity. The test was adjusted to population in Serbia and has good psychometric properties (reliability –internal consistency coefficient is 0.86).The scale has two poles, with 8 items indicating directive or non-directive attitude of the person, with the answers given on a six-level scale. The total score is obtained by adding the positive and the negative part of the scale. The tendency to direct and control the behavior and attitudes of others in accordance with their own beliefs, managers can manifest in the low, moderate, high and very high level.

2.5. Examinees sample

The research was conducted in April, 2012 in the company Mercator-S, Novi Sad. At that time the company employed 3716 people out of which 700 were managers. The sample is appropriate and it consists of 292

managers of different hierarchical level from the territory of Republic of Serbia, working in operations (in retail and wholesale units of different formats) and administration (sector directors, heads of departments and divisions).

2.6. Method of result analysis

The following was applied on the collected data: descriptive statistics, T-test fo rtesting the significance of differences between arithmetic means of two independent samples; analysis of variance to determine the significance of differences between multiple arithmetic means; correlation analysis to determine the degree and direction of association between variables and regression analysis to determine the predictor connection between locus of control and level of self-esteem, on the one hand and striving for power, on the other hand.

2.7. Results

H -1. Locus of control of people in managing positions is predominantly internal.

The results on a scale of locus of control can be classified into five categories, and the following table lists the frequency of examinees in each category.

Table 1: Frequency of examinees by categories on a scale of locus of control

Locus of control	Results range	Frequency	%
1.strong external	0-19	0	0
2.external	20-39	0	0
3.external and internal (balance)	40-59	36	12.33
4.internal	60-79	143	48.97
5.strong internal	80-100	113	38.70
Total:		292	100

The largest number of respondents (almost 88%) has the internal locus of control dominant, and as many as 38.7% of managers strongly manifested an internal locus of control. In a small number of managers (12.33%) locus of control is in balance. The sample does not have managers who interpret causality phenomenon with external factors.

Table 2: Parameters of normal results distribution

Self-confidence	Kurtosis	Std. error	Skew	Std. error
	- 0.040	**0.284**	**- 0.675**	**0.143**

Since the values of skew (coefficient of curve distribution) and kurtosis (degree of elongation of normal distribution) are less than the limit value of 1.96, at a reliability level of 0.05, it can be concluded that the distribution of the results does not differ significantly from the normal distribution, but it is certainly moved to the right.

Table 3: Test of normality of distribution

	Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Statistic	Degrees of freedom (df)	Sig.	Statistic	Degrees of freedom (df)	Sig.
Directiv. attitude	0.158	292	0.000	0.945	292	0.000

Test results of Kolmogorov-Smirnov and Shapiro-Wilkinson are statistically significant at all levels of reliability, thus proving that the distribution of the results obtained in the study on a scale of locus of control does not deviate significantly from the normal distribution. Based on the above results, it can be said that the initial assumption was confirmed, at which the locus of control of persons in managerial positions is mostly internal.

H- 2. Managers have a high level of self-confidence.

When initiating the research, the assumption was made that the extent to which managers believe in themselves and their abilities manifests when they make business decisions, communicate with others, in their willingness to provide initiatives, appraisals, interactions to praise and criticism, or in all those situations typical of managers' daily routines.

These results can be divided into five categories, which represent certain levels of self-confidence, so that the distribution of frequencies in each category can be seen in the table below.

Table 4: Distribution of results on a self-confidence scale

Self-confidence levels	Results range	Frequency	%
1. negative self-assessment	30-59	0	0
2. low level of self-confidence	60-89	5	1.71
3. moderate level of self-confidence	90-119	112	38.36
4. high level of self-confidence	120-149	165	56.51
5. very high level of self-confidence	150-180	10	3.42
Total:		292	100

The results show that there are no respondents in the category of negative self-assessment, and a very small number of managers have low self-confidence. Most of the respondents 56.51%) have a high level of confidence, then a moderate 38.36% and 3,42% of managers have a very high level of self-confidence. The values of the mean, standard deviation, and minimum and maximum score of the examinees on a scale of self-confidence are shown in the following table.

Table5: Results distribution characteristics on a scale of self-confidence

Arithmetic mean	Std. Deviation	Minimum score	Maximum score
122.76	15.222	80	171

Comparison with theoretical minimum (30) and maximum (180) results, respectively (mean,105), provides the basis for the conclusion that the distribution of the results obtained in this study is movedt o the right.

Table 6: Test of normality of distribution

	Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Statistic	Degrees of freedom (df)	Sig.	Statistic	Degrees of freedom (df)	Sig.
Directiv. attitude	0,035	292	0,200(*)	0,995	292	0,450

a Lilliefors Significance Correction

Since the test results are not statistically significant, it is proved that the distribution of the results of the self-confidence scale deviates from the normal distribution. Overall, it can be concluded that the population of managers has a high level of confidence, as it could have been expected. In this way the initial assumption was confirmed according to which managers have a high level of confidence. Gaining a higher-level of the organization is to be successful and somehow above the rest of the employees and that certainly contributes to positive self-image.

H - 3. Managers strongly strive for power.

The values of the mean, standard deviation and minimum and maximum score of the examinees on a scale of directive attitude are shown in the following table.

Table 7: Descriptive parameters of results on a scale of directive attitude

			Statistic	Std. Error
Directive att.	Mean		- 0,86	0,485
	95% Confidence Interval for Mean	Lower Bound	-1,82	
		Upper Bound	0,09	
	5% Trimmed Mean		- 0,63	
	Median		0,00	
	Variance		68,648	
	Std. Deviation		8,285	
	Minimum		-31	
	Maximum		30	
	Range		61	
	Interquartile Range		9	
	Skewness		- 0,434	0,143
	Kurtosis		1,773	0,284

These results can be divided into four categories, which represent certain levels of striving for power, so that low, moderate, high and very high levels of striving for power can be distinguished. Frequency distribution in each category is shown in the following table.

Table 8: Results distribution on a scale of directive attitude

Directivity level or striving for power	Frequency	%
(-33) to (-12) – low level	24	8.22
(-11) to (-4) – moderate level	76	26.03
(-3) to (3) – high level	111	38.01
(4) to (30) – very high level	81	27.74
Total:	292	100

As it can be observed from the table, most of the examinees (38.01%) had a high level of directivity, then the most numerous category is the one with very high levels of striving for power (27.74%). Thus, 65.75% of respondents have high or very high striving for power.

Table 9: Test of normality of distribution

	Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Statistic	Degrees of freedom (df)	Sig.	Statistic	Degrees of freedom (df)	Sig.
Directive attitude	0,079	292	0,000	0,965	292	0,000

a Lilliefors Significance Correction

Test results of Kolmogorov-Smirnov (0,079) and Shapiro-Wilkinson (0,965) are statistically significant at all levels of reliability, which proves that the distribution of the results on a scale of directive attitude does not differ significantly from the normal distribution. The above results confirm the initial hypothesis that managers have a higher strive for power as it is evidenced by the arithmetic mean of the result which is in the category of high level of striving for power.

H-4.Locus of control and level of self-confidence are predictor connected with strive for power.

Before multiple regression analysis was applied a linear correlation was established between striving for power to each of the predictor variables. Based on the values of the Pearson correlation coefficient (0.185) we see that the positive correlation between striving for power and self-confidence is statistically significant at a reliability level of 0.01.Regarding the locus of control a positive low correlation with striving for power is confirmed but it is not statistically significant at a reliability level of 0.05.

Table 10: Linear correlation between striving for power and locus of control, or self-confidence

		Locus of control	Self-confidence
	N	292	292
Strive for power	Pearson Correlation	0,103	0,185(**)
	Sig. (2-tailed)	0,079	0,002
	N	292	292

** Correlation significant at a level of reliability of 0.01

Multiple regression analysis was used to examine the influence of predictor variables of self-confidence and locus of control on the criterion variable, that is managers' striving for power. The introduction of predictors was conducted in blocks so that the first phase included self-confidence, whose predictor's contribution was to explain the 3.4% variance in striving for power and it is significant at a reliability level of 0.01.

The next step was to introduce the locus of control as a predictor, but since it was found that there is a low correlation with striving for power, which is not statistically significant, it was pointless to continue to measure the predictor correlation.

Table 11: Model Summary

R	R Square	Std. error	Change Statistics				
			R Square Change	F Change	Deg. of freedom (df1)	Deg. of freedom (df2)	Sig. F Change
0,185(a)	0,034	8,157	0,034	10,229	1	290	0,002

a Predictors: (Constant), Self-confidence

Table 12: ANOVA model of hierarchical regression

Model		Sum of Squares	Degrees of freedom (df)	Mean Square	F	Sig.
1	Regression	680,598	1	680,598	10,229	0,002(a)
	Residual	19295,922	290	66,538		
	Total	19976,521	291			

Predictor: (Constant), Self-confidence
Dependant variable: Striving for power

Beta coefficient which confirms partial contribution of predictors of self-confidence is statistically significant at a reliability level of 0.01. Based on all of the above, it can be concluded that self-confidence can be defined as a predictor of striving for power, but not the locus of control.

3. DISCUSSION OF RESULTS

Results of the research regarding the locus of control among managers indicate that they have predominantly internal locus of control. The internalized have a strong need for achievement, high standards of work, challenging goals, control and independence. There are a smaller number of managers where the locus of control is in balance, there is an equal amount of the internal and the external one. The sample did not indicate managers whose interpretation of causality phenomenon gives preference to external factors, as it could have been expected, given the organizational culture of the company in which the study was conducted and where very high expectations of staff in managerial positions are openly communicated. Based on findings of Joe (1971) and Lefkart (1976), people with dominant internal locus of control are more successful in overcoming life problems and are better socially oriented. This manager's characteristic can be a significant predictor of their success as managers. The obtained results confirm findings by Hersch and Scheibe (1977) that internally oriented examinees show higher degree of dominance, sociability and intellectual efficiency as opposed to externally oriented ones.

The findings confirm that managers have a high level of self-confidence. Gaining leadership position in the enterprise means that a person believes in their abilities and their efficiency, and could be viewed as an indicator of the existence of feelings of personal adequacy. Self-confidence plays a very important role in business decision making, problem solving, acceptance of risk, responsibilities, expectations of a positive outcome of his own actions and those of his associates.

The results of the research show that the managers are a population with a characteristic high level of striving for power. These results could have been expected since people with developed striving for power prefer those positions in the organizational structure, which allow them to meet this motivational disposition. On the other hand, striving for power is connected to daily managerial demands when it comes to responsibility to influence their associates, in certain situations managers tell associates what to do, monitor their work in order to achieve better performance, convince them of validity of their opinions etc. Those are all integral activities of a manager which they use to guideline their associates' behavior, organize work activities and maintain necessary work discipline. People who avoid affecting other people, who do not want to impose and who find it difficult to tell others what to do, do not possess the characteristics that are a prerequisite for a manager. Striving for power can be seen as a dimension and managers differ in levels of development of striving for power. The results of the research confirm that managers have a high level of striving for power. People with higher level of self-confidence are less susceptible to the effects of social interaction and they tend to influence attitudes and actions of other people whereas people with lower level

of self-confidence do not exert such tendency. Predictors connection of levels of self-confidence with striving for power is confirmed but not in the case of locus of control and striving for power.

4. CONCLUSION

The employees' personality traits have an important role in predicting different forms of their behavior in the context of the work, and that also applies to the managers. Since the management is a very complex psychological phenomenon, the subject of this research the focus was only on some aspects of this role.

This paper studied leadership within specific types of large groups, such as enterprises, where there is a clear hierarchical structure and formally defined roles for managers. The company where this research was conducted has a very clear and rigid hierarchical structure with the organizational culture in which high demands addressed to managers of all levels are very openly communicated. The subject of the research were some aspects of the managers' personality, locus of control, self-confidence and level of striving for power, their interconnectivity as well as the impact of various socio-demographic characteristics and aspects of work on stated personality traits of managers.

The results of the research showed that basic settings, defined in the starting assumptions, were confirmed in most cases. The results analysis, which are in relation to the interpretation of causality of phenomena, confirmed that people in leadership positions mostly have internal locus of control, and these people successfully overcome life problems and are more socially oriented, which is in accordance with the Rotter (1966) theory. At first glance, the dominance of the internal locus of control is preferable and healthier since it gives a person a sense that they can affect the outcomes in their life, making people more proactive and more oriented toward achievement. However, if the internal locus of control is not accompanied with appropriate competencies, personal efficiency and specific capabilities, it can lead people astray, or cause anxiety, neurosis or depression as evidenced in the research of Kobasa (1979). On the other hand, people with external locus of control, unburdened by high expectations, can lead peaceful and happy life, unless existentially threatened, because they are not expected a higher level of performance. Therefore, rigid and extreme manifestation of internal or external locus of control is not desirable. Simply, some life events can be influenced and some cannot. It is very important to properly distinguish them and accept them adequately.

The main findings of this study about self-confidence confirm that managers have a high level of self-confidence, which helps them in making business decisions, problem solving, risk acceptance, responsibility... Cohen (1968) particularly emphasizes the role of self-confidence in social interaction. People with higher levels of self-esteem are less susceptible to the effects of social interaction and tend to influence the attitudes and actions of others, unlike people with lower levels of self-confidence.

The results confirm that managers at higher hierarchical levels have a higher level of confidence. Education level of managers is a significant factor in self-confidence which means that managers with higher levels of education have higher levels of self-confidence. However, the results did not show that older managers have a higher level of self-confidence than younger ones. This finding is very interesting and is not in line with the initial hypothesis that the total life experience affects self-confidence build-up. Managers who work in administration have a higher level of self-confidence than those who work in operations, which may be associated with the level of their formal education. The number of employees who report to them is not a significant factor in the expression of the level of self-confidence nor is the experience in management.

Striving for power can be observed as dimension and managers can be distinguished by the degree of directivity development. The results of this research confirm the initial assumption that managers strive for power strongly and have a tendency to guide and control behavior and attitude of others. People with higher levels of self-esteem are less susceptible to the effects of social interaction and tend to influence the attitudes and actions of others, unlike people with lower levels of self-confidence. The results are in accordance with those theories which see managing as a role, realized through social interaction between the superiors and subordinates in the group. For managers, subjective experience of social environments the reality within which they choose their own ways of handling the interaction with others, which is consistent with the views represented by Hollander (1971).

This research confirmed the predictors' connection of levels of self-confidence with striving for power but not in the case of locus of control and striving for power.

On the basis of these results, it is recommended that in the management selection process an assessment is conducted which will provide information on the level of self-confidence, the dominance of the internal locus of control and presence of striving for power. All these traits are very important for the successful functioning of managers in their daily activities. It would be very interesting to see what the difference in these respects

between management and non-management population would be through the correlation research model. Striving for power, as a complex variable, can be divided and some of its aspects analyzed as well as its impact on management.

REFERENCES

Bass, B. M. (1990). Bass and Stogdill's handbook of leadership. New York. Free Press.

Baumeister, R. F. (1998). The interface between intra-psychic and interpersonal processes: cognition, emotion, and Self as adaptations to other people. In J. M. Darley and J. Cooper. Attribution and Social Interaction. Washington, DC. American Psychological Association. 201-223.

Calder, B. J. (1977). An attribution theory of leadership. In B. M. Staw and G. R. Salancil, (Eds). New directions in organizational behavior. Chicago: St Clair Press.

Cohen, A. R. (1968). Some implications of Self-Esteem for social influence. In C. Gordon and K. J. Gergen. The Self in social interaction: Classic and contemporary perspectives. Vol 1. New York. John Wiley and Sons. Inc. 383-389.

Franceško-Salaj, M. (1999). Social and psychological factors of company management. Doctoral paper. Novi Sad.

Gordon, C. (1968). Self-conceptions: Configurations of Content. In C. Gordon and K. J. Gergen. The Self in social interaction: Classic and contemporary perspectives. Vol 1. New York. John Wiley and Sons. Inc. 115-135.

Hollander, E. P. (1971). Leadership, innovation and influence: an overview. In E. P. Hollander and G. Hunt. Current perspectives in social psychology. New York. Oxford University Press. 495-505.

Kay, D. And Wrightsman, L. S. (1984). Social psychology in the 80th. Monitery, California. Books/Cole Publishing Company.

Katić, I., Penezić, N., Borocki, J., Zekić, S. (2011). Entrepreneurship significance in restructuring process, Technics Technologies Education Management, ISSN: 1840-1503, Vol.6.No.4.

Katić,I., Grubić-Nešić, L., Mihailović, D., Lalić, D.(2013).Overworking as a threat to modern business**,** ISSN: 1840-1503, Technics Technologies Education Management, Vol.8.No.1. 2/3,2013.

Katić,I.,Ivanišević,A.,Lalić,G.,Penezić,N.,Tasić,N.(2013). Effects of fatigue to operational productivity with employees, Metalurgia International,ISSN: 1582-2214,No.4.

Katz, D.& Kahn, R. L. (1966). The social psychology of organizations. New York-London. John Wiley&Sons.

Kobasa, S.C. (1979). Stressful Life Events, Personality and Health: An inquiry into Hardiness. Journal of Personality and Social Psychology, 42, 168-177.

McClelland, D. C. & Burnham, D. H. (1976). Power is the great motivator. Harvard Business Review, March-April, 100-110.

Popadić, D. (1986). Locus of control and attribution in understanding causes of performance. Master paper. Belgrade.

Podsakoff, P. M., Todor, W. D., Grover, R. A.& Huber, V. L. (1984). Situational moderators of leader reward and punishment behavior: Fact or fiction? Organizational Behavior and Human Performance, 34.

Rotter, J. B. (1966). Generalized expectancies for internal versus external locus of control of reinforcement. Psychological Monographs: General and Applies, 80, 1-28.

Seligman, M.E.P. (1991). Learned optimism. New York: Knopf.

Slović,D. (2001). Psychology and management, A.D. „FINEKS", Belgrade.

Stoltz, P. (1997). Adversity Quotient: Turning obstacles into opportunities. New York: John Wiley & Sons.

Tenjović, L. (2002). Statistics in psychology. Belgrade.

Čizmić, S., Bojanović, R., Štajnberger, I. Petrović, I. (1995). Psychology and Management. Belgrade. University of philosophy.

Weiner, B. (1985). An attribution theory of achievement motivation and emotion. Psychological Rewiev, 92, 548-573.

APPEARANCE ON SOCIAL NETWORKS

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Abstract:*The aim of this research was to examine the habits and appearance of average social network users. With particular behavior on social network, user can provide some basic information about his personality and traits. Therefore, determination of user's profilewas based on examination of their behavioron social network. There were 40 participants involved in this research. Each participant provided answers based on his own experience related to using social network. Four categories of social network users were defined based on their activities on social network, number of friends, photos, etc. Results showed that it is possible to relate behavior on social network with psychological profile of a user.*

Keywords*:social networks, cyber profiling, cyber psychology, behavior on social network*

1. INTRODUCTION

The emergence of social media has resulted in new ways of communication, easier insight into the interests and lifestyles of others, increasing the number of acquaintances, and sometimes false representation. The fact is that more and more young people around the world devote its time to build a certain image on social networks such as Facebook, Twitter, etc. The aim of this paper is to examine what is the impact of social networks to the life of respondents, as well as features that are identifiable regarding their behavior on a social network.

Frequently asked question is what encourages young people to communicate, share interests, photos using social networks. Is it loneliness or some other reason? Social networks like Facebook can provide a sense of importance, belonging and closeness with others (Teppers, Luyckx, Klimstra, & Goossens, 2013). Studies show that the average user usually maintains this "superficial", instead of real "offline" friendships. However, the difference is in the reason for usage of social networks. In fact, if Facebook is used to meeting new people and making new friends, loneliness is decreasesin time.

Popularity on the social network can also affect the emotional condition of the user. The relationship between popularity (status) among coevals and social popularity (likes) was investigated (Stopfer, Egloff, Nestle, & Back, 2013). Their study showed that degree of popularity may be determined based on the profile on the social network and profile picture. The authors divided user's characteristics in the following way: agent (usually in terms of an attractive person with a large number of friends on a social network), utilities (those that have a large number of publications by friends of the opposite sex, and who are members of groups with positive character) and creative (people with innovative profiles and elegant pictures). Research has shown that agents characteristics have influence on the status, while the liking and social popularity is influenced by utility and creative characteristics.

Since social networks make it easier to access and communicate with other people, users often expand circle of friends by accepting / inviting acquaintances, and sometimes even strangers into their virtual life. Not knowing who is behind the profile, an individual can become a victim on the Internet (so-called "fake profiles"). Also, depending on the individual's behavior on the Internet, the type of images and the entire social network look, an average social network user can attract a negative audience which can become so-called "cyber bullying".

By his behavior on the Internet, individual reveals his main character traits and habits. Therefore, it is possible to analyze personality with so-called "profiling".

Some authors have written on the topic of cyber profiling relevant to the determination of the subject's profile based on individual'sbehavior on the Internet (Yu, 2013). The concept itself is derived from crime profiling, which refers to the process of determining the necessary information about the type of criminal, as well as its unknown characteristics based on what is known about him. The cyber profiling was analyzed by(Yu, 2013)using the principles of BPA - Behavioral pattern analysis. In his study he included 100 Facebook users. The conclusion to which he came in his research is that the self-control plays a major role on behavior of individuals on the Internet. Social network user share files, comments, favorite music and choose friends and

according that reveals basic information about them - gender, race, age, while the degree of self-control can be established on the basis of non-verbal behavior, impulsivity, failure to envisage a consequence, inconsistencies, etc.

It is assumed that there is a connection between social networks usage and loneliness and shyness. People who are socially anxious and having difficulty in direct communication with the people, see the Internet as a lighter, alternative type of communication (Papacharissi & Rubin, 2000). By following the comments, photos and videos, shy social network users do not have to reveal their true identity and that is exactly what makes it easy in communication with other users (Aydın, Muyan, & Demir, 2013). When it comes to loneliness (Aydın, Muyan, & Demir, 2013) have come to the conclusion that there is a negative correlation between loneliness and online communications in the sense that when increased levels of loneliness, the frequency of communication with friends decreases, and vice versa. Research shows that although personality characteristics affect the usage of social networks, it is not the only factor that affects the use of the Internet as a means of communication (Ross, Orr, Sisic, Arseneault, Simmering, & Orr, 2009).

On the basis of mentioned above, the question which arise is how the average Facebook user in Serbia is experiencing the opportunities that this social network provides, and which are their habits on the social network that reveal their character. For this purpose, a survey was conducted which will be described in the following sections.

2. RESEARCH METHODOLOGY

Since Facebook has become a trend that is followed by all younger and older people around the world aim of this study was to measure the users' habits, their behavior on Facebook and characteristics of their character.

2.1. Defining the problem

The problem which needs to be examined is importance of social networks like Facebook to the users, and what is the main reason for opening the profile. It is necessary to investigate which personal information users leave on their profiles and how they can assist in determining an individual's lifestyle. Certainly it cannot be ignored the number of friends, number of photos as well as their content. These are all important sources of information requested.

2.2. Designing the research instruments

The research will be conducted on a random basis and will last 3 weeks. It is assumed that respondents spend enough time on the Internet, especially on Facebook and will be able to fill out the online questionnaire. Therefore, for the research instrument it will be used poll. The poll will have seventeen questions that are related to the habits on the social network and three demographic questions.

2.3. Participants

This study involved 40 participants (23 - female, 17 - male). The largest percentage of respondents (45%) are in the age group between 25 and 30 years, 33% had between 20 and 25 years, 3% (i.e. only one respondent) aged between 15 and 20 years. Only 15% of respondents aged between 30 and 40 years and 5% over 40 years. The largest proportion of respondents is from Belgrade, several from Novi Sad, Pirot, Pancevo, Smederevo, Krusevac and Uzice. They are all users of Facebook social network and they accessed online poll through their Facebook accounts.

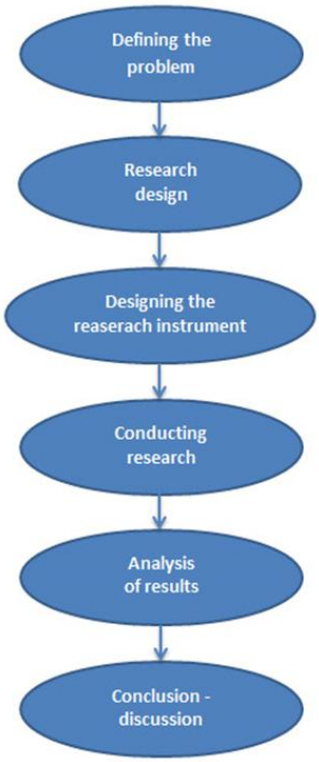

Figure 1: Research methodology

3. ANALYSIS OF RESULTS

Based on the results, the author of this paper has made a classification of participants and divided them into four groups:

- *Facebook addicts* - users whosee Facebook as an important source of information, and way of communicating with even strangers. These are also users who often share their photos, and which every aspect of the "offline" life trying to share with their online friends.
- *Facebook trend followers* - users who access to Facebook because their friends follow this trend. To them Facebook is not very important as a social network, but as aninstrument of following the trend.
- *Curious Facebook users* - these are the most frequent users who are, unlike the previous group, interested in the social network itself, for its functionality, as well as to follow the activities of their Facebook friends.
- *Sociable Facebook users* - these are mostly the users which meet new friends on various places and who are constantly expanding their circle of friends. They have friends abroad and use Facebook as a way to communicate with physically distant friends, sharing photos with them, videos, and so on. They use a check-in option whenever they find themselves in a new, interesting place.

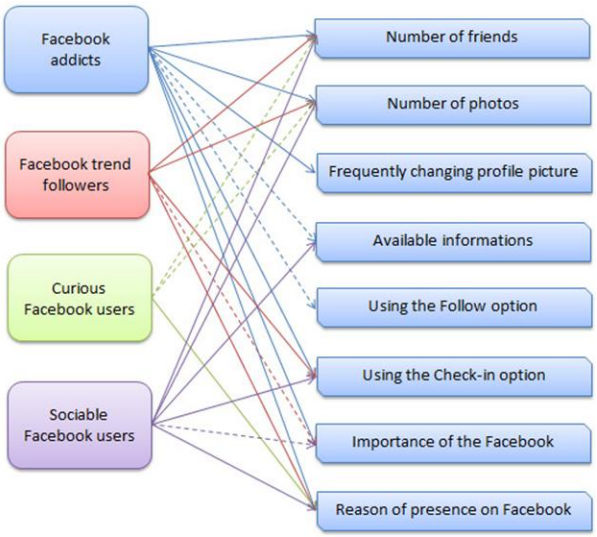

Figure 2: Categories of Facebook users and their habitats

The tables show the answers to the questions in the survey.

Table 1: Results – time spend on Facebook

How much time do you spend on Facebook on a daily basis?	
Half an hour to 1 hour	45%
Between 1 and 2 hours	35%
Between 2 and 3 hours	10%
3 hours and more	10%

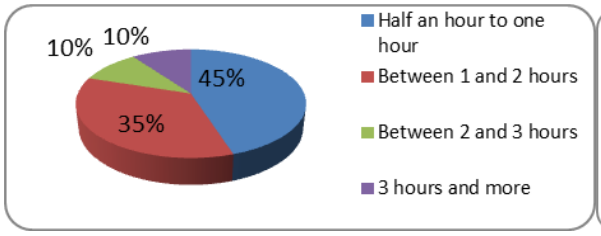

Figure 3: Graphic – time spend on Facebook

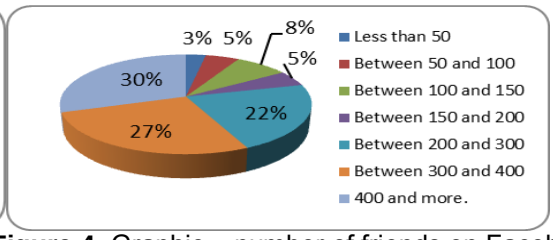

Figure 4: Graphic – number of friends on Facebook

Table 2: Results – number of friends on Facebook

How many friends you have on Facebook?	
Less than 50	3%
Between 50 and 100	5%
Between 100 and 150	8%
Between 150 and 200	5%
Between 200 and 300	22%
Between 300 and 400	27%
400 and more.	30%

The largest proportion of respondents (45%) spends less then hour on Facebook. A slightly smaller percentage (35%) spends mostly two hours. Number of friends varies, but the most (30%) have more than 400 Facebook friends.

Number of photos on profile is one of the indicators of how the subject is active on Facebook, and the results of the survey indicate that the lowest percentage (only 8%) of respondents have over 800 pictures in the profile, and the highest percentage (27%) have less than 50 images on profile.

Table 3: Results – number of photos

How many photos do you have on profile?	
Less than 50	27%
Between 50 and 100	15%
Between 100 and 200	20%
Between 200 and 400	15%
Between 400 and 800	15%
800 and more.	8%

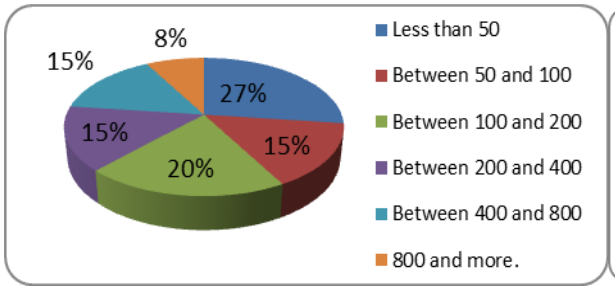

Figure 5: Graphic – number of photos

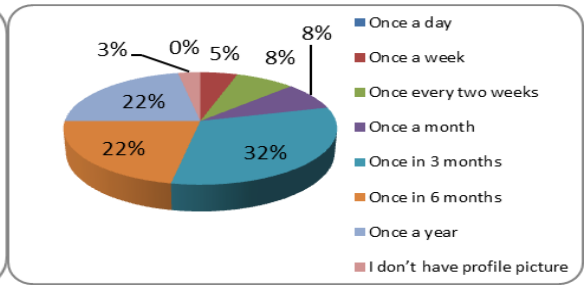

Figure 6: Graphic – Frequency of changing picture

Table 4: Results – Frequency of changing profile picture

How often do you change the profile picture?	
Once a day	0%
Once a week	5%
Once every two weeks	8%
Once a month	8%
Once in 3 months	32%
Once in 6 months	22%
Once a year	22%
I don't have profile picture	3%

The frequency of changingprofile picture also indicates the activity of users on Facebook. 5% of respondents changed the profile picture every week, but the largest percentage of respondents (32%) change their profile picture once in three months. 3% of respondents do not have a profile picture.

Table 5: Results – photos availability

Your photos are available:	
Only me	3%
Only to my friends	70%
Only particular friends	7%
Friends of my friends	13%
Everyone	7%

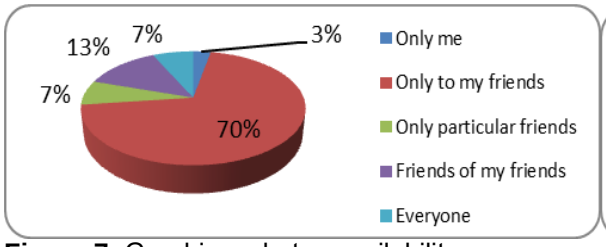

Figure 7: Graphic – photos availability

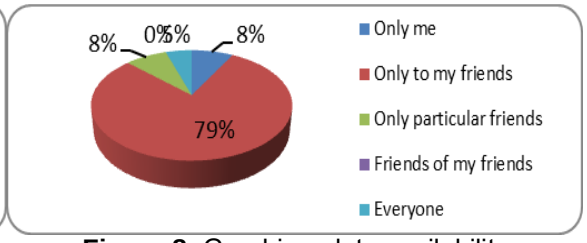

Figure 8: Graphic – data availability

Table 6: Results – photos availability

Your personal information are available:	
Only me	8%
Only to my friends	79%
Only particular friends	8%
Friends of my friends	0%
Everyone	5%

Availability of pictures and basic data is showing how many respondents are open to make new friends and connect with new people. 7% of them leave photos visible to everyone and 13% to friends of their friends. 5% of respondents share personal information with everyone, and 8% of respondents do not share information with anyone. However, the largest proportion of respondents shares photos and information only with friends (70% and 79%).

Of all respondents 73% share music with friends, and even 52% accepted the invitation for friendship from strangers. The largest proportion of respondents (40%) intensively communicates with up to 5 friends. Only 5% of respondents use Facebook as a tool to communicate with more than 15 friends.

Table 7: Results – communication with friends

With how many friends you intensively communicate via Facebook?	
2 at most	10%
Between 2 and 5	40%
Between 5 and 10	28%
Between 10 and 15	17%
More than 15.	5%

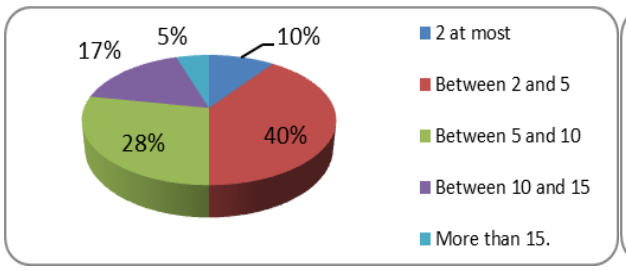

Figure 9: Graphic – communication with friends

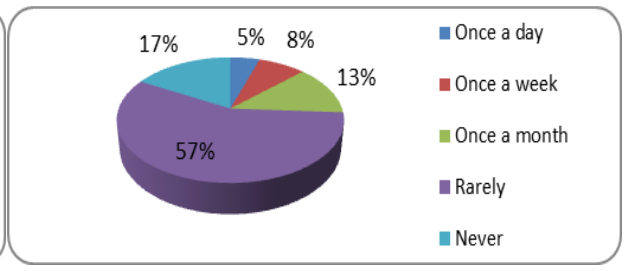

Figure 10: Graphic – posts frequency

Table 8: Results – posts frequency

How often do you post statuses?	
Once a day	5%
Once a week	8%
Once a month	13%
Rarely	57%
Never	17%

According to the survey, 57% of respondents rarely publish status, only 5% of respondents publish once a day. 10% of respondents use the option to follow people who are not their friends. 10% of respondents actively participate in discussions of Facebook groups. The largest proportion of respondents (90%) accesses their Facebook account via mobile phone.

When it comes to the check-in option which Facebook users can use on their mobile devices, the survey shows that 43% of respondents use this option, of which 37% of respondents use it only at interesting places.

During the analysis of poll results it was showed that 10% of respondents said that Facebook is very important to them, 42% believes that access to Facebook has a medium importance, and 15% that it have small importance (see Figure 11). Some respondents indicated that, in addition to connecting with people and sharing photos, Facebook is suitable for easy organization of dates and meetings, as well as the proper place for the collection of new information.

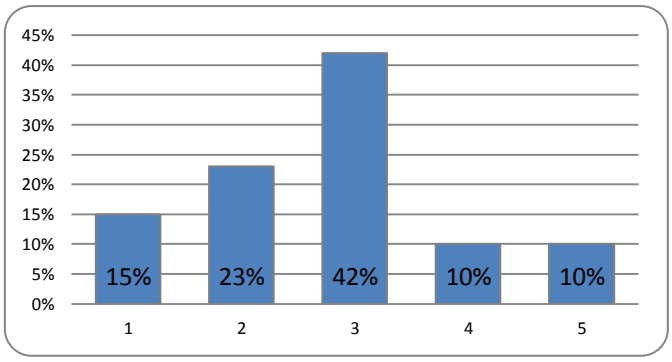

Figure 11: Graphic – Facebook importance for users

The last question concerns the reasons for opening the Facebook profile. This is key question because in most it helps to identify to which category user belongs. The largest proportion of respondents (48%) as the reason for opening the Facebook profile states communication with friends from abroad, which, clearly, indicates that these are *Sociable Facebook users*. 20% of respondents said that they joined to this social network out of curiosity to see how it works and what people share with their friends, and this group of respondents belongs to the *Curious Facebook users*. There are 17% users who belong to the group*Facebook trend followers* because they stated the influence of their friendsas the main reasonfor opening the profiles. 15% of respondents are part of category*Facebook addicts*, because,among other things, they stated that Facebook is extremely important to them, not only for socializing, but also for sharing photos, check-in and connecting with the people in general.

4. CONCLUSION

Taking all the answers of survey participants into consideration, it is possible to determine that among the respondents there are members of all groups represented in Figure 2. Respondents who belong to the first group, *Facebook addicts* have the following characteristics: time spent online (3 hours and more - 10 %), the number of friends on Facebook (between 300 and 400-27%), the number of photos on profile and frequency of changing profile pictures (800 more photos - 8%; once a week - 5%), frequency of publication status (once a day - 5%), network access via mobile phone (yes - 90%), the importance of Facebook (great - 10%). These participants highlighted the importance of Facebook as aninstrumentfor connecting with people and sharing photos and thus they opened their profiles.

On the other hand, among respondents there are those who belong to the group of*Facebook trend followers* with next characteristics: number of friends (which are usually their acquaintances), personal information are available only to friends (79%), intensive communications with up to five friends (40%), rejection the friendship invitation from strangers (48%), rarely publishing status (57%), the importance of Facebook (2-23%). The main reasons for these users to access to Facebook are influence of their friends and a sense of belonging to this trend.

There are also a *Curious Facebook users*, to which is not especially important number of friends (between 100 and 150 - 8%) nor the time spent on Facebook (half an hour to one hour - 45%), but these are the most frequent users who accept the invitation from strangers (52%) out of curiosity and using the option to follow people that are not on their list of friends (10%). The reason for their stay on a social network primarily is curiosity regarding the Facebook functionality as a social network, but also for following the events in the online lives of other users.

For the end, there are *Sociable Facebook users*who open profile to extend the circle of friends they met on their journeys and in different places. These are active users of social networks that leave their photos available to friends and their friends (13%), and for them is extremely important the number of friends (400 or more - 30%). They often use check-in option when they are at the interesting places (37%), but do not attach great importance to Facebook in general (3 - 42%).

From all the above it can be concluded, that based on the respondents' answers and their habits on social networks and Internet in general, can identify some basic characteristics of their personality. The aim of this study was to determine the rough character traits based on the online survey, as well as whether it is possible to determine some of the habits of the participants based on specific questions.

The fact is that social networks have become the basic platform for sharing photos with loved ones, friends, but also the place where you can make new friends. However, the user decides how much and in what way he distributes information about himself. With development of mobile applications, Facebook has opened new doors for spreading among users, and offered users possibility to share favorite moments with friends. Check-in option offers the possibility of capturing the user’s current location.

In order to determine the detailed character traits of Facebook user, this research must be conducted in detailon the contents of customer’s photos, the content of their posts, statuses. Also,the structure of Facebook friends and pages that respondent follows, must be taken into consideration. For the purposes of this paper it was sufficient to collect respondents' opinions about their own habits on the social network.

REFERENCES

Aydın, G., Muyan, M., & Demir, A. (2013). The investigation of Facebook usage purposes and shyness, loneliness. *Procedia - Social and Behavioral Sciences 93*, 737 – 741.

Papacharissi, Z., & Rubin, A. (2000). Predictors of internet use. *Journal of Broadcasting and Electronic Media*, 75-196.

Ross, C., Orr, E. S., Sisic, M., Arseneault, J. M., Simmering, M. G., & Orr, R. R. (2009). Personality and motivations associated with Facebook use. *Computers in Human Behavior*, 578-586.

Stopfer, J., Egloff, B., Nestle, S., & Back, M. (2013). Being popular in online social networks: How agentic, communal, and creativity traits relate to judgments of status and liking. *Journal of Research in Personality*, 592–598.

Teppers, E., Luyckx, K., Klimstra, T., & Goossens, L. (2013). Loneliness and Facebook motives in adolescence: A longitudinal inquiry into directionality of effect. *Journal of Adolescence*, 1-9.

Yu, S. (2013). Analysis of samples of behavior on Facebook: Test cyber profiling. *Defendology 33*, 19-30.

COMMUNICATION MANAGEMENT AND SOCIAL NETWORKING

MODEL OF CRISIS COMMUNICATION IN MILITARY ORGANISATIONS

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Abstract: *Crisis Communication has become an increasingly important activity of the military organisations. In this study we are considering one of the models of Crisis Communication in the public sector, as well as a special model of responding to crisis, as the most important phase in communication in a crisis case, that may apply in military organization.*

Key words: *crisis communication, crisis communication model, public sector, military organization, crisis management*

1. INTRODUCTION

Crisis communication consists of interlinked processes and activities undertaken by organisations in order to plan for management of unpredictable events. In addition, these activities are parts of continuous research related to public relations and crisis management because inadequate communication, especially in for-profit organisations, can create a perception of crisis; this in turn may affect the reputation, cause financial loss and threaten the existence of the private organisation itself.

Crisis communication has been increasingly perceived as an important activity in the social and public sector. It is due to the fact that the reputation of an organisation relies not only on its ability to manage the crisis, but also in its power to control its public image.

Crisis events in military organisations are always news, because the public is the main stakeholder. The public perceive crisis in military organisations with a lot of scrutiny, as it is the organisation that has a task of protecting the highest values of said society. Crisis communication within military systems creates multiple benefits if it is performed adequately. It lessens the negative effects of the public perception of a crisis, creates trust, and protects the reputation of the military as a socially responsible institution.

Two other elements emphasise the need for preparation and implementation of crisis communication in modern military organisations and these are: the complex roles of the defence forces and the development of information and communications technology (ICT). The tasks of military organisations in many countries worldwide is not only defence but also contribution towards world peace, opposition against asymmetric threats and challenges, and increasingly numerous activities in support of the civic stakeholders of society. At the same time, development of ICT has made mass media an ever-present, accessible, and powerful tool in the information sphere. ICT has reduced the possibility of information control and forced military organisations to be more transparent.

The elements of crisis communication for the Ministry of Defence and the Serbian Army have been included in the existing documents such as *Guidance on Communication Strategy*, as well as instructions on standard operating procedures in the case of unpredictable events. However, there is no policy that would clearly lay out division of jurisdiction and responsibilities related to crisis management; in particular for external stakeholders.

Primary elements of crisis communication in a military organisation that is a part of public sector are not identical with the ones in for-profit organisations or other public sector organisations. Thus it is necessary to examine the model of crisis communication in the public sector and emphasise the specific points of crisis communication in modern military organisations.

2. CRISIS COMMUNICATION MODEL IN THE PUBLIC SECTOR

Various theories of crisis communication, coming mostly from sources within the USA, produced various models. Nevertheless only a few of these are applicable to crisis communication in the public sector. One of these few models was based on analysing the crisis communication in for-profit organisations and then

extrapolated to the public sector. Since these model structures of crisis communication in the for-profit sector have been incorporated into the public sector, it is called a **synthesis model**. (Horley, S., Baker R, 2002).

The synthesis model of crisis communication in public sector organisations has six stages:

1.existing activity related to ongoing public relations;
2.identification of and preparation for potential crises;
3.internal training and rehearsal;
4.a response to the crisis event;
5.evaluation and revision of communication; and
6.Inter-agency and political coordination analysis.

1. In order to create an appropriate public image the organisation must proactively form public relations, be socially responsible, and build a good relationship with journalists. Research in this area has indicated that establishing a good relationship with all stakeholders before the crisis and endorsing social responsibility will increase the organisation's ability to positively influence all interested parties during the crisis event. A proactive stand towards media includes continuous survey of news reports on the organisation, regular contact and visits to news agencies; as well as inviting news agencies to attend important events, take part in training for responses to the crisis event and distributing information that are relevant to organisational crisis management. Equally important is the efficient and positive response to media inquiry, such as requests for interviews or specific information related to defence and security matters.

2. A crisis can be defined as 'a specific, unpredictable and unusual event which creates a high level of uncertainty and (possible) threat to organisational priorities'. (Seeger,M.T and others 2012) In addition to this, another important defining characteristic is the need for change. In the case that change is not needed, the event may be described as (only) a failure. Some organisations define crises as accidents, incidents or conflicts. For this reason it is important that each government entity identify what their perception is of a possible crisis. (Venette, S. J, 2013)

Preparation for a potential crisis starts with identifying and reducing risk that can lead to said crisis. Communication on risk is a two way dialogue between organisation and stakeholders who should be aware of potential risks that the organisation may face and the methods of risk management. Certain government entities and in particular, military organisations often consider risk data to be confidential. This also applies to communication on risk management. The result of such policy is that the public is not sufficiently informed.

The most important activity in the second stage of the model is the preparation of a communication plan. The plan sets out the way in which the organisation will communicate with the public in a certain crisis. Every organisation in the public sector, even those that have not adopted a plan for crisis management, should prepare a plan for effective communication with the public in a case of an unpredictable event. The model for these plans is to contain the following steps: establishment of a special crisis team; selection of the most effective communication methods (communication tools), and assessment of the results. The emphasis in crisis communication plans should be on proactive action in the pre-crisis phase. These plans should be adjusted to each specific potential crisis.

The authors of the synthesis model conducted a study on readiness for crisis communication in 107 state government agencies. The results showed that government agencies do not have proactive communication with the media, although they have developed a good relationship with journalists. Less than half of these agencies had a crises communication plan in place. (Horley, S., Baker R, 2002)

3. The third stage of the model is rehearsal of roles in crisis communication, training and acting out prepared scenarios, and undertaking simulations of crisis communication. A crisis communication team is institutionalised within the preparation for crises with fewer numbers of permanent members. The number of the team members will grow in the moment of crisis with other members joining. These newly joined members would have their role, authority, and expertise defined beforehand.

At this stage the most important thing is selection and training of the spokesperson; one or more of whom will communicate with the public in an instance of crisis. Large organisations, such as an army, should have several spokespersons, i.e. people trained and ready to undertake communication with the public when crisis strikes. In order to gain public trust and support, the most important goals for the organisation are to have enough public exposure, show concern for crisis development, and issue public statements of key personnel. Nevertheless, other member of the military organisation can gain public trust if they are well trained. Well

trained staff are capable enough to prepare and announce appropriate messages, control their statements, and interact well with the media. They also know to provide the right answer that highlights important facts without jeopardising confidential data, prepare succinct answers, and be ready for various requests from the media.

At this stage it is also required to prepare policies on security and quality controls of the measures that organisation employs to prevent a crisis. These policies should be available to media representatives and other stakeholders in the case of a crisis.

The preparation stage of crisis communication relies on three pillars: a crisis plan, a crisis team and a spokesperson that is trained in proper media handling for efficient crisis communication.

4. A response to the crisis event when it actually happens is the key moment for communication. The Synthesis model does not provide specific elements for this phase of crisis communication. The model does not define necessary steps in response to a crisis. However, it would be advisable to identify these steps, which can be outlined as: observation, interpretation, choice and dissemination of crisis messages. (Hale J., Dulek R., Hale D, 2005)

An organisation faces public reaction which is mostly formed by media reports. Crisis produces more intense public emotions which can be influenced by limited access to information, rumours, speculations, and assumptions that may lead to wrong conclusions. Research in crisis communication (Coombs, T, 2005) confirms that a negative reaction by the public to the crisis in any organisation does not always have roots in the crisis itself. It is rather that the organisation refuses to accept responsibility or provide complete and accurate information.

Observation encompasses gathering information on crisis from the place of origin as well as from other sources such as responsible entities outside of the organisation and experts for certain elements of the crisis. The most frequent problems at this stage can be lack of adequate physical indicators of the crisis and inability to use regular channels of communication to collect data due to malfunction of said channels or other various forms of telecommunication network.

Existing information is analysed at the **interpretation** stage. The key task is to establish and identify what is true or half-true, and what is confusing or contradicting information. This is done to address shortcomings such as incomplete and/or contradictory interpretations of the crisis event.

The **choice** of information for dissemination in crisis communication is influenced by the necessity to answer the most important questions and whether the message satisfies public interest. The information must answer questions of interest to the public such as: *What has happened?* What *is the cause?* and *What measures has been undertaken to address the crisis?* At the same time, addressing the public should express behaviour such as empathy and care; competency and credibility, honesty, openness, and commitment. (Djuric-Atanasievski K,Karovic S, 2011)

The message will satisfy public perception if it is well presented which, in other words, means that it has chosen the appropriate aspects of reality. The message should contain the definition of the problem, interpretation of the

cause to it, moral evaluation and/or proposed solutions. Successful presentation of crisis content enables key public stakeholders to assess information, understand implications and, if applicable, undertake action.

Communication done by public sector and private companies differs in legal obligations to provide information. Government institutions and public companies have procedures in place which implement freedom of information and insist on answering the public on any question they may have. Requests for information may be submitted through the media or by individuals requesting access to certain documents. It is common that the public sector would have certain legislative provisions that deal with public access to certain types of information related to military operations, security, investigation and casualties.

Problems that may be present at the choice stage are: lack of time to evaluate and choose alternatives as well as inadequate communication filters. Well prepared communicators in a crisis event need less time to evaluate the significance of all received information and the effectiveness of communication filters. Effective communication filters should give priority to only the information that is relevant to the crisis.

Dissemination or forwarding refers to fast and resolute communication that can help to lessen the effect of rumours and speculations during the time of the crisis; especially in a situation when it produces public fear and uncertainty.

Four steps at the response stage do not represent linear model since one of the activities initiates and completes the other one. These steps represent instead a spiral model. One step would be incorporated into the next one; but at the same time the steps may be repetitive as new information is introduced, interpreted, chosen and addressed to the public (Hale J., Dulek R., Hale D, 2005).

At the response phase, various strategies of crisis communication are implemented. Each one of these strategies may be carried out with different tactics. More than a decade ago, the experience of the US military system offered a list of twelve strategies which represent the stage of proactive response in communication crises (Hunter, D.,2000 as cited in Beyond Maximum Disclosure, Minimum Delay, Military Public Affairs Practitioners on Proactive Crisis Communication Strategies):

1. Openness – all information released immediately;
2. Agenda setting – everything is open to public access, especially at the beginning of the crisis;
3. Relevance – release of information that led to a crisis but without permitting questions on responsive actions
4. Legal privileges – input from a legal team within the organisation that has to be provided at the same time as the media questions are submitted;
5. Legal privileges that are specific to the host country – this is applicable when a crisis is unfolding in a foreign country
6. Coordination of public announcement – this entails that everyone involved in the process of coordination is aware of questions related to the crisis, in order to avoid making any contradictory statements
7. Public opinion – it is necessary to respond to public opinion on said crisis and provide answers to public request for information
8. Response readiness – quick reaction and response to any request for information that the media may have
9. Messages – the appropriate message should be prepared in advance for all scenarios, especially at the initial stages of a crisis;
10. Respect for cultural differences, i.e. awareness of culture, ethnic and language sensitivity;
11. One spokesperson – engagement and training of one person who is ready to answer to all tasks related to the organisation and its role in the crisis;
12. Engagement of a 'fireman', i.e. staff that can analyse all questions that can aggravate the situation during a crisis.

A survey was conducted with professional military personnel of the US army that were engaged in the communication crisis process. The survey results revealed that the most frequently used strategies were messages that were prepared beforehand alongside quick reaction and response to any request for information from journalists and the public media. After that on a list of the most frequently used strategies, comes

'openness' and readiness to provide all relevant information immediately in order to impose their own story. At the bottom of this list are coordination of public announcements, making sure that everybody is on the same page on a crisis and that no contradictory statements are issued. (Beyond Maximum Disclosure, Minimum Delay, Military Public Affairs Practitioners on Proactive Crisis Communication Strategies, 2000).

5. The evaluation is the fifth stage of the crisis communication model which encompasses various activities. As a priority, it includes follow up communication with stakeholders, release of new information on progress and recovery from the crisis, actions that were undertaken to prevent a new crisis, and also, the release of information that have been promised during the crisis but were not presented.(Djuric-Atanasievski K, Karovic S, 2011)

At this stage, proper information will be released to these agencies and services that are in charge of investigating the cause of the crisis. All crises involves investigation that is led by responsible government agency or the organisation itself which is the case with most military organisation. These information must be easy to understand and must be released in due time. During the previous stage of responding to the crisis event, many organisations would initially announce the release of the results of the investigation, but would fail to do that or they would do it after considerable period of time. If an organisation fails to release the outcome of its investigation then the media may do it.

The last component of this stage of crisis communication is an assessment of the 'lessons learnt', that is to say, an evaluation of what was successfully completed and what steps in the process need improvement. This stage is also known as 'post mortem'. The key issue here is an analysis of different aspects of crisis communication. It is related to an analyses of the usefulness of information released as a response to a crisis; and how effective was the dissemination of various messages to numerous stakeholders during the crisis communication.

6. The model of crisis communication for government agencies and public sector differs significantly to crisis communication for independent and for-profit organisations due to the last stage which is inter-agency coordination. Crisis in security sector and especially in military systems, effects the other public sector agencies. Crisis that is of larger proportion and with more casualties can also have impact on other executive and regulative government bodies. It is for this reason that the coordination of crisis communication is very important. It encompasses transparent exchange of information open to public eyes. In addition, this stage includes political analyses that deals with cause and consequences of the crisis effecting not only military organisations but other institutions of public sector as well.

3. CONCLUSION

Crisis communication in a military organisation can be analysed as a specific case of crisis communication within public sector. The synthesis model of crisis communication in public sector organisations sets out six stages; puts emphases on preparation and training for a crisis and clearly defines a response to potential crisis as the most important stage of them all.

In addition to that, it is necessary to be aware of a specific role of military organisations that can greatly influence potential crisis communication. On one side, military organisations are part of public sector and government body that has the task of protecting society and the state. On the other, these specific tasks are influenced by unique nature of military organisations which is characterised by chain of command and decision making process within the limited time-frame.

For these reasons, the synthesis model of crisis communication must be extended to define strategies of proactive response. It is also necessary to choose appropriate policy for relationship with the media. With these additional actions, the syntheses model becomes optimal for military organisations.

REFERENCE:

Beyond Maximum Disclosure, Minimum Delay, Military Public Affairs Practitioners on Proactive Crisis Communication Strategies (2000) Department of Defence USA Communication Course

Crisis Communication Handbook, ed. Fernandez L, Merzer M, Jane`s Information Group, UK, 2004

Coombs, T. Crisis Management and Communications, Institute for Public Relations, 2007, www.instituteforpr.org/files/uploads/Coombs_Crisis2.pdf

Covello V. (Februay 1996). Environmental Risk Communication and Public Dialogue. Risk Communication Conference. Hampton Va

Djuric-Atanasievski K, Karovic S (jesen, 2011) In Serbian: Krizno komuniciranje u vojnoorgainzacionim sistemima, Beograd.Vojno delo

Seeger,M.T, Sellnow, T.L Ulmer, R.R (1998). Communication, organization and crisis in Roloff M.E (Ed) Communication Yearbook 2, 231-275

Hale J., Dulek R., Hale D. (April 2005). Crisis response communicaiotn chalenges:building theory from qualitative data, Journal of Business Communication

Handbook of Risk and Crisis Communication (2009), ed.Heath. R, O`Hair,D, Routledge

Horsley S., Baker R. (October 2002). Toward a Synthesis Model for Crisis Communiction in the Public Sector. Journal of Bussiness and Technical Communication 16, 406-440

Hunter, D., Berry, D., Goodrich-Hinton, R., & Lincicome, B. (2000) Proactive crisis communication in public affairs. Department of Defense Short Course in Communications Capstone project, Class 00-B

Venette, S. J. Risk communication in a High Reliability Organization, APHIS PPQ's inclusion of risk in decision making., Retrieve http://www.designacademy.nl/Portals/9/Documents/grad2010new/images/Bart%20Nijssen/BartNijssenDesignInTimeOfCrisis.pdf

COMMUNITY MANAGEMENT IN SERBIA AND FACEBOOK INFLUENCE ON SERBIAN SOCIETY

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Abstract: *The concept of community management in Serbia is spreading in the last few years. Companies became aware of the importance of social networking and their influence on business as well as everyday life. The basics of community management are communication with customers and answering to their needs on the best possible way. Considering the fact this business direction is still in developing process, the most influence on Serbian society have Facebook. The main idea of this study is to approach the concept of community management to people in Serbia, to point out its advantages and development process, but also to point out the differences between social media management and communication management in Serbia and abroad.*

Keywords: *management, communication, customers, social networking, research, development, community*

1. WHAT IS COMMUNITY MANAGEMENT?

Community management can be best described as a complex term, which includes variety of management basics, as well as networking skills. It is a combination of data analysis and strategic inputs for supporting social media strategy, social media campaigns and social reporting, both long-term and short-term engagement. To simplify, it is a mix of skills and knowledge needed for a project, which depends on nature and the purpose of the community. Community management has been treated as a special business direction since the huge expansion of social networks, so today almost every company has its own account on Facebook, Twitter, Google etc. (Gentle, 2012)

Community management is a kind of job direction which is not clearly understandable in Serbia thus is not developed. Still, employers realized that communication with customers is one of the top priorities in their business and that shouldn't be ignored. The most appropriate person for this position is someone who understands the policy of a company, mission and vision, who has information about company itself, but at the same time has marketing skills and creativity. It is important that person is patient and capable to answer to all questions customers have, and to take care about the content of posts which will be posted on some social network.

Considering that on-line communities are really "sensitive", community manager needs to be aware that every mistake can be fatal. It's important that the information we're giving is right and given on time. Besides that, it's of great importance to know when to post something on Facebook, how to reach our target groups and make them trust us.

By defining essential responsibilities of a community manager we can see the complexity of that job. Besides the daily, or better say minute by minute interaction with customers, for that position is important to be “eyes and ears” of a promoting brand as if our own reputation is depending on it. Not only the communication with customers is important, but also interaction with other legal clients and cross corporate agencies. Managing and tracking campaigns, coordinating different spheres of business, creating and updating daily, weekly and monthly reports, translating data into plans for revising the social media campaigns – it’s only a part of job description of community manager. (Bacon, 2009)

In this research focus is on Facebook influence on Serbian society in general and what is the role of community management in business purposes. The goal is to prove what kind of Facebook communication will be the most effective, when we talk about the promotion of a brand or company’s activities. Considering the activities community manager has, which is primarily maintenance of profiles on social networks, here will be focus on the most common ways of communication between companies and customers in Serbia. By companies we mean on international and domestic brands and branches that exists in Serbia.

2. FACEBOOK INFLUENCE ON SERBIAN SOCIETY

Development of community management in Serbia is definitely rising. Community manager, as we said before, could be treated as online PR manager of a company, intermediary between customers and companies, someone who is following situation on market and with online activities is making the brand even better and more successful. Social media marketing as a business direction is trying to get people’s attention, then to make profile visitors to profile followers, followers to buyers, which lead us to sales increase. Only in Serbia there are 3 million Facebook users, which can be treated as a market with a lot of potential clients. Companies, aware of that, are starting to invest in occupation known as “community manager”. However, we can still find a lot of misplaced pages, analytics, market tracking etc. It is of a great importance for companies to realize that the most important thing is following the user’s needs and data updating.

When talking about the specifics of the community manager job on Facebook, it is important to start from the beginning, to give all possible information about the company, business activity, foundation, awards, to leave a contact, pay attention to “about me” part – actually, whatever visitors of Facebook page give the impression of a serious business. Before all of that, it is important to create a strategy for all networks we want to operate on. The Facebook situation is that a people have experienced it as more intimate social network than others, so we need to put an effort to share and post things with positive connotations. We should write simply, understandably, enrich pages with pictures, videos, applications – leave a good visual impression. Often we can unconsciously run negative campaign, so in this situations is important not to argue, but to admit the mistake and to divert attention from the bad to a good thing brand carries. Statistics should be regularly monitored, content changed and adapted according to indicators. (Kirkpatrick, 2010)

2.1. Mistakes and crisis situations on Facebook from the perspective of community manager

As in any business, mistakes are the part of it. Without them we wouldn't be able to have a real insight into what is good and what is bad for us, how to approach to a problem, what to edit, what to delete. When a company has a good community manager or some external collaborator who takes care of company's account on social networks, there is larger possibility errors will be corrected on time and situation will be solved in the best possible way. In every business there are crisis and the reason for their occurrence may be accidental, intentional, products of competition or perhaps expressions of customer's dissatisfaction.

Crisis situations, although they can be very stressful, in the future can reduce the possibility of mistakes in business. In community management there is a "Response Time", which means there is a certain agreed period of time for which community manager needs to respond to an emergency. It suggests that if some undesirable situation happens, community manager will have some time to respond to that situation. The essence of that is to reduce the time as much as possible.

When we talk about those problems in Serbia, crises are usually associated with Facebook, but also with Twitter. Users on these social networks are very different and therefore, there are different approaches for solving problems. As we said before, critical situation can be caused by competitors, dissatisfied clients or some third group of people. People who are loyal to brand usually solve problems directly and they are trying to find a solution. Problems can be made by Facebook status, posting pictures, creating "anti-groups" etc. To reduce and eliminate mistakes and crises, it's very important that community manager react to any kind of people's dissatisfaction and for doing that, it's important to have skills we mentioned before.

Considering that people are the key factor in this type of business, we should try to include them in as many activities, like – asking them for advice, for suggestions about work, brand, actions etc. It is important to build trust with customers, because that will help us to get over crisis.

3. SPECIFICS OF SOCIAL MEDIA MANAGEMENT AND COMMUNITY MANAGEMENT IN SERBIA

It is often a case that, when the job description of a community manager should be given, people think it is a campaign guiding and collaborating with people who are in charge of budget, brand, stores, better say - with anyone who can give us any information about the brand. In Serbia, the practice differs from the theory, so the job of a community manager often identifies with customer service. However, this is far from the truth, although the description of the community manager includes communication with target groups /customers/consumers. People don't pay too much attention to this job, unaware of the fact that it is a job without work time, without holidays and weekends – you always need to be there for your followers. If this work is done within an agency highly specialized for social media marketing, which is rarely the case in Serbia, it can be treated as a desk job, considering you need to participate in activities, starting with creating online campaigns through collaboration with designers, up to posting something on social network.

For this job is important that there is awareness of the individual who is doing this job that he not only represents the brand but also the company. Besides rich vocabulary, creative writing and creativity in general, computer literacy and continuous developing, reading and following trends (or better say, be well informed) is also of a great importance. Another "skill" need is listening to the needs of the target group and indentifying what content will be the most interesting for them. Although this job is still not well defined in Serbia, the competition in this business exists so we need to put an effort to create

something new, unique and something which no one else has the thought of, and in this time of facilities hyper-production, it is very difficult to achieve.

In Serbia is often a situation that clients usually know what they want to achieve by promoting their brands, on which networks they want to promote and how much they want to invest in a particular project. Usually the situation is everyone wants to be represented on Facebook, not realizing the importance of other social networks, so basically the number of clients who want to be promoted on other social networks beside Facebook and Twitter is negligible.

The problem with community management development in Serbia is the fact that a small amount of companies has internal resources (employed persons) who can answer to needs of online communication. In that case, companies often decide either to introduce the business direction under the leadership of their company or to engage the help of an external collaborators (outsourcing). External collaborators in Serbia are usually marketing and PR agencies, which are not focused precisely on online marketing and PR, but they perform those activities as a part of their regular activities, ie. diverted part of the social media campaign on specially created social media accounts for specific campaigns. For social media marketing mostly are engaged companies whose representative offices are outside of Serbia and that's the reason there aren't enough trained experts in the field of community management. In Serbia, situation is that often individuals are conducting various campaigns, instead of separate specialized agencies for social media marketing. Therefore, companies should wait for using social media for business purposes, while they don't "build" a person who will deal only with community manager. (Solis, 2010) Until then, companies operating in Serbia will be forced to hire external resources to communicate on social media, but only at a basic level of communication. As usually happens with most of professions, it's very likely to happen the invasion of this profession of community manager, but it's well know that situation will make clear as to distinguish individuals and companies that have measurable results.

3.1. Difference between community management in Serbia and abroad

Talking about this occupation, the difference in business should be found especially in culture and area we live on. It is difficult to present something which will fully respect the spirit of the Serbian language. This is especially the case when it comes to foreign brands, whose campaigns adapt the area in which the brand is promoted. In addition, our culture is more narrative than visual, grammar is complex and it is difficult for us to seen the message in shorter forms. The opposite example we can find in Western cultures, which can send the message in a short way, without the fear it won't be understood. Besides that, we can see that people more invest in campaigns and contents abroad thus they are getting better and more complete feedback, customers are becoming more interested and they are always waiting for more. Considering all of this, the fact is that creators of campaigns have in mind also the psychological aspect of customers/users. (Evans & McKee, 2010)

People in Serbia are not yet relaxed when it comes to using social networks. Again, culturally speaking, people generally do not debate online, do not express their opinions publicly and usually they don't go beyond some of its narrow interests. However, there is a lot of potential to encourage people to engage and embrace all the benefits social networks have.

3.2. Difference between Community Manager and Social Media Manager

Marketing experts have pretty same opinion about the difference between those two professions. They treat them as separate – community manager is someone whose activities we mentioned before, that

is – they are in charge of placement of the content and social media manager is a person who is in charge of planning network strategies as well as budget part, with experience in that area. In Serbia is case that the entire job is done by one person, but there are certainly chances that result will be better if more than one person is involved in that work and if their activities are divided, instead of dealing with everything in the same time.

Confusion is made because in both cases the person managing the initiative is responsible for being conversational, for making sure that the success of interactions have the desired outcome and they are sometimes using similar tools. (The Community Roundtable, n.d.)

Social Media Manager	**Community Manager**
Responding to conversations about the brand	Moderating conversation and encouraging specific topics
Managing tools - mostly social networks (Facebook, Twitter, etc)	Managing tools – might be a combination of enterprise and social networks
Planning and developing strategies for increasing engagement	Building relationships with key members of the community
Reporting	Welcoming members to the community
Content creation designed to induce conversation	Enforcing guidelines

4. RESEARCH RESULTS

In order to examine the habits and attitudes of Facebook users, with aim to increase effectiveness of Facebook communication between companies and consumers, we conducted an online survey. The main objective of companies which are present on Facebook is to send the right message at the right time, in the right place. In this way, the relationship between companies and consumers becomes stronger and consumers are more engaged to their favorite brands, and therefore to companies that produce these brands.

The survey involved a random sample of 200 respondents – Facebook users, where 60 % are female and 40 % male. 75 % of participants are aged between 21 and 25 years, 16 % are younger than 20, and 10 % are aged between 26 and 30 years. They are all people who live in Serbia, with different household incomes, but the largest group is the one where income is bigger than 100.000 RSD, with 27 % of survey participants.

The question regarding to frequency of use of Facebook indicated that 97 % of survey participants visit their profiles several times a day, with an average stay of 10 minutes per visit. Other 3 % of respondents visit their profiles once a day.

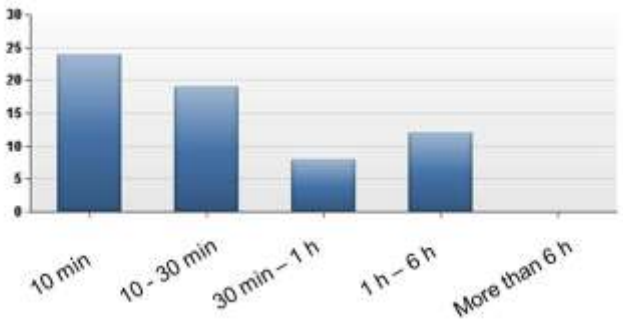

Figure 1: Frequency of Facebook use

We have analyzed the time of the day when our respondents most often visit Facebook. The highest percentage of visits occurs after 9:00 PM (52 %). Possible reason lies in the lifestyle of the majority of Serbs. Working hours in Serbia are until 5:00 PM, but employees often stay longer at work. Students are attending schools and faculties during the day, and unemployed are busy with the house chores. They all have in common the fact that their free time occurs just after 9:00 PM, when they like to socialize through social networks unless they have not done it in person.

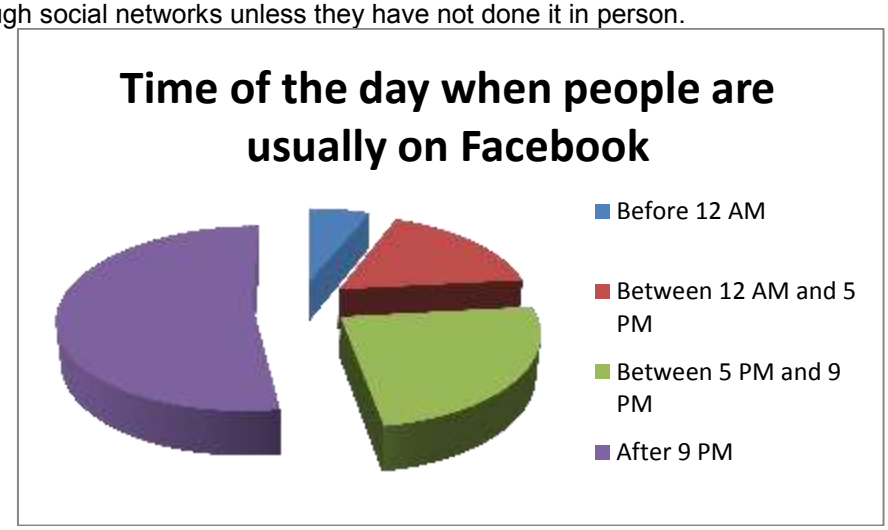

Figure 2: Time of the day when people are usually on Facebook

Taking this into consideration, companies should think about communicating with their fans mostly after 9:00 PM, because it is obvious that then is the greatest opportunity to attract someone's attention.

Examing the attitudes about advertising on Facebook, 41 % of respondents click on the link of an advertisement they are interested in, while 51 % completely ignores it. Only 8 % of respondents said they noticed sponsored advertisements, so companies should otherwise attract the attention of their target audience. 81 % of respondents said they like a Facebook page only when something really interests them. If you offer interesting content to your Facebook page's fans, be sure that they will focus their attention towards you.

Interesting fact is that 78 % of survey respondents are more likely to be informed about company's product or services via company's website, rather than via official Facebook page, while 54 % of respondents are using rather Facebook page for informing about promotional campaigns rather than website. This sets a challenge in front of the companies, where the question is how to interest Facebook users to frequently visit their page. This is where content marketing takes steps.

Furthermore, only 21 % of participants contact the page administrator when something interest them. Contradictory, regarding to 67 % participants who agreed that communication via Facebook company's page is more efficient and easier than via e-mails and telephones, it is possible that people

do not trust the person running the page, or they are suspicious that the page is official, or they are simply indifferent about this type of communication.

5. CONCLUSION

Summing up the impressions from research we made, we came to the conclusion that community management became the necessity of today's business development, when the subject is online marketing and social media management. Therefore, investing in this branch of management could increase the profit of companies and make huge number of satisfied clients in our market. Still, it is necessary to be worked on people's activation and freedom on social networks, not only Facebook, but also on Twitter, Linked in, Google + etc. This is also supported by the fact that our market is suitable for development and on the basis of the above in this study, we can agree that expansion of this profession and business direction generally is expected in the near future.

REFERENCES

Bacon, J. (2009). The Art of Community. O'Reilly Media, Inc., California.

Evans, D. & McKee, J. (2010). Social Media Marketing – The Next Generation of Business Engagement. Wiley Publishing, Inc., Indianapolis, Indiana.

Gentle, A. (2012). Conversation and Community - The Social Web for Documentation. XML Press, California.

Kirkpatrick, D. (2010). The Facebook effect: the inside story of the company that is connecting the world. Simon & Schuster, New York, United States of America.

Solis, B. (2010). Engage!. John Wiley & Sons, Inc., Hoboken, New Jersey.

The Community Roundtable. Differentiating Between Social Media and Community Management (n.d.). Retrieved from http://www.communityroundtable.com/uncategorized/differentiating-between-social-media-and-community-management/

NEW MEDIA IN INTERNAL COMMUNICATION

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Abstract: In this paper will be discussed the consideration and the implementation of the elements of mobile applications that are important for internal communication in daily business operations. Regardless of the company size or market position, a good and accurate internal communication provides companies the opportunity to direct their supplies to customers and solve their problems. Internal communication takes place between employees in the organization. Today, it is considered one of the most important tools in the organizational management. Improvement of the internal communication system includes diagnosing the current situation in the organization, identifying difficulties, points of failure and deformation process of communicating with analysis of the key barriers. Improving internal communication can be achieved by changing the organizational structure to combining the existing or establishing new communication channels.

Key words: *Internal communications, internal marketing, Mobile applications*

1. THE CONCEPT OF INTERNAL COMMUNICATIONS AND MOBILE APPLICATIONS

Internal communication significant changes are happening in the organization, it is almost impossible to hide the truth from the employees. In other words, they will create their own version of the truth. In these types of situations, it is necessary to inform employees as much and as quickly as possible, to enable the process of changing. The development and effective performance of internal communication requires:

- establishing the time and the form of communication (meetings, reports, etc)
- utilising all existing and already tested communication channels
- developing efficient channels that are missing
- being familiar with the sources of information
- checking and eliminating rumors
- targeted linking message content to a narrow circle of recipients.

Poor internal communication is considered a key factor to poor employee relations (Proctor&Doukakis, 2003). Therefore, it is necessary for each target group in the organization to develop a separate communication strategy that includes more information about the target group, knowledge of formal channels of communication, informal leaders, and finding more places where the information can be found. Most organizations are in a constant process of change, within which the changing habits of employees and organizational culture are changing as well. Internal communication is almost always a goal and a means of creating a change. This requires openness and a willingness of a holder of internal communication; a message must contain the following: a clear and current substance, call for participation, a broader explanation of why something works. The internal communication receivers know the sender, or have more or less correct information about them. Senders or sources of information must provide feedback and insight into the effects that produced the information. Certain messages or information causes much greater effect if the present context, or the entire process. This avoids the feeling of contempt, and provides behavior that is consistent with the main ideas. People often, consciously or unconsciously, make relevant conclusions and decisions based on impressions from smaller parts of planned and unplanned communication.

Networking through mobile applications is a way of interacting in a virtual environment, where individuals with similar or the same type of interests exchange opinions, views and information, using only their mobile devices. Design and implementation of a specific application is based on the requirements defined by the identified needs and limitations of associates on the interactive mobile systems. Therefore, today there are more organizations that provide formal communication of their employees through mobile applications, while the informal is mainly done through prevalent applications for mobile devices.

The development of the software known by the acronym MoSoSo (Mobile Social Software) was prompted by the fact that users are physically inseparable from their mobile devices, and often wants to use it outside of their homes and offices. This software does not limit the use of mobile phone only to telephone calls between two individuals, and it provides a variety of social networking opportunities (Counts, ter Hoft & Smith, 2006). Authors Biel, Grill and Gruhn (2010) describe the context of use of mobile applications as mobile context

factors (MCF). By using these mobile context factors, we can explain mobile applications with the help of mobile environment and the perspective of the user of mobile devices. Also, the mobile context factors are used to describe mobile applications.

2. COMMUNICATION BETWEEN EMPLOYEES

Communication structure affects the efficiency of operations in the organization. Goldhaber (Berlogar, 1999) defines the communication structure as a system of roads and canals that the messages go through - lines of communication within the organization. In every organization there are both formal and informal communication structures. All organizations communicate with their relevant public inward and outward. Every organization regardless of its size has its own internal public. Relationships with internal public or communication with employees is perhaps the most important communication in the organization, because employees actually represent the organization and achieve the competitive advantage in the marketplace. Employees are not a unified group. They consist of workers, leadership and administration. In order for the organization to be successful, communication between management and the employees must be efficient - and two-way symmetrical. Cutlip (1971) points out that the relationship with the staff is very important for the successful functioning of the organization and he says that: "Nothing is more important for the organization, as much as relationship with employees at all levels." Employees in organizations serve as a means to achieve goals, but they are primarily a group of key stakeholders that affect organizational performance and achieve competitive advantage. For most organizations, this means that good foreign relations are based on the quality of internal relations. Well-informed employees are motivated to be more productive, which certainly helps the organization in its external action. The organizations that communicate with their employees know well what they can expect from them, and vice versa, the employees know what to expect from the organization. Both sides will not always find a common solution, but will achieve an understanding, which is one of the main goals in successful internal communications. The essence of internal communication is to reach a compromise in communication, so that the company will achieve profit without difficulty. Through internal communications, executives 'pilots' the organization, as well as assure and guide employees to follow the mission and goals, encourage loyalty, enhance employees to identify with the organization, increase their motivation and satisfaction with their work, develop mutual positive relationships between employees and the impact on the socialization of employees and organizational culture. Employees receive important information about the work of the organization through internal newsletters, intranet, bulletin boards, mobile applications, meetings, etc. The inside communication takes place in different directions and through different channels, as it depends on the organizational culture.

3. CHARACTERISTICS AND PROBLEMS OF INTERNAL COMMUNICATION

Employee relations are functions of organizational management. Therefore, systematic comunication is necessary, and communication strategies must allow smooth operation in the organization. Employees must be properly informed about the important issues, because it is the only way to get a feedback and create a feeling of being a part of the company. Stone suggests that it is necessary to appoint individuals that will mediate the transfer of information to others (Theaker, 2001). Employees must be provided with the following information: about the organization and everyday activities, the purpose of business, politics, image, reputation, goals, principles, vision, information on the individual department work, information about other companies, of the industry in which the organization operates, about marketing, advertising and sales, information on personnel policy, employees and professional achievements, additional information on education, information on recreational and cultural activities. The diagnosis of the current situation of internal communication include: research awareness and attitudes of employees, the research culture of the company, research the communication channel, to identify delays in the communication of key messages to be transmitted and the way in which communication is performed.

Determining the objectives of internal communication planning involves answering the question: What are the reasons for intensifying the internal communication, and what do we want to improve? Goals in planning internal communication are:

a) Improve internal communication at all levels of the organization
b) Improve clear and accurate expressing of ideas in written and oral form, by mastering communication skills (oral and written communication, managing a business meeting, communication with employees, communication in crisis situations, teamwork, leadership groups, performance in a group...)
c) Removal of information uncertainty, reduce the spread of rumors, raise employee awareness

Practice has shown that middle management is the most responsible for inadequate internal communication - so, when applied to it, these measures give the best result.

There are two opposite extremes which occur as one of the problems of internal communication. These are the lack of information and redundant information. Optimum is somewhere between too little and too much information. Employees will not be satisfied if they do not have enough information that are important for effective job performance. But also, too much unnecessary information leads to confusion and reduces motivation, and employees become dissatisfied with the job. In contrast, the optimum amount of information gives employee maximum satisfaction. The satisfied worker works more and better, and good communication can save time which can be used for work that the employee performs at their workplace. This all leads to increased productivity. (Filipović & Kostic - Stankovic, 2009). An example of a poor internal communication is the fact that many companies fail to link brand strategy with internal communication. People outside the company are traditionally a target group for all the messages about the company's brand. On the other side, employees get a sense of purpose and loyalty through internal branding. The sense of belonging to the company is important because it reduces the departure of the company workers. The departure of skilled workers from the company and hiring new employees is very expensive, and these costs can also affect the productivity of the company.

4. CHANNELS OF INTERNAL COMMUNICATIONS

Communication channels are the media through which messages are sent and received. Today, organizations and their employees have access to many channels of communication. Selection of relevant media for communication is very important for professional communicators who have specific goals and strategies set forth by the relevant public and created posts.

McLuhan (2001) makes a division between "hot" and "cold" media that differ in the degree of participation of the recipient. "Hot" media (eg, print media) require less active participation and involvement, are more segmented and linear than "cold" media (eg TV, FTF), which are more abstract and require participation in understanding the Vedas . Internal communication can be (Wilcox et al, 2005) written, oral, visual and audiovisual.

4.1 Mobile applications in modern communication

Available on almost all phones nowadays, mobile applications represent one segment of the global mobile market which is the largest and fastest-growing. They help a company to easily and efficiently manage and inform its employees of any changes in the market, the stock market and the organization. Their purpose may vary, ranging from basic functionality of mobile phones such as chat and messaging, to play video games, or more advanced services such as search the internet and watching video content. Different types of mobile applications are used in the upgrading of internal communication. Of course, it is possible to combine in a single application and do a number of different categories, all depending on what is the target group of the company. The expansion of mobile telephony in the last year is more expressed. Smartphone or mobile computer is dominant in all business transactions. Smart phones are cheaper and more companies are using packages for their employees. They have a Web browser, PDF reader, DOC, XLS and WiFi.

4.2 The evolution of mobile applications in social networking

The enormous development of mobile / wireless telecommunication networks and the emergence of computers, palmtop and PDA devices have caused the emergence of many new mobile applications and services that enable access to the Internet, corporate intranets and databases, electronic mail, teleconferencing anytime and anywhere. Two main types of mobile applications include: 1) horizontal applications that operate independently of the type of operating system and 2) vertical applications, tailored to specific operating systems. Horizontal mobile applications typically require access to specific local databases depending on the current location of the user , based on which they provide information on local newspapers, information on special offers in supermarkets or films shown in local cinemas. On the other hand, vertical mobile applications are designed for a niche market, ie. segments with specific requirements that make and use mobile devices. For example, technicians who do their work on the ground must have access to the instructions to repair the machine. As a sub-type of mobile applications there are also those that have been developed based on infrared communication, and are used to track employees and divert voice mail and data (Pierre, 2001).

Original mobile applications that are developed for social networking are:
1) MAMJ - a platform for the communication of people who are on the same or relatively near the location via SMS, developed in the UK;

2) Rummble - similar to the previous application also connects people based on their location, ie. their postal code , and for exchanging the same or similar interests and views with friends ; (Terdiman , 2005)
3) Dodgeball functions within twenty two cities in the United States and by advising the networked individuals on the movement of others, their current locations, especially if they are close to the range of ten blocks.
4) Plazes is also an interactive mobile application that connects friends or people who have similar occupations and interests globally.
5) Jumbo Networks connects people with similar interests, which are close to each other, and who want to achieve personal, direct contact. This application requires a stable WiFi connection between laptops, mobile phones and PDAs.
6) ProxyDating is a mobile application that, if it is installed on the mobile phone automatically via Bluetooth technology comes into contact with people with similar interests, provided that the maximum distance of individuals is fifteen meters.

Some of these applications are still operating but under different names. A significant increase in the use of laptop computers, primarily by users who are constantly on the move for accessing Internet services like e - mail and WWW contributed to the increase in demand for mobile applications, which will allow the use of Internet services through other mobile devices (cell phones and PDAs). Internet protocols on mobile devices contribute to the solution of key problems in the development of a mechanism that ensures that IP nodes change their physical location without changing IP addresses, thereby offering Internet users called "nomadism" (Pierre, 2001). This means that you can make telephone calls from their cars or while on the beach, receiving all voice (voice), e- mail or fax messages, and are available all over the world.

In addition to access social networking sites through a desktop computer and a laptop, users can use their smart phones to connect to these services. According to a survey conducted by Ruder Finn (PR agency) showed that 91% of smartphone users in social networks, as opposed to 79 % of the users of traditional desktop computer. This study also showed that 43% of smartphone users use the same communication with other people on social networking sites (Finn, 2012).

4.3. Contemporary mobile applications for social networking

Contemporary mobile applications have become a part of everyday life, as shown by their daily development. They are still developing and are used depending on the mobile device and the operating system on which they operate. Currently present mobile devices that support the installation of mobile applications are mobile smartphones, iPad, iPhone, Tablet, PalmPilot (PDA), etc. Mobile applications are developed in accordance with the operating system (OS) that exists on the mobile device. The latest mobile applications which were developed and caused strong popularity are Viber, Facebook Messenger, Twitter, LinkedIn, WhatsApp, Skype, Hi5, SAPO Messenger, My Space, GoogleTalk, etc.

Viber is a cross-platform application for instant messaging (chat) over the Internet Protocol that was developed for smart phones by Viber Media. Through Viber , users can not only share text messages but also share pictures, video and audio media file. Client software is available for Android, BlackBerry OS, iOS (iPhone Operating System), Series 40, Symbian, Bada and Windows Phone. Viber works over 3G and over Wi - Fi networks, originally launched for iPhone in December 2010, as a direct competitor to Skype. The first release version of Viber for Android is released in May 2011, but was limited to 50,000 users; unlimited version was released on 19 July 2012. Viber application for BlackBerry and Windows Mobile was launched on 8 May 2012. Services group of correspondence and HD Voice have been added on July 24, 2012 for Android and iPhone applications, which has reached 90 million users. Viber includes text, picture and video messages on all platforms, with voice calls (voice calling), which is only available for iPhone, Android and Nokia Windows Phone . The user interface includes an application tab (title) bar on the bottom that provides access to messages, access recent calls, contacts, and keypad and includes a button to access more options. After installation it creates a user account using the personal phone number as the user name. Viber synchronizes contacts from the phone's address book, so that users do not need to add contacts to a separate directory. Since all users are registered with their phone number, the software returns the members of one's contacts.

Facebook Messenger is a service for instant messaging (chat) and a software application that provides text and video communication. Characteristic of Facebook chat is that connects users to Facebook and syncs with the website. Facebook Messenger is developed for mobile devices and desktop computers. This application for mobile devices was released in August 2011 for iOS (iPhone operating system) and Android, and on October 11th was updated in the development of applications available for the BlackBerry OS. In December 2012 Facebook Messenger app for Android added the possibility that in some regions (such as Australia, India, Indonesia, South Africa and Venezuela) use Messenger without Facebook accounts easily

using the name and mobile phone number. These changes are intended to enable Facebook Messenger in order to compete with other similar mobile messaging platforms such as WhatsApp.

LinkedIn is a social networking site for business people, which makes it a unique network to establish business contacts. The site was founded in December 2002 and launched in May 2003 and is mainly used for professional networking. According to the LinkedIn in January 2013, it had registered 200 million users in more than 200 countries. The mobile version of the site was launched in February 2008 which was giving access to reduced operational site via mobile phone. It syncs contacts with selected personal mail and automatically sends request to connect. It also provides an insight into the personal LinkedIn profile, sending messages, reading messages, reading news etc. Mobile service is available in six languages: English, Chinese, French, German, Spanish and Japanese. In January 2011 LinkedIn added a mobile app CardMunch , which scans business cards and converts them into contacts. In August 2011 LinkedIn redid mobile applications for iPhone, Android and HTML 5. The percentage of usage of Linkedin via mobile applications has increased approximately 400% in the last year according to CEO Jef Weiner.

WhatsApp is a cross-platform mobile application for instant messaging (IM) for smart phones. In addition to the text messages users can send each other images, video and audio media files. Client service is available for Android , BlackBerry OS , iOS, Series 40 , Symbian (S60) and Windows Phone . After installation it creates a user account using the personal phone number as the user name, for example: (Jabber ID: [phone number] @ s.whatsapp.net). WhatsApp is facing strong competition Messaging service created in Asia, such as LINE and KakaoTalk. However, WhatsApp recorded about 10 billion messages per day in August 2012, and previously in April 2012 their number amounted to $ 2 billion per day in October 2011 1 billion messages per day. According to the Financial Times "WhatsApp is done for SMS messages to mobile phones what Skype did for international landline calls."

Skype is a software application and service voice (Voice). Skype was first released 2011, written by Estonian developers Ahti Heine Priit Kasesalu and Jaan Tallinn, who originally developed Kazaa application. Skype has evolved into a platform with over 600 million users which was purchased in 2011 by Microsoft for $ 8.5 billion. Skype works on a number of platforms such as Android, BlackBerry 10, iOS, Symbian and Windows Phone. This service enables users to communicate via voice with colleagues and peers using a microphone, allows video calling and instant messaging (chat) over the Internet. Calls can be placed on recipients over the traditional telephone network. Calls to other users within the Skype service are free, while calls to both fixed and mobile networks are charged and collected over debit - based user account system. Skype has also become very popular for its additional features such as file transfer, and video conferencing (group video or just audio call). Its competitors are Linkphone and Google Talk. In October 2007 Skype has launched its own mobile phone under the brand name Skypephone. Skype also offers wireless mobile phone that allows users to make calls within the Skype via wireless (wireless) internet connection. Skype Wi-Fi has a menu screen that allows Skype users to see who is online and available to talk, similar to what is seen on the desktop computer. It can also be used to talk with non - Skype users. SkypeOut minutes can be used to call any mobile phone for a very low price and no monthly fees.

Hi5 is one of the most successful social networks of Web-based assessment with the usage of about 60 million users. This application allows users to create a profile and to present information to their friends and visitors to their profiles, such as interests, age, location, along with a personal photo - album and music preferences. Much like Twitter and Hi5 service allows users to send a message to the network with information about the current activity that the user does. Context information is published via Wi-Fi or GPRS/3G connection and is available at a time.

SAPO Messenger is an instant messaging client (IM - instant messenger client) through which different users can chat via text messages in real time. This allows them to assign each user status message that displays all contacts. In a similar way as the previous scenario, the system announces the context information to update the status messages in the SAPO Messenger.

5. EXAMPLES OF MOBILE APPLICATIONS IN INTERNAL COMMUNICATION

5.1 Example of e-mail application

Communication is the basis of establishing contacts and creates business relationships in the marketing process. Electronic mail is a great communication channel for sending, sharing, receiving information and exchange opinions. For some topics communication via e - mail is more useful than a brief meeting, because

e - mail discussions among the participants give more time to think, to consult and to reflect on all the received information. All participants can easily share documents, images, audio and video recordings. Electronic mail (e - mail) has taken over a large part of business communication, which usage is increasing everyday. All modern mobile units which have e-mail applications that are built-in accelerate the correspondence between the employees themselves as well as internal stakeholder's enables timely information and quick action in emergencies. Suitable means of communication in large organizations, where it is not possible to talk directly. The point of it is to satisfy two factors: the communication needs of employees (information needs and vocational training) and communication goals of management (communication and transfer of the mission and vision of the organization to employees, justification of business decisions that require consensus employees). Increasing the authority (and responsibility) of workers - employees of a company are encouraged to make changes, big and small, every day. Ideas are collected from all employees. All of the information are published via email in need of quick correspondence. Increasing the authority implies that frontline employees are motivated to apply discretion in some sense when providing services. An Innovative hotel chain allows employees expense in the amount of $ 2,000 to correct deficiencies service which were encountered by or to respond to the complaint. E-mail as a mean of internal communication speeds up the flow of information and decisions.

5.2 Example of Instant Messaging applications

Instant messaging has even a full range of benefits of SMS messages. Depending on the tariff or package of traffic that the company uses for the price of one SMS message hundreds of instant messages are sent. Employees of a company use iPhone messaging applications (Beejive), the best known and most reliable application for instant messaging on iPhone. Although the price at which it is sold is relatively high, Beejive offers wide range of options and adjustments to the needs of the company. The application allows you to receive push news and not be active in the background to receive them.

A large number of the studied companies are using horizontal integration in order to achieve the effects of internal marketing , believing that should be addressed each communication with all employees in order to maximize employee participation and commitment. To encourage the commitment of employees, most companies have a shallow hierarchy management processes and provide decision support to employees in many key business decisions. This is done with virtual meetings. Internet and information technology are connecting people who are physically in different locations. By holding virtual meetings temporal and spatial distance is resolved. Also this way of communication helps with addressing important issues. This mode of communication has its advantages and its disadvantages, which will be discussed in the remainder of this paper. Benefits of virtual meetings:

• The main advantage, which is usually put in the first place, is money because they are useful and less expensive than live meetings:
• They eliminate the cost of travel, lodging and meals.
• They minimize the inconvenience of work being constantly interrupted.
• Reduce downtime and increase productivity.

Another great advantage is that it can connect people who are separated by time and space, such as employees who work in different locations and / or in other time zones. It also claims to increase objectivity, because every participant feels the presence of others in the group less than what it would be in person. In famous food company employees in marketing, brand management and communications with other employees have additional applications that the company paid for. By doing so, they ensure meeting the needs of consumers. Some companies implement internal marketing through widely covered steering committee composed of representatives of the departments of human resources, operations, brand management, sales and marketing, among others.

5.3 Example of application news

This type of application is as a periodic reminder to certain contents. Most employees bring about innovations in their field of work, changes in organizational policies, introducing new products and services, specific achievements and awards, and news about specific events, outings, etc. (Wilcox et al, 2005). Their purpose is to make all employees with less cost and more quickly be informed about the overall developments in the organization and to attract them to participate in various activities of the organization. The development of modern technology and IOS systems, especially the Intranet and e-mail makes it easy to quickly and easily perform. That is why they are appropriate for rapid, highly targeted and specific information (Newsom & Carrell, 2001). The practice is to be written in a clear and concise style. With more than 123,000 employees worldwide, the consulting company has put a strong focus on internal communications during the period of reduction of the workforce. Once this trend was set, consulting company continued efforts to improve internal communications. An important lesson drawn from a series of focus groups through internal communications

revealed the desire of employees to communicate with them only the information they need to perform their jobs. The company includes each employee to measure attitudes toward the individual responsibilities of each position in the company, the attitude towards the management, performance and evaluation of corporate programs and initiatives. It was so widespread as to have the applications that they had all the employees in the company.

5.4 Java portals

These portals can help employees in the execution of daily tasks and making everyday decisions, because their primary purpose is primarily informing and educating employees (Newsom & Carrell, 2001). This mean of communication is very important especially for new employees, which helps them in understanding the basic rules, strategies and vision of the organization and contributes to their faster and more successful socialization in the environment (Baskin & Aronoff, 1988). The information which are usually shared are about organizational policies, employment insurance, pensions, information about the broader social issues and standards relevant to the environment that may affect the operation (Baskin & Aronoff, 1988). If the guides include o tips for communicating with the media, tips for resolving conflicts and crises, tips for better relations with subordinates and superiors, they can be more effective. The best guides that are the ones designed modularly and that allow employees the possibility to shape them according to their own measure (Gruban, 2002). A car company has applied this portal mobile application with its employees. Satisfaction increases because of the direct communication and direct interaction between the CEO and other employees.

6. CONCLUSION

The importance of communication and the need for internal communication does not expire, regardless of which period the business is doing. What has certainly changed over time is the intensity of the role of the consumer in communicating with the company, as well as the ways in which communication between them may be performed.

The following conclusions can be pointed out:

- New generation, new technologies and “new" relationships between employees.
- Mobile applications and services are organized around people, not interests.
- Mobile applications support pre-existing social relations and have an impact on employee satisfaction with communication.
- Exclusive use of technology does not contribute to good relations and communication satisfaction of all employees in the organization.
- Employee satisfaction and mobile communication network are critical to the organization.
- Internal communication is not a tactical but a strategic tool.

It is necessary to monitor the behavior of employees in the mobile networks given the ambiguous effect that occurs on the fact that the presence and communications staff on mobile applications and networks can not be managed.
The success and forms of internal communication affects the way managers in the management of the organization. The presence of employees in social networks is a multi-layered and multi-component, which means that the very specific characteristics of social networks have become symbols of communication of employees. This is a very important element, because it is a specific form of informal communication, which can not be caused, but it also can not be controlled within the company

REFERENCES

Ahmed P, Rafiq M. (2002), Internal marketing, Butterworth-Heinemann, Woburn

Anosike U. (2008), A Phenomenological exploration of the domain and structure of internal marketing, University of Wolverhampton

Baskin, O. W., & Aronoff, C. E. (1988). Public relations: the profession and the practice (2nd ed.). Madison, WI: Brown & Benchmark Publishers.

Berlogar, J. (1999). Organizacijsko komuniciranje. Ljubljana: Gospodarski vesnik.

Biel, B, Thomas, G. & Gruhna, V., (2010). Exploring the benefits of the combination of a software architecture analysis and a usability evaluation of a mobile application, The Journal of Systems and Software, Vol 83,str. 2031–2044.

Burmann C, Zeplin S, Riley N. (2009), Key determinants of internal brand management success: An exploratory empirical analysis, Journal of brand management, 16 (4), 264-284
Chaffey, D, E-Business and E-Commerce Management, Pearson Education Limited (Financial Times, Prentice Hall), Harlow, England, 2002.
Counts, S., ter Hofte, H., & Smith, I. (2006). Mobile social software: Realizing potential, managing risks. In Proceedings of the workshop at the conference on human factors in computing systems.
Cutlip S. M, Center A. H. (1971) Effective public relations, Prentice-Hall (Englewood Cliffs, N.J)
Davis T, Nance J. (2001), Integrating internal marketing with participative management, Management Decision, 39 (2), 121-130.
De Ridder, J. (2003). Organisational communication and supportive employees. Human Resource Management Journal, 13(4).
Egan, J., (2004) Relationship Marketing, Pearson Education Limited, Essex England,
Filipović V, Kostić-Stanković M. (2012), Marketing menadžment, Beograd, FON
Gruban, B. (2002). Nova menedžerska teorija ili mobilna komunikacija? Organizacijske interne komunikacije tretje generacije. V: Industrijska demokracija, št. 3, str.3-8.
Keleman M, Papasolomou I. (2007), Internal marketing: a qualitative study of culture change in the UK banking sector, Journal of marketing management, 23 (7-8), 745-767.
Kotler, P., Armstrong, G., Saunders, J., Wing, V., Principles of Marketing, 2nd European edition, Prentice Hall, New York, 1999.
Mamula T.,Upravljanje odnosima – zaposleni kao stejkholderi, Symorg konferencija, Zlatibor 2012.
Newsom, D., & Carrell, B. (2001). Public relations writing: form and style, six edition. Belmont: Wadsworth publishing.
Norton A, Symanski R. (2005), The Internal marketing systems of Jamaica, Geographical review, 65 (4), 461-475.
Pierre, S. (2001). 'Mobile Computing And Ubiquitous Networking: Concepts, Technologies And Challenges'. Science Direct Telematics and Informatics, Volume 18, Issues 2-3, (May-Dec), pp. 109-131.
Proctor T. Doukakis I. (2003) Change management: the role of internal communication and employee development, Corporate communications 2003; 8, 4; ABI/INFORM Global str. 268
Ruder, F. (2012). New study shows 'intent' behind mobile Internet use. Preuzeto sa: http://www.prnewswire.com/news-releases/new-study-shows-intent-behind-mobile-internet-use-84016487.html
Senic, R. (2001). Marketing Development: New Tendencies. Nis: Faculty of Economics.
Shahriar Ferdous A. (2008), Integrated internal marketing communication, The Marketing review, 8 (3), 223-235.
Terdiman, D. (2005) 'MoSoSos Not So So-So', Wired 3 March, URL (consulted Oct. 2008): http://www.wired.com/culture/lifestyle/news/2005/03/66813
Wilcox, D., Cameron, G., Ault, P., & Agee, W. (2005). Public Relations: Strategies and Tactics, Study Edition. Boston: Allyn and Bacon
http://mobilnimarketing.me/mobilne-aplikacije/vrste-mobilnih-aplikacija (1.4.2013.)
http://www.octus7.si/mobilne-aplikacije/ (2.4.2013.)
McLuhan, M. (2001). Understanding media: the extensions of man (1st ed.). New York: Routledge.

INFOGRAPHIC AS A MARKETING COMMUNICATION TOOL

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Abstract: *Infographics became powerful and widespread communication tools. Their advantages are related to their design, long history of use and human psychology and behavior on the Web. This paper is taking a special reference on those psychological factors: visual-pictorial primacy, attracting and retaining attention, content organization, shareability and aesthetics. As a marketing tool, infographic has its effectiveness measurement system, its faults and ethical dilemmas, and rules on how to create it and put it to maximum effectiveness. The potential for further research is discovering which industries can profit most with this tool, for its advantages may not be suitable for all target audiences.*

Keywords: *infographic, content marketing, visual communication, Internet, social networks*

1. INTRODUCTION

Communicating with target audiences is one of the functions of marketing. The way that communication is executed determines its success or failure, meaning that marketers are continuously trying to discover more efficient means of distributing their messages. In the age when the quantity of available information overwhelms us, it is challenging to grab our attention. Infographics recently became one of the popular solutions for that. By combining textual and visual elements, they present useful content for consumers and thus attract them to the company.

This analysis will present infographics as a part of content marketing, reasons behind their efficiency, ways they can be created and their advantages and disadvantages.

2. CONTENT MARKETING

Content marketing can be defined as using informative, editorial content in order to direct attention to the company, create impression of it being a leader, with a purpose of attracting present and potential customers (Lankow, Ritchie & Crooks, 2012, p.21). Content launched by the company has a role to empower, engage, educate, inform, entertain, create trust towards the company and connect consumers (The Internet Marketing Academy, 2011, p.11, 15).

As such, content marketing has always existed, but it became more relevant than ever with the increasing number of Internet users and greater availability of information. It is said that this is the age of "information overload", that is, "Big Data" when anyone can publish anything online (Mack, 2011, p.4). These circumstances have forced traditional marketing to change its advertisement-oriented approach and establish new rules (The Internet Marketing Academy, 2011, p.10):

- People are well informed and demand the truth, not "spin";
- Ad-breaks are not tolerated in the age of DVR and e-mail spam filters;
- People are demanding value for their time and are using Internet to get it;
- Marketing and PR strategies are created in a way to target niche audiences, and are using many techniques to achieve that;
- Content stays online forever, thus the campaigns never end.

The general idea behind content marketing is that content consumers will think well of the brand/ company if they find their content useful and if the company creates the image of it being an expert in the industry (Lankow et al., 2012, p.126). For example, technology company Cisco launched the "Internet 2015" infographic based on an internal study about the future of Internet. This showcases the company's reliability and flexibility to changes in the environment, which sells the Cisco brand (Mack, 2011, p.16). Even if the content users do not become consumers, there will still be a non-consumer fan base that can recommend the brand or at least share the content online so potential consumers can see it.

Content marketing is based on five core principles (Lankow et al., 2012, p.11):

- Editorial content which is relevant and valuable to consumers;

- Marketing objectives are a foundation;
- Orientation to changing or maintaining consumer behavior;
- Using different media platforms: print, audio, video, digital media etc;
- Targeting specific consumer segments.

This approach is unique and challenging to marketing professionals because they are not the only ones who create content – consumers can create it and share it online too (The Internet Marketing Academy, 2011, p.11).

It is essential for marketers to understand why consumers share content online. Jason Ho and Melanie Dempsey (2010, p.1004) have identified two key needs which are satisfied by sharing: need to be different and need for altruism. By sharing content, Internet users want to show off their uniqueness in comparison to their group, but they also want to help others. These are the needs campaign creators should have in mind.
Content marketing has several advantages over traditional advertisement: lower expenses and greater interest from consumers who want answers rather than distracting commercials (Houghton, 2013).

3. INFOGRAPHICS – DEFINITION, APPLICATION, HISTORY

An infographic is an image representing an integration of design and visually pictured data helping organizations convey their messages to the audience in a concise fashion. Smiciklas (2012, p.3) defines them as visually presented data or ideas, used to present complex information in a way that makes it easier and faster for audience to understand and adopt it. Infographics can represent (ibid p.5):

- Statistical data;
- Processes;
- Ideas;
- Chronological data;
- Geographical data;
- Anatomy;
- Hierarchy;
- Relations;
- Personality.

It is important to stress that infographics are not only intended for the purpose of communicating with consumers – they are equally used for internal communication (with employees, job candidates, partners, the media and other stakeholders). This way, infographics can be used in a wide range of ways within the framework of a holistic approach to marketing.

The history of the infographic was systematized by Morris and Wocknitz (2013, p.2-8) in the paper they presented at the SAMRA conference.

The visualization of data originated pre-17th century, when it was used to produce maps and geometric diagrams. The beginnings of modern graphics date back to the 19th century, when bar graphs and pie charts came to use, as well as histograms, line charts etc. During this period, graphically represented data were used to analyze military campaigns, meteorological conditions, geology, epidemiological data, social and moral behaviour, economy and trade. In the second half of the 19th century, Florence Nightingale first used the pie chart to show that more British soldiers died during the Crimean war due to poor hygiene conditions in hospitals than in combat. This chart was included in the report of the Royal Commission, and is considered to have been the most significant part of the report, because it quickly relayed important information to the public and thereby instigated public support for reform.
Since 1975 to modern day, the use of computers has been the basis for widespread and speedy development of infographics. The visualization and design of visually presented data are universally available today, and their efficiency and effectiveness have made it so that they are being utilized in nearly all aspects of life.

4. THE EFFECTIVENESS OF INFOGRAPHICS FROM A PSYCHOLOGICAL PERSPECTIVE

There is a sizeable amount of empirical data that attest to advantages of using infographics. In the following section, we shall describe the psychological factors that make the infographic an effective communication tool.

Visual-pictorial primacy

Vision and processing visual information make up a large portion of our brain activity. Around 50% of cerebral structures are in direct or indirect relation to visual function (Sheth, Sharma, Rao, Sur, 1996, p. 2110-2114). Our mind deals mainly with pictorial, not textual data. Reading and writing are skills learned later in life, whereas we deal with pictures from birth. The processing of text, in our minds, takes place in a serial manner, word by word, while a picture is processed as a whole. Accordingly, visual processing of a picture consumes less time and energy than visual processing of textual data (Smiciklas, 2012, p.7).

Initial research of visual representations (Nickerson, 1965; Rock & Englestein, 1959; Shepard, 1967) shows that people are successful in the visual stimuli recognition task, even when a great deal of time has passed since the initial exposure to the stimulus. Later research (Standing, Conezio & Haber, 1970, p.73-74) confirms that even when the number of images that the subject is exposed to is drastically increased, successfulness in delayed recognition does not drop significantly. The fact that such high percentages of correctly recognized stimuli are not achieved in tasks that show verbal (textual) material has lead psychologists to the conclusion that the mechanism of storing and arousing visual representations differs from the mechanism of storing and arousing verbal, symbolic representations. Paivio's research (1969; 1971; Paivio & Csapo, 1969) shows that in the case of recalling and reproducing verbal material, people are better at memorizing concrete terms as opposed to abstract terms. He attributes this phenomenon to the possibility that concrete terms are double-coded. Namely, a concrete term may be memorized verbally, as a written or spoken word, but also visually, as an image of the object it refers to. This theory implies that verbal content is better retained when it can be, or is, accompanied by an image. Infographics provide us with the option of giving visual support of abstract terms (often used in marketing and business) which will result in better memory.

The research of Nelson, Metzler and Reed (1974, p.184-186) showed that superior retention of pictorial material does not depend on the amount of detail contained in the image. This fact contains yet another advantage of infographics: even when reduced and simplified to the extreme, they are still equally successful in improving the retention of material.

One must not forget the VARK model (Fleming & Mills, as cited in Smiciklas, 2012, p.11) which refers to different learning styles. According to this model, people use four primary learning styles by which they process information. An estimated 65% of the population belongs to the group that learns visually (through observing graphs, maps and diagrams), giving infographics an advantage as a form of marketing communication.

Attracting and retaining attention

Today's audience consumes more information than ever by using the Internet. Because of this, it is important to know what separates the process of interacting with digital data as opposed to the process of interacting with printed data. Generally, people have a tendency to read much more slowly from a screen than off of paper. Since we are subjected to an avalanche of data on a daily basis, we have gotten into the habit of skimming online texts without lingering or immersion. During the last two decades, Jakob Nielsen (Weinreich et al, as cited in Smiciklas 2012, p.12) has been conducting research on the ways which users interact with Internet data. He discovered that people do not like to read texts on the Internet almost at all, and that the average person reads a total of 20% of words from a web page. Also, the way we maintain attention when it comes to Internet content has changed. Users are simultaneously connected via multiple channels to maximize their information access. However, Smiciklas (ibid, p.12), despite larger exposure to data, each channel is given attention on a much more superficial level, resulting in fragmented and divided attention. The rapid pace of life prevents us from dedicating too much time to any content. Along with growing time pressures, there is an increasing need for short, clear and concise communication.

Although the world has changed since the first researches of human attention, certain knowledge acquired at the time is useful to us to this day.

Anne Treisman’s research (1960, p.242–248) indicated that even when we devote our undivided attention to a certain content, we are not entirely “blind and deaf” to other stimuli we are exposed to. It is possible to divert attention from one channel to another if some content that differs from the rest, presents news or touches us on a personal level (our own name, emotionally charged content, etc) appears on the other channel.

As an innovation in the world of marketing communication, infographic often stands out from the context in which it is found, so it fulfils all the prerequisites of attracting and keeping the audience’s attention long enough to convey its message in an “online” environment.

Content organization

In 1965 George Miller (as cited in Kostic, 2006, p.115-116) examined the capacity of the human operative memory and got to the conclusion that people can handle a maximum of five to nine elements at a time. In this context, an element does not constitute a piece of information or a fact, but a meaningful unit. One meaningful unit may contain multiple pieces of information. The cognitive system is sensitive to the number of meaningful units, but not to the amount of information derived from the number of elements. Thus, people are capable of simultaneously manipulating a great number of facts if these facts are organized in a meaningful way.

Research conducted by Pressley and McCormick in 1995 (as cited in Vizek-Vidovic, 2003, p.173) shows that, while studying, subjects spontaneously attempt to tie together material that is not meaningfully organized.
An infographic aims to represent data in a clear, concise and organized way, which makes content consumption quicker and easier.

Shareability

One of the core aspects of Internet communication is the possibility of sharing information between people (Smiciklas, 2012, p.15). In addition, people do not like to share links to articles, pages or blogs that they hadn't read. With the aforementioned time pressures in place, less time is dedicated to reading long texts on the Internet. Since an infographic does not take up too much time, it has better odds of being consumed and forwarded to a large number of people.

Aesthetics

A well-designed infographic is an efficient communication tool now when the fight for attention is ruthless. Visual and aesthetic differentiation in organization, brand or idea is critical. The use of attractive colours and shapes, modern design and aesthetic appeal may be the decisive element in winning over audience's attention.

Back in 1933, Nelson Gilbert (1933, p.52) proved that aesthetics play an important role in remembering newspaper ads and advertisements. Respondents were more successful in remembering the products marketed with colour ads than with those printed black and white.

5. MEASURING THE EFFICIENCY OF INFOGRAPHICS

Defining the best way to measure efficiency of infographics can be a futile task. The organization's goals, the way it defines return on an investment – all this affects the decision of how and if at all to measure the business performance of an infographic. Favouring quantitative financial indicators of performance has a long history. In many organizations, it is thought that if the marketing investment is not measurable through a return of the investment, it cannot be considered sustainable or useful.

However, not every marketing initiative can always be directly linked to its results. Understanding the relationship between resource allocation and marketing performances is more important than measuring the direct correlation between marketing initiatives and financial results. To managers justifying the internal and external value of infographics as communication tools is a priority (Smiciklas, 2012, p.159).

This implies the short-term and long-term consideration of tangible indicators and intangible benefits of infographics. Since they are usually distributed via the Internet, we shall focus on indicators in the digital environment, as divided by Smiciklas (ibid, p.161-163).

Tangible indicators include: awareness and engagement of the audience.

Awareness refers to the level of audience exposure to an infographic through various digital channels. It can be measured in several ways:

- Through potential range (using the Google Analytics and Google Webmaster Tools services);
- Through hyperlinks (using the Google Analytics service);
- Data on search keywords;
- By the number of content subscribers.

Engagement refers to how the audience relates and behaves towards infographic content. When measuring engagement, it is important to take into account the level of commitment needed for a content-related action

to take place. Leaving a comment on a blog takes a higher level of engagement than “liking“ content on Facebook or sharing it on Twitter. Engagement may be measured in several ways:

- Through the average amount of time spent on a website monthly (using the Google Analytics service);
- Through the number of comments and their tone;
- Through the number of shares on social networks (using tools such as Hootsuite).

The intangible benefits of infographics can be classified as internal and external.

Intangible external benefits include:

- Establishing relations (through publishing and promoting infographics an organization has the opportunity to establish relations with numerous influential individuals, media and organizations);
- Credibility (publishing relevant and useful infographics and offering first-hand perspectives on an organization builds credibility);
- Connection to the brand (infographics and other content create micro-interactions with their audience thus supporting positive audience experiences related to the organization).

Intangible internal benefits include:

- Ease of communication (infographics facilitate the exchange of problems and ideas among employees, as well as sharing information and relating knowledge, and their viral nature gives them the potential to spread through all parts of an organization and encourage internal debate and dialogue);
- Corporate pride (in the event that an infographic gains popularity and is widely shared through social networks, it may spark employee and organizational pride);
- Easier decision making (infographics expedite the consumption and comprehension of information - quicker decision making follows as a result);
- Better organizational learning (infographics make complex information more understandable, and help employee education).

6. CREATING INFOGRAPHICS

When designing an infographic, the first thing one should have in mind is the end-user, says Natasha Loyd (as cited in Yuk, Diamond, 2014, p.9). According to her, the most important qualities of good visual data presentation are usefulness, because people use them to make decisions, and desirability, because it gives them satisfaction to use data arranged in a pleasant way.

Focusing on the end-user means answering two questions – what the message is and who the receivers are (Smiciklas, 2012, p.77). Smiciklas (ibid, p.78) differentiates the following types of audiences: present and potential consumers, present and potential employees, partners and the media. The type of information that will be launched depends on the audience. For example, employees are interested in the organizational structure, consumers in products and prices, and partners in the value chain. Therefore, an inforgraphic must have a communication goal – to increase awareness of the brand, to entertain, inform, increase web page visibility etc.

One of the key tasks for designers is to use valid data, especially if the goal of the infographic is to educate. Credibility of the company and the brand may be jeopardized if the infographic displays wrong claims, grammatical errors, plagiarism and/or offensive content (Protz, n.d.).

As for the designing process, these are the guidelines we selected:

- Less is more – only one important message should be presented. Less important information should not have a striking size, color and location. The most important part of the story is supposed to be most visible.
- Information should be organized like a story, but there must be a balance between factography and aesthetics – one part should not be emphasized over the other (Suleman, 2012). Having that in mind, the structure *introduction – explanation – conclusion* works best for infographics because it visually and logically guides the reader. Also, all elements of the design should be consistent – typography, colors, shapes, alignments, location etc. (Morris & Wocknitz, 2013, p.17).
- When choosing colors, designer must consider their meanings and associations. Labrecque and Milne (2012, p.712) researched how colors influence the perception of "brand personality" which further influences the customers' relations to the brand, their preferences and trust. For example, when choosing a color for the logo, designer must be careful so that the colors convey values important to the brand, such as trust, honesty, expertise etc. Those associations will then be evoked in consumers who see the

logo for the first time, just because of the colors they connect to certain characteristics. Researchers have discovered that colors influence brand's image and likeability, so they can be used in differentiation strategy; but, marketers have to be aware not only of the general meaning of colors, but also of their meaning in the industry.

Some authors do not consider infographics the best solution for every topic. Shell Harris (2013), the founder of *Bestinfographics.co* website, found seven topics which infographic designers should not use:

- Qualitative data on emotions, preferences and aesthetic choices cannot be measured, which can make them unclear on infographics.
- Simple topics which do not present complex data or comparisons should not be presented with infographics, but with posters or similar visual tools.
- Simple procedures would be further unnecessarily simplified, which would definitely not attract the target audience.
- On the other hand, infographic is not meant to convey complex procedures, especially if they require fast decision making, such as evacuation plan in case of fire.
- Promoting new products and services can be done more efficiently with traditional marketing means. That is primarily because infographics are meant to be shared as useful content, which will not happen if they are advertisements.
- Information already presented as infographics should not be repeated unless it suffered a significant change. For example, searching "social media infographics" on Google displays 124.000.000 results (checked on On March 19th 2014), meaning that users will not be particularly interested in another infographic of this kind.
- Humor should be used carefully, so that it is appropriate for the target audience.

7. ADVANTAGES AND DISADVANTAGES OF USING INFOGRAPHICS

As any marketing tool, infographic is not panacea for every communication. Its unique characteristics make it popular online, but it also has downsides. Both are analyzed in further text.

Advantages

The main qualities of infographics are that they easily get attention and enable further dissemination among potential customers.

Infographics tend to attract more readers than text and distinguish themselves from other online content (Lankow et al., 2012, p.126). As we have already explained, people have access to a lot of media on a daily basis, but they rarely decide to focus on longer texts. They need their answers fast, and well designed infographic provides exactly that (Culberston, 2013). Also, in the section "The effectiveness of infographics from psychological perspective", we explained that visual nature of this communication tool can convey the message faster and more efficiently than words, which enables easier memorization.

From a technical point of view, infographics are easily shared online because of their format (usually PNG or JPEG images) which are displayed as a whole on Internet platforms (Lankow et al., 2012, p.127). Sharing an article on social media, for example, leads to only displaying the URL, title and first few sentences, which will not as easily attract audience.

Disadvantages

Popularity of infographics might be the reason for their downfall. The consumers can become overwhelmed and get used to infographics to the point when they become expected and predictable. That way, they are no longer unique and therefore, unable to attract attention. Brian Eisenberg (2001) believes that marketers rely too much on the idea of people as "visual beings", which results in commercials being easily forgotten because our brain organizes the content in a predictable way. That is why he suggests that marketers focus on sense of hearing and quotes Roy H. Williams, a world-renowned authority and a best-selling author on advertising and marketing: "Describe what you want the listener to see, and she will see it. Cause her to imagine taking the action you'd like her to take, and you've brought her much closer to taking the action".

Different critique deals with the quality of information infographics display. Kendra Mack (2011, p.6) wrote that the most important characteristic of infographic is that it shows the story as a whole, without context or additional content. Since phenomena showcased on infographics are usually more complex than what infographics can convey, there is a distinct possibility for manipulation. That is particularly dangerous in

marketing, because companies are not inclined to show information which can diminish their image, but will probably make them seem less important or not show them at all. Furthermore, most information on infographics are not a result of research, but a pile collected from different sources which then go through companies' and designers' filters. Most infographics do not reveal their sources, not even when they are coming from official institutions such as the White House (ibid, p.11). Also, purchasers and authors of infographics usually do not have experience with quantitative and statistical data which can lead to "style replacing content", that is, valuing design rather than valid information (ibid, p.10).

Finally, infographics are criticized for the same reason as any content on the Internet – that they are encouraging superficial, non-analytical way of thinking. Making facts seem simpler and organizing them so they can be consumed with more ease does not leave much room for thoughtful consideration. Nicholas Carr (2008) in his article "Is Google making us stupid?" analyzes how the Internet as a media influences the way we are thinking. Searching and using data online can be similar to browsing a book – we are trying to get as much information as fast and efficient as we can, while longer texts cannot grab our attention. The reason for that is also in the fact that computers nowadays have functions of different devices – they are a TV, radio, mailbox, alarm clock and book all in one. Different notifications which often pop up at the same time diffuse our attention span, which increases tendency to superficially consume content forced upon us.

8. CONCLUSION

The visual nature in combination with useful information make infographics an important marketing tool in the age of "Big Data" when one of the vital features of content marketing is wide distribution. The infographics' format and likeability provide exactly that. Marketing experts can use this tool to offer valuable information to wide range of consumers and build their company's brand at the same time. On the other hand, because of the potential for deceit, marketers must consider the quality and honesty of information they use. Consumers are not likely to forgive manipulation, not even when it is packed in a colorful and funny infographic.

The potential for further research is discovering how versatile infographics are, that is, which industries can profit most with this tool. Its advantages may not be suitable for all target audiences. Fortunately, since there are ways to measure their effectiveness, companies can decide if infographics can help them achieve their goal image in an online environment.

REFERENCES

Carr, N. (2008). *Is Google Making Us Stupid?* Retrieved from http://www.theatlantic.com/magazine/archive/2008/07/is-google-making-us-stupid/306868

Culbertson, J. (2013). *Top Benefits of Using Infographics as a Powerful Marketing Tool.* Retrieved from https://community.dynamics.com/partner/b/lookingglassmarketing/archive/2013/04/11/top-benefits-of-using-infographics-as-a-powerful-marketing-tool.aspx

Eisenberg, B. (2001). *A Pair of Ears Beats a Pair of Eyes*. Retrieved from http://www.clickz.com/clickz/column/1714201/a-pair-ears-beats-pair-eyes

Gilbert, H. N. (1933). An experiment with colored and uncolored advertisements, *Journal of Applied Psychology*, *17*(1), 49-54.

Harris, S. (2013). *7 Infographic Topics You Should Avoid*. Retrieved from http://blog.crazyegg.com/2013/04/02/infographic-topics-to-avoid/

Ho, J. Y. C., Dempsey, M. (2010). Viral Marketing: Motivations to forward online content, *Journal of Business Research*, *63*(9-10), 1000-1006

Houghton, A. (2013). *The Benefits of Content Marketing*. Retrieved from http://webmarketingtoday.com/articles/The-Benefits-of-Content-Marketing

Kostic, A. (2006). *Kognitivna psihologija*, Beograd, Srbija: Zavod za udžbenike i nastavna sredstva

Labrecque, L. I., Milne, G. R. (2012). Exciting red and competent blue: the importance of color in marketing, *Journal of the Academy of Marketing Science*, *40*, 711-727. doi: 10.1007/s11747-010-0245-y

Lankow, J., Ritchie J., Crooks, R. (2012). *Infographics: The Power of Visual Storytelling*, Hoboken, NJ: John Wiley & Sons

Mack, K. (2011). *Viral Visualizations: Online Infographics as Reflections of the Internet's Informational Landscape*. Retrieved from http://www.kendraemack.com/wp-content/uploads/2012/04/Mack_ViralVisualizations.pdf

Morris, C., Wocknitz, S. (2013). *Teaching an old dog new tricks: How data visualization & design can be used by everyone*, Southern African Marketing Research Association Conference 2013

Nelson, T. O., Metzler, J., & Reed, D. A. (1974). Role of details in the long-term recognition of pictures and verbal descriptions. *Journal of Experimental Psychology*, *102*, 184-186

Nickerson, R. S. (1965). Short-term memory for complex meaningful visual configurations: A demonstration of capacity. *Canadian Journal of Psychology*, *19*, 155-160.
Paivio, A. & Csapo, K. (1969). Concrete image and verbal memory codes. *Journal of Experimental Psychology*, *80*, 279-285.
Protz, H. (n.d.), *How to Promote Your Business Using Infographics*. Retrieved from http://blogsandyou.com/how-to-promote-your-business-using-infographics
Rock, I., & Englestein, P. (1959). A study of memory for visual form. *American Journal of Psychology*, *72*, 221-229
Shepard, R. N. (1967). Recognition memory for words, sentences, and pictures. *Journal of Verbal Learning and Verbal Behavior*, *6*, 156-163.
Sheth, B. R., Sharma, J., Rao, S. C., Sur, M. (1996). Orientation Maps of Subjective Contours in Visual Cortex, *Science*, *274*, 2110-2114.
Smiciklas, M. (2012). *The Power of Infographics*, Indianapolis, IN: Que Publishing
Standing, L., Conezio, J., & Haber, R. N. (1970). Perception and memory for pictures: Single-trial learning of 2500 visual stimuli. *Psychonomic Science*, *19*, 73-74.
The Internet Marketing Academy (2011). *Content Marketing*. Retrieved from Scribd.com
Treisman, A. (1964). Monitoring and storage of irrelevant messages in selective attention, *Journal of Verbal Learning and Verbal Behavior*, *3*(6), 449–459
Treisman, A. M. (1960). Contextual cues in selective listening, *Quarterly Journal of Experimental Psychology*, *12*(4), 242–248.
Vizek-Vidovic and associates, (2003). *Psihologija obrazovanja*, Zagreb, Hrvatska: IEP-VERN
Yuk, M., Diamond, S. (2014). *Data Visualization for Dummies*, Hoboken, NJ: John Wiley & Sons

CORPORATE SOCIAL RESPONSIBILITY

FAIR TRADE BUSINESS MODEL AS A FUNCTION OF SUSTAINABLE DEVELOPMENT

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Abstract: *Fair Trade as an innovative trading model strives to achieve greater equality in the international trade, by offering equitably distribution of the gains between marginalized producers, traders and consumers. In this way, it aims to improve producers incomes in some of the poorest countries in the world and help them to actively participate in the development of their communities and societies. Fair Trade contributes to sustainable development by promoting environment-friendly technologies, corporate social responsibility, human rights, elimination of child labour, campaigns to change practices in international trade, raising consumer awareness etc. In this paper are identified the organizations within Fair Trade business model, using the analytical description method. In the proces of analyzing the Fair Trade contribution to sustainable development, the focus is placed on the available data of Fairtrade Labelling Organizations International on benefits of Fair Trade Premium to small producer organizations in the developing countries.*

Keywords*: Fair Trade, supply channel, sustainable development, World Fair Trade Organization, Fairtrade Labelling Organizations International*

1. INTRODUCTION

The following universally accepted definition of Fair Trade was created by FINE in December 2001(World Fair Trade Organization, 2009): „Fair Trade is a trading partnership, based on dialogue, transparency and respect, that seeks greater equity in international trade. It contributes to sustainable development by offering better trading conditions to, and securing the rights of, marginalized producers and workers – especially in the South. Fair Trade organizations have a clear commitment to Fair Trade as the principal core of their mission. They, backed by consumers, are engaged actively in supporting producers, awareness raising and in campaigning for changes in the rules and practice of conventional international trade."

The roots of Fair Trade can be found in the initiatives of North Americа`s and Europe`s churches in the late 1940s. They wanted to assist poor communities in developing countries in a way that will allow them to obtain higher profits through direct tade and fair prices. Fair Trade as a movement pointed to the disadvantaged agricultural and handicrafts producers in the developing countries.

Today, Fair Trade is also a business model, with a number of organizations ensuring compliance to defined Fairtrade standards in every phase of the supply channel from small producers in the South to the consumers in the North.

2. ORGANIZATIONS WITHIN FAIR TRADE SUPPLY CHANNEL

The organizations that make up the structure of Fair Trade movement undertake various activities within the trade chain from producers in the South to consumer in the North. They can be classified into the following groups:

1. Producer organizations in developing countries or countries of the South, which produce and supply the market with Faritrade products;
2. Buyer organizations in developed countries or countries of the North, which appear as importers, wholesalers or retailers of Fairtrade products purchased from producer organizations in a developing country;
3. Network of Fair Trade organizations that sets standards for Fairtrade certification;
4. A large number of primarily conventional organizations involved in some way in the chain of Fair Trade and
5. Lobbying organizations.

2.1. Producer organizations in developing countries or countries of the South

Producer organizations involved in Fair Trade system grow or produce products (food, such as coffee, cocoa, tea, fresh and dried fruit, spices, etc., as well as handicrafts such as balls, glassware, jewelry, musical instruments, toys, etc.) and export them to Fairtrade products consuming countries. Producers are the heart of Fair Trade. Producer organizations differ among regions and depending on product. They include producer associations, cooperatives, family units, workshops for handicrafts, government organizations, private companies and others.

Membership in producer organization is voluntary. There are large differences in the size of the organizations. Although they differ in size, common to all, is that they represent „marginal“ producers. They operate in economies where wages and incomes are low, social benefits almost non-existent and working conditions are extremely difficult. Considering the lack of experience or available resources, without the help of Fair Trade organizations, they are not in position to obtain direct access to the market, neither local nor foreign. Producer organizations face with difficulties which are often associated with issues of racial, ethnic or gender inequality.

Martins (2011) points out that "The participation in the Fair Trade movement implies knowledge of business management, ranging from simple accounting techniques to the sustainable use and conservation of natural resources. Usually, these tasks are far beyond the capabilities of many local communities if they are intending to get involved in exporting their products and becoming part of the international trade. These different capabilities demand efforts in areas that are not directly linked to the production and commercialization of the products, such as education and capacity building" (p. 418).

Any producer organization that wants to support sustainable development, to provide stable income to its members, to encourage democratic participation and respect other criteria, such as women`s equality, human rights, environmental protection, local culture, etc., is a potential partner of Fair Trade. Producer organizations to be accepted as a trade partner in the Fair Trade system, must be able to produce (usually after getting some help) a marketable product. They must be able to provide a range of products at a reasonable price and in sufficient quantity for a specified period of time.

2.2. Buyer organizations in developed countries or countries of the North

To be able to use the Fairtrade mark, organizations which import products with this label, must meet the following requirements:

- They have to buy directly from producer organizations using purchasing agreements that extend beyond one harvest cycle;
- They have to pay a guaranteed minimum price and a social premium above this minimum or pay the world market price when it is higher. For certified organic products they have to pay an additional premium;
- Importers must offer pre-financing equal to 60 percent of the contract upon request.

In addition to these conditions, their role is also, to encourage and assist producer organizations in different ways, such as advising them about the possibilities to develop their production, provide them training and skills in management, provide them with additional support in the difficult economic and social conditions, etc.

Importers initiate or participate in campaigns that aim to increase consumer awareness about the problems in the North-South relations. They promote Fair Trade as an alternative to the „unfair“ foreign trade activities and lobby for change on the policy level. Therefore, they are associated with different organizatios working on similar issues (NGOs, aid agencies, educational centers, etc.).

Organizations which import products with Fairtrade lebel in their countries emerge as wholesalers or retailers (sometimes a combination of both), offering Fairtrade products through various channels, such as specialty shops (Worldshops) and local groups or representatives, as well as many other channels as stores, shops for organic food, gift shops, supermarkets, catalogs and Internet sales. Certainly, an important channels are, also, restaurants, cafes, canteens, etc.

2.3. Network of Fair Trade organizations

Fair Trade organizations work in joint efforts to promote Fair Trade. They have a common vision and principles which direct their operations. A special role and importance in the supply channel have the World

Fair Trade Organization, which has developed Fairtrade standards for the organizations, and Fair Trade Labelling Organizations International, which established standards for the Fairtrade products. Both systems are based on common definitions and principals of Fair Trade.

2.3.1. World Fair Trade Organization – WFTO

The International Federation for Alternative Trade – IFAT was established in 1989. It rebranded and became The World Fair Trade Organization on 15 October 2008. This change is significant and was created to meet the requirements of Fair Trade organizations and the general situation in the modern world. The decision was accepted by the majority of its members (91% of the vote), which are now collectively known as the FT100.

WFTO is one of the most important institutions of Fair Trade and unique in representing Fair Trade members of the North and the South. It represents the Fair Trade organizations at all levels, managing the system of Fair Trade for more than 20 years. It is the only global nework of Fair Trade, in the sense that its members represent the entire range of Fair Trade, from production to sales.

WFTO is the global representative body for over 400 organizations, so we can say that it is the „authentic voice" and „guardian" of the values of Fair Trade. WFTO operates in more than 70 countries, grouped into 5 areas (Africa, Asia, Europe, Latin America and North America and the Pacific), with elected global and regional boards, which create market access through its policies, advocacy, campaigns, marketing and monitoring.

Around 110 million artisans, farmers, growers and producers lead Fair Trade through cooperatives, networks, brands and business and supply around 2.2 billion dollars net sales of Fair Trade throughout the world. One of the goals of WFTO is to enable small producers to improve their lives and communities through sustainble Fair Trade.

In this sense, the agenda of WFTO is very clear: the agreement on the framework and implementation of strategies and tools for change that will affect the poverty reduction, climate change and the financial crisis.

The opportunity to become members of WFTO have only organizations that are fully committed to upholding Fair Trade and its 10 standards. Their specificity is reflected in their 100% commitment to the goals of Fair Trade to eradicate poverty through sustainable economic development, supporting social and environmental policy and continual investment in marginalized artisans, farmers and producer communities in some of the poorest parts of the planet. WFTO members, which are subject to monitoring in relation to the application of these standards are listed on the FT100 index of world`s leading Fairtrade brands, businesses and organizations. FT100 aims to become a powerful instrument of transparency, traceability, social and environmental impact on public opinion.

2.3.2. Fairtrade Labelling Organizations International – FLO

Fairtrade Labelling Organizations International was established in 1997. It represents 24 organizations working to secure better conditions for producers and setting international standards of Fair Trade. FLO members around the world produce and promote products with the Fairtrade mark.

FLO coordinate the processes of identification and standardization of Fair Trade at the international level, through various activities, such as:

- Setting standards of Fair Trade. (The key role of the FLO is reflected in the development and monitoring of standards of Fair Trade. These standards apply to all Fairtrade products.)
- Organizing support for producers around the world. (FLO helps producers to get Fairtrade certified and develop market opportunities through locally established liaison officers to provide training, instruction, certification and to facilitate customer relationship management.)
- Coordinating the global strategy of Fair Trade. (One of the roles of FLO is to determine the feasibility of how members can contribute to progress and become more effective in the future. Changes in the world, climate changes, food insufficiency and global recession are more important issues to the public and stakeholders in Fair Trade. FLO manages the global strategy development on these issues. It is currently implementing a new global strategy for Fair Trade called „Making a Difference".)
- Promoting Fair Trade. (One of the FLO tasks is to create conditions for Fair Trade in debates on trade and development. It does this in cooperation with other international Fair Trade organizations, such as WFTO, NEWS! and EFTA. Together they lead the Fairtrade Advocacy Office in Brussels. This office coordinates the activities of the international Fair Trade movement in Europe and around the world.)

FLO vision is a world in which all producers enjoy security and sustainable development, satisfying their own potential and deciding on their future. FLO believes that trade can be a fundamental leader of poverty reduction and more sustainable development, but only if it is conducted with the aim of creating greater equality and transparency than those that exist today. FLO members believe that producers can overcome inquality and marginalization if they strengthen their position and take more control over their work and their lives, if they are better organized, have better resources and support and can provide acces to markets under Fairtrade conditions.

This FLO vision is based on the fact that citizens, businesses and institutions in developed countries support trade in this way, especially when they understand the needs of producers and the opportunities offered by Fair Trade to change and improve their situation. Informed consumers choices and business desires to meet the expectations of its customers, provide crucial support for FLO broader campaings to reform the rules of international trade and create more just economic system.

FLO vision and mission are reflected in the values and principles by which it works, so it sets itself as an example of the changes required in others. Trust is the most important factor in its operating.

Although the sale of Fairtrade products has grown rapidly last 20 years, many products remain outside the Fair Trade system. Therefore, FLO invited its partners to join it in the development of new strategies.

2.4. A large number of primarily conventional organizations

A large number of primarily conventional organizations, such as supermarkets, are involved in some way in the chain of Fair Trade. Approximately 43,000 supermarkets across Europe and 7,000 in the U.S. and Canada has in its assortment Fairtrade products. Although they are outside Fair Trade movement, they are becoming increasingly important participants in the Fairtrade products retail chain. With the growing Fair Trade market share will increase their importance in the distribution of these products. Many supermarkets are starting to sell Fairtrade products which are purchased directly from the producers with this trademark.

Selling in large supermarkets, national chains or small stores, Fairtrade products are becoming more accessible to consumers. The most important for them is certainly the trust in the Fairtrade label, so the Fair Trade labelling organizations never diminish the criteria that mus be meet. Accordingly, the Fairtrade label on products, no matter where consumers buy them, guarantees that they met the strict social, economic and environmental standards. The same international Fair Trade standards apply to all companies and retailers, regardless of their size or organizational structure.

It is important to point out that the Fairtrade certification model does not include monitoring of other business activities, so the certificate is valid for certain products and not for the company.

2.5. Lobbying organizations

Lobbying organizations contribute Fair Trade development, which is confirmed by the work of Fair Trade Advocacy Office (FTAO). It represents FLO, WFTO and EFTA in Brussels, where successfully lobby for the European Commission contemporary politics to support Fair Trade.

FTAO supports Fair Trade with the aim to improve trading conditions for the benefit of small and marginalized producers and poor workers in developing countries. It:

- Coordinates representation of FLO, WFTO and EFTA;
- Monitors the European and international policies on trade and development;
- Provides a continuous dialogue between the Fair Trade movement and decision makers;
- Develops policy positions in the field of Fair Trade and equity trading;
- Publishes informational publications and brochures.

However, it must be noted that if the lobbying organizations are considered as organizations which are trying to „persuade“ the government to change its views in favor of certain issues, than all Fair Trade organizations have a role in lobbying, either in the traditional way or giving the public its successful story.

3. FAIR TRADE CONTRIBUTION TO SUSTAINABLE DEVELOPMENT

Government support in developing countries is often limited, so communities must take on the role of government structures, providing support, protection and advocacy of individual needs and interests.

Participition in Fair Trade contributes and promotes the survival of communities, and brings many and various benefits to small producers.

One of the most significant is certainly, the guaranteed minimum prices for the products included in it, which increases their income. Jaffee (2010) points out that "The base prices for Fairtrade products (at first only coffee) were initially established by movement NGOs in the late 1980s based on assessments of producers` costs and livelihood needs. Individual buyers may pay higher than the FLO minimums if they choose. The setting of prices became the purview of FLO after its creation in 1997" (p. 276). Greater economic stability, better credit and financing terms, lower interest rates, diversification of income sources, access to markets of developed countries, are important as well.

Beside these obvious benefits of Fair Trade, other are more complexed and less visible. In addition to the minimum prices, producer organizations receive Fairtrade Premium, as a sum of money paid above the guaranteed price of Fair Trade. It is precisely defined for all Fairtrade products and must be invested in a way to contribute sustainable development. Premimum can be invested in projects of social, environmental and economic development, based on democratic decisions at the level of producer organizations. Some forms of using these means are: building pharmacies, hospitals, schools, bakeries, storages and transportation facilities, constraction and reconstruction of houses, promotion of organic industry, effective management of water resources, cooperation with other communities, reducing illiteracy, etc.

Figure 1. shows how producer orgainizations in developing contries distributed Fairtrade Premiums recevied in the period 2010-2011 on the global level (Fairtrade Labelling Organizations Intenational, 2012, p.58). Most of the amount was spent on investment in business or organizational development, production and processing, while there was no expenditure on gender equity during this period.

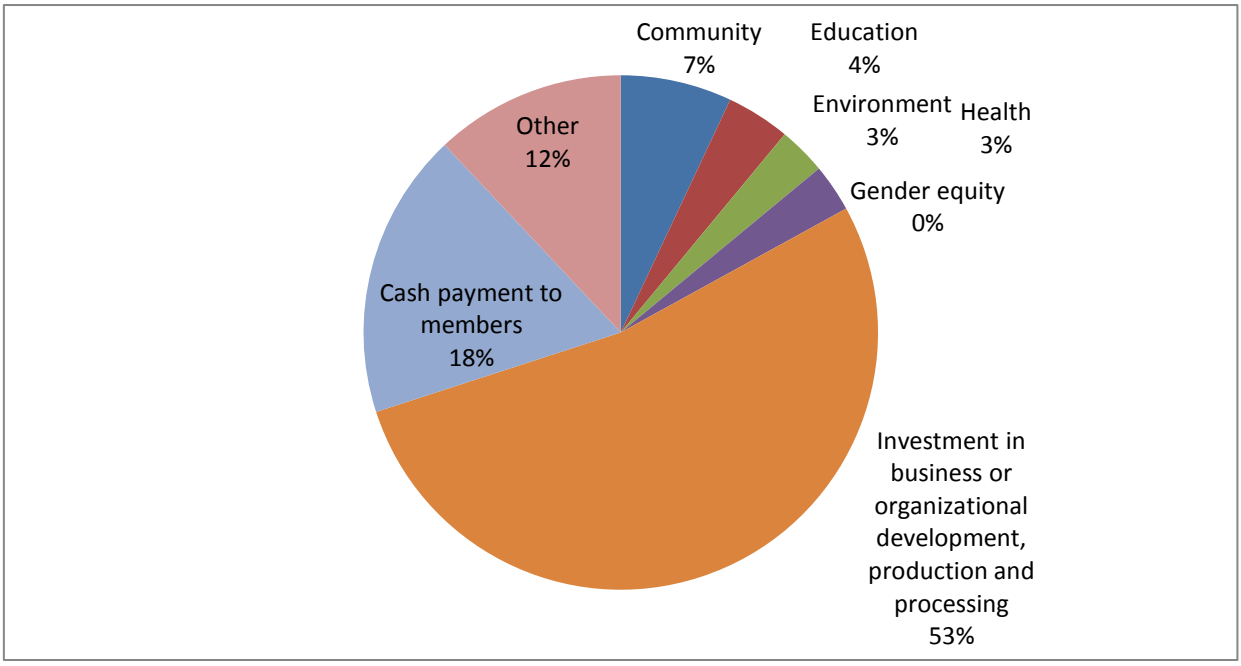

Figure 1: Fairtrade Premium expenditure by category: Small Producer Organizations and Contract Production 2010-11

On the other side, consumers in developed countries show great concern to know not only what quality products they buy, but also, where and how they were produced, and who has benefits of their purchase. They express their concerns through their ethical behaviour and that is why they are willing to pay higher prices for Fairtrade labeled products. Fairtrade label on products packages indicates to consumers that they are produced according to Fairtrade standards whose adoption and implementation is in charge of Fair Trade organizations.

Fair Trade is a part of ethical consumerism, but the profit gained operating through this business model differes from the profit gained by maximizing sales. There are obvious differences in the transparant negotiation, information and Fairtrade premium and prices which receive trading partners within the Fair Trade network.

Kroger and Schafer (2014) point out that "Organic agriculture and Fairtrade have become the most important alternative food production systems worldwide, and both are supported of a broad movement of social actors. They represent important challenges to the ecologically and socially destructive relations that characterize the global agro-food system. Both movements critique conventional agricultural production and consumption patterns and seek to create more sustainable world agro-food system" (p. 45).

4. CONCLUSION

The network of Fair Trade organizations promotes Fair Trade, sharing a common vision and principles which govern their operations. Their work from its foundation until today shows positive sentiments and opinions, emphasizing their contribution to the improvement of living standards and business conditions of marginalized producers, sustainable development, financial and other conditions in local communities, creating a good image in the eyes of consumers and others. The role of Fair Trade organizations as the fundamental „guarantee“ of this concept is unprecedented, even in the future will certainly come to their transformation.

Fair Trade shows that marginalized producers in developing countries can benefit from trade with their partners in developed countries. It is not a charity or donation, but a successful business model including better trading partnership in which each participant achieve profit.

REFERENCES

Chambolle, C., Poret, S. (2013). When fairtrade contracts for some are profitable for others. European Review of Agricultural Economics, pp. 1-37. doi: 10.1093/erae/jbs039.

Fair Trade Advocacy Office. (2013). Speaking out for Fair Trade and Trade Justice. Retrieved from http://www.fairtrade-advocacy.org

Fairtrade Labelling Organizations International. (2012). Monitoring the Scope and Benefits of Fairtrade - fourth edition – 2012. Retrieved from http://www.fairtrade.net/impact-and-research.html

Fairtrade Labelling Organizations International. (2013). Annual Report 2012-2013: Unlocking the Power. Retrieved from http://www.fairtrade.net/annual-reports.html

Jaffee, D. (2010). Fair Trade Standards, Corporate Participation, and Social Movement Responses in the United States. Journal of Business Ethics, 92:267-285. doi: 10.1007/s10551-010-0583-1.

Kornberger, M. (2010). Brand Society: How Brands Transform Management and Lifestyle. New York: Cambridge University Press.

Kroger, M., Schafer, M. (2014). Between Ideals and Reality: Development and Implementation of Fairness Standards in the Organic Food Sector. Journal of Agricultural and Environmental Ethics, 27:43-63. doi: 10.1007/s10806-013-9444-0.

Martins, R. (2011, Oct./Dec.). Fair Trade Practices in the Northwest Brazilian Amazon. Brazilian Administration Review, v. 8, n. 4, art. 4, 412-432. Retrieved from http://www.anpad.org.br/bar

World Fair Trade Organization (2009). What is Fair Trade? Retrieved from http://www.wfto.com/index.php?option=com_content&task=view&id=1&Itemid=13

World Fair Trade Organization (2012). Annual Report 2012. Retrieved from http://www.wfto.com/index.php?option=com_content&task=view&id=26&Itemid=109

ANALYSIS OF THE LEVEL OF ALIGNMENT OF MARKETING OBJECTIVES WITH SOCIAL RESPONSIBILITY IN THE COUNTRIES IN TRANSITION

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***Abstract**: corporate social responsibility and sustainable development have become a global paradigm. Current conditions and characteristics of the global business point to the necessity of gaining competitive advantage, and achieving goals that do not solely imply an increase in profitability. The companies in the market economy countries follow the strategies that are economically profitable, but at the same time socially responsible and establish a symbiosis between the principles of profitability and social responsibility. Implementation of CSR is based on the full commitment to the principles and processes through the alignment of the objectives of marketing activities. Literature and practice show that profit and social responsibility do not always go together. This is particularly evident in the countries in transition, such as the Western Balkan countries. An undeveloped institutional framework, frequent law amendments, inadequate corporate governance and a lack of strategic approach are conducive to business uncertainty and an exclusive orientation to profit. Doing business in these countries generally carries the risk for the owner, especially when operating in varying conditions where profit is emphasized and social responsibility neglected. Weaknesses in the implementation of corporate social responsibility arise from conflicting objectives, organizational culture, management, strategy and a wider social context. CSR is an important marketing tool in gaining a sustainable competitive advantage that ensures an interaction between different stakeholders and alignment of marketing objectives. The aim of the paper is to point out to the need to reconcile economic with social interests in the countries in transition by analysing the level of alignment of marketing objectives with social responsibility.*

***Key words:** social responsibility, marketing, stakeholders, transition society*

INTRODUCTION

Social responsibility is increasingly growing in importance in the world of business. The organizations that operate at the national and global level, regardless of ownership, are becoming more complex, because the requirements for financial sustainability and integration into the social and economic environment form part of contemporary business premises. Corporate social responsibility (CSR) has become a strategic and integrative element of modern business, which is basically a continuation of business activities. Porter & Kramer (2011) pointed that " CSR programs focus mostly on reputation and have only a limited connection to the business making them hard to justify and maintain over the long run" (p.76) and also emphasize that "the solution lies in the principle of shared value, which involves creating economic value for society by addressing its needs and challenges" (p.64).

An economic approach that perceives business as a basis for making profit is related to the social responsibility of business entities. In modern conditions economic responsibility has a tremendous importance in the competitive game. Harmonization of the interests and demands of stakeholders expressed through an approach for increased social responsibility is not of lesser importance in business, especially in the countries with developed market relations. Today, social responsibility is integrated into the business strategies of companies, particularly regarding the labour standards, environmental sustainability, reporting, transparency and relationships with suppliers and customers which is shown in Reports State of the Profession (2013). Social responsibility has become a necessity of modern business, which includes achieving and maintaining the satisfaction of customers, employees, shareholders, owners and other stakeholders. The companies that establish a symbiosis between the principles of profitability and social responsibility have long-term growth prospects. Development of corporate social responsibility has become a

leading paradigm at the global level. It has originated from the belief that companies are not only economic, but also social entities, which have a responsibility towards the society and are required to do things to improve the situation in the society in general. In addition to knowledge, skills, and process management, modern companies find competitive advantages in social responsibility as well. Social responsibility is seen as a necessity adopted by a growing number of companies with the aim of maintaining their market position.

Corporate social responsibility in the countries in transition is declarative and business entities are faced with numerous problems, including inadequate policies, the practices aimed at profit and maintaining business for profit. The absence of public policies on social responsibility, lack of experience in the application of modern marketing techniques and inadequate strategic management result in a low level of implementation of social responsibility which is reflected in inconsistency and conflicting objectives of business entities with the principles of corporate social responsibility, especially in the Western Balkan countries in the transition process. The aim of the paper is to point to the importance of reconciling marketing objectives with social responsibility in the countries in transition and the need to change the way of doing business in order to strengthen the moral, ethical and business values of modern business in the countries in transition.

1. THE ROLE OF SOCIAL RESPONSIBILITY IN BUSINESS

The role of business is primarily focused on creating the value for the owner or shareholder, in the manner that the value for the society is simultaneously created. When we look at market economies, the primary responsibility of business is the return of invested funds and economic benefit for the society. The fundamental principle of business is the ability of the company to create value for itself and in turn to create value for the society. The differences that arise between the goals of the company and the society cannot be ignored, especially if the societies have developed mechanisms to encourage social responsibility. There are conflicting opinions in the literature over the issue of whether the companies should be focused solely on the financial interests of owners, or the interests of stakeholders. The proponents of the former opinion explain that the business carries a great risk for the owner of the company, and lesser for the public concerned. In corporations, shareholders aim to achieve their interests, according to which they create values. Rappaport (1986) emphasized that business strategies should be aimed at maximizing the shareholder's value. He also pointed out to the fact that corporate missions primarily point to the responsibility of the management for profit maximization in the interest of the owner, and that the research indicates that the majority of employees in industrial complexes have similar views on the issue of profit maximization.

New perspectives have shown the weaknesses of the "shareholders theory" and acceptance of the" stakeholders theory (Freeman and Gilbert 1988) according to which the interested public has the power to seriously affect the corporations and their moral responsibility towards the stakeholders' interests. Hamel & Prahalad (1994) pointed out that the companies join the society due to their interaction in the complex, highly complicated and unstable environment and besides the economic mission they also have social responsibility. The competitive game in a turbulent environment brings to the fore the issue of sustainability which starts from the premise to meet the needs and expectations of customers (Kotler & Armstrong, 2010). .

Corporate social responsibility in the 21st century reflects the core values of the companies and forms part of their business strategies. Under the influence of numerous stakeholders the business is focused on the strategies that include the principles of social responsibility, among which environmental sustainability and resource conservation are very important (EEA 2013). In recent years, a growing number of companies worldwide have some form of corporative social responsibility. The "Sustainability Disclosure Database" Global Reporting Initiative includes 6065 companies with over 17.642 reports. CSR ranks high on the priority list of a growing number of companies and represents their commitment to the society in which they operate and implement their business activities. Requirements for environmental protection and the protection from unethical exploitation of resources have resulted as a response of companies to consumer demands. New technologies, resource conservation, consumer demands and government policies change the objectives of the company towards social responsibility. The companies that wish to maintain their competitive advantage adopt the principles of environmental sustainability and incorporate them into the corporate goals. Nemitz (2013, p 92) points out that "The majority of environmental goals fall into category in which market values are

not available. These goals, termed have two characteristics: non-exclusion-meaning that one person could not prevent another from consuming the resource and joint consumption".

Unlike large corporations, small companies have more freedom to direct their business objectives towards social responsibility, which is due to their financial power, mainly focused on the use of renewable energy sources, efficient use of resources, relationship marketing, as well as philanthropic activities.

The system of social responsibility strengthens the core values of the company, through cohesion of the objectives and tasks focused on the core of the competitiveness and resolving the social and environmental problems of the societies in which they operate.

2. MARKETING OBJECTIVES AND SOCIAL RESPONSIBILITY

The modern market is an "ethical arena" in itself, which reflects the goals of the company and the society, through the application of the principles of social responsibility. Kotler & Armstrong (2010 p. 629) point out that "Good ethic is a cornerstone of sustainable marketing".

Requirements for greater social responsibility are initiated by major social actors, as the need to solve numerous social and ethical issues. Most business organizations are faced with the challenges of reconciling corporative social responsibility (CSR) with strategic goals, and with the problems in their implementation. Modern business conditions require the integration of economic principles and the principles of social responsibility. The marketing objectives must provide the right direction and sufficient flexibility so that the company could adapt to changes. Kotler & Armstrong (2010) point out that „The social marketing concept holds that marketing strategy should deliver value to customers in a way that maintains or improve both the consumer's and society's well-being" (p 35).

Today CSR represents the agenda of all large corporations. The World Economic Forum has particularly stressed the link between corporate governance, corporate responsibility and competition, as the basis for conducting business. The studies show that corporate socially responsibility business is the basis for differentiating companies and consumers choose products of the companies that are recognized for their social responsibility. Most studies confirm a positive correlation between social responsibility and financial performances. Dess, Lumpkin & Eisner (2007) indicated the McKinsey&Company studies (p.332) that have been carried out, point to the relationship between good corporate governance and performance. This study includes the results of 12 analysed developing markets, which indicates that the worst companies, in terms of corporate governance, have lower return on capital than the market average. Moreover, the results show that the activities of the Board of directors were as important as the financial performances. The study showed that effective corporate governance affects the financial viability and social responsibility.

The statements on social responsibility set forth in the missions of companies are reflected on the marketing objectives. The task and purpose of the mission of a business entity is to guide the company towards the execution of its strategies. The power of the mission is reflected in how successfully the objectives of different strategies are harmonized. In practice, it happens that the objectives are intertwined between different business levels. Furthermore, there are conflicting objectives among stakeholders, as well as the question of trust among all stakeholders. Social responsibility rests on trust and voluntariness, and the trust is built through appropriate relations between external and internal stakeholders and managers. The managers are the first strategic players who are responsible for strategic choices, which include the most important predictions about the environment and the need of companies to gain the competitive advantage. The greatest attention of managers is mainly focused on key stakeholders, such as the society and customers, rather than on specific social groups. Their role in the implementation of social responsibility is very important.

The subjects of all marketing efforts that recognize the role and importance of social responsibility are customers. They are the ones who make decisions, put pressure and make purchasing decisions and choices. Customers in developed countries have a high level of awareness of the social corporate responsibility, as a factor that influences their purchases. "Sustainable marketing goes beyond caring for the need and wants of today's customers. It means having concern for tomorrow's customers in assuring the

survival and success of the business, shareholders, employees, and the broader world in which they all live" (Kotler & Armstrong 2010, p 663).The authors point out that the fulfilment of the needs of the target market and consumers is ensured through harmonization of public interests, economic efficiency, and information and consumer protection. The implementation of social responsibility implies harmonization of marketing and strategic goals, as well as the commitment of business entities to their own values and interests, as well as to the society as a whole.

3. SOCIAL RESPONSIBILITY IN THE TRANSITION COUNTRIES

Transition is a challenge for the countries that are building the market economy and which must deal with the issues not only related to business and economy, but to the social responsibility as well. The approach to corporate social responsibility is essentially based on creating a greater quality of life of the societies lagging behind in their development. Addressing this problem cannot be simply a matter of the economy, but the influence of political structures which create the system of values and relationships within individual countries. Numerous problems of the Western Balkan countries are reflected in the high unemployment rates, excessive foreign debt, structural problems and lack of liquidity (EC Progress Report, 2013). The economic objectives have become dominant, so the primary objective of business entities is to make profit, regardless of social consequences. Therefore, the governments in these countries are forced to solve numerous social problems. The uncertainty of economic operations, undeveloped markets and the effects of the economic crisis affect the inconsistency between marketing strategies and social responsibility.

Social responsibility is based on the trust between social actors which has been lost in the transition process. Institutional deficiencies and frequent amendments, or insufficient application of adopted laws, in most of these countries have influenced the level of social trust. There are a lot of regulations and little trust of the companies that do not have adequate strategies for corporate social responsibility and strategic market activities. Social responsibility is generally given very little importance. Improvement of working conditions, the overall social environment and ethical values should be the basis for an increase in profit, with the maintenance of the basic standards of the conservation of natural resources and protection of consumers. Despite this, the fact is that corporate governance is in its infancy. The public owned companies operating in the domain of public interest are an obvious example of this. The mechanisms of management are not aligned with the interests of the owner, or the state. Namely, the boards of directors usually act in an opportunistic manner, while the managers are usually appointed using political connections. The issue of making profit in the companies that are registered as public limited companies is similar. A lack of experience in the application of modern marketing concepts generally reduces the operating results and presents a barrier to business based on social responsibility. Compared with the developed market countries it can be concluded that there is no successful business without the development of the market and social responsibility.

The research on the application of corporate social responsibility in the countries of the Western Balkans is supported by international organizations with the aim of raising awareness, improving the institutional framework and enhancing confidence in social responsibility. The research studies point to the differences in the levels of implementation of social responsibility within the official policies and a declarative public interest for the introduction of corporate social responsibility. The results show that the index of social responsibility is larger in the companies with a large number of employees and that the perception of corporate social responsibility in the public is still low (Project "CSR of MNE Company", 2013).

The analysis of the practice reveals that the companies in the sectors of telecommunications, finance and energy that normally apply CSR in their home countries take advantage of the ambiguities of statutory provisions, the monopoly and underdevelopment of infrastructure for consumer protection by making the extra profit in the markets of these countries. This is particularly reflected in their relations with consumers who still do not have any real protection instruments. Examples of good practice of corporate social responsibility in successful companies are mainly philanthropic activities, rather than a systemic approach that integrates business objectives and social responsibility. The Western Balkan countries that are in the process of accessing the EU are obliged to harmonize the legislation and the policies for the improvement of

business operations and monitoring of social responsibility. The EU policy is focused on maximum transparency and informing consumers about the potential risks in the market (EEA, 2013).

The responsibilities are also aimed at strengthening the institutional mechanisms, developing the market, improving corporate governance and transferring the knowledge of modern business principles so as to create economically viable and socially responsible companies.

CONCLUSIONS

Social responsibility is of special importance in modern business. The theorists suggest that modern business is oriented towards sustainable competitive advantage, superior performances, corporate social responsibility and shared value. The system of social responsibility strengthens the core values of the company, through the cohesion of the objectives and tasks focused on the core of the competitiveness and resolving the social and environmental problems of the societies in which they operate.

The modern business paradigm requires the corporate social responsibility towards the community and developed market relations that create competitive advantage for the socially responsible companies. The business success in the market is achieved through the symbiosis of the business developmental goals and the goals of the society.

Implementation of the goals of the company and the application of social responsibility are ensured through the institutional mechanisms, developed market and the implementation of appropriate stakeholder-oriented strategies. The modern marketing provides the necessary interdependence and harmonization of marketing objectives and social responsibility among all stakeholders. Stakeholders, investors, customers and consumers represent the target points around which it is necessary to integrate the marketing efforts for the acceptance of social responsibility and implementation of the business strategy.

The companies that operate in the markets of transition countries have a low level of harmonization of marketing objectives and social responsibility, which reduces the effects of their operations and is reflected on the society as a whole. Insufficient social responsibility results in the reduction of efficiency and the value created and inadequate exploitation of resources. The companies that operate in the countries with undeveloped social responsibility practices are faced with the problem of sustainability and the slowdown in development.

The Western Balkan countries need to strengthen the institutional framework, develop market mechanisms, and improve corporate governance and the transfer of the knowledge of modern business principles in order to create economically sustainable societies.

REFERENCE

Brown J.T., Dacin, A.P. (1997) The Company and the Product: Corporate Associations and Consumer Product Respons“, *Journal of Marketing 61, p.69.*

Davies J.(2013)Report State of the Profession.

Retrieved from http:// www.info.greenbiz.com/rs/greenbizgroup/image

Dess G.G., Lumpkin G.T., & Eisner B.A., (2007) Strategic Management: Text and Cases. McGraw-Hill Companies

EEA (2013): Environmental pressures from European Consumption and Production: A Study in Integrated Environmental and Economic Analysis, EEA Technical Report No2, Copenhagen. Retrieved from http://.www.eea.europa.lu/publication

Fred R., D. (2011) Strategic Management – Concepts and Cases. 13th Edition, Pearson Education, Prentice Hall, New Jersey.

Global Reporting Initiative. Retrieved from http://www.database.globalreporting.org

Hamel, G., & C.K. Prahalad (1994) Competing for the Future. Cambridge, MA: Harvard Business School Press.

Kotler Ph.,& Armstrong G., (2010) Principles of Marketing. 13th Edition, Pearson Prentice Hall, New Jersey.Kotler Ph., & Keler K., (2008) Marketing Management. 12th Edition, Prentice Hall.

Drumwright,E. M. (1994) „Social Responibile Organizational Buying: Enviromental Concern as a Noneconomic Buying Criterion, *Journal of Marketing, 58.1-19*

Nemitz N.,P. (2013) Business and Sustainability Challenge: An Integrative Perspective, Routledge,New York. Retrieved from http://ebscohost.com

Porter, E.M.,& Kramer, R.M. (2011, January-February) Creating Shared Value. HBR. Retrieved from http://ebscohost.com

Porter, E.M., Kramer R.M.,(2002)The Competitive Adventage of Corporative Philantrophy. *Harvard Business Review*

Project (2011) Corporative Social Responsible of Montenegrin Company, Podgorica.

Progress Report, www.oecde.org/progressreport

Rapaport A.,(1986) Creating Shareholders Value: The New Standard for Business Performance. Free Press.

EDUCATION MANAGEMENT

STUDENTS' PREFERENCES TOWARDS E-LEARNING ENVIRONMENT

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Abstract: *E-learning opportunities are rapidly expanding in higher education. To meet the needs of students enrolled in such courses, universities must rethink how they deliver knowledge and understand the factors that influence students' satisfaction. Such understanding can be used for appropriate design and improvement of e-learning environments based on their preferences, with the aim to enhance student learning experience. The purpose of this study was to identify students' preferences and their levels of satisfaction. Special attention was given to differences between the students in e-learning environment (Moodle and open courses) in comparison to traditional students who experience only face-to-face delivery of knowledge or attend few courses in e-learning environment. Conjoint analysis was used for this purpose. Results indicate that there is a difference both in satisfaction and preferences between two groups of students, and factor that singles out is method of knowledge assessment.*

Keywords*: E-learning, satisfaction factors, student preferences, conjoint analysis.*

1. INTRODUCTION

When learning is mediated with technologies then we can assume that some form of e-learning happened. Advancements in technology have revolutionized the opportunities for educators to teach and the means for students to learn (Tutty & Martin, 2009). Rosenberg (2001) emphasized that e-learning refers to the use of Internet technologies to deliver a broad array of solutions that enhance knowledge and performance. E-learning is networked (instant updating, storage/retrieval, distribution and sharing of instruction or information). It is delivered via computer and goes beyond traditional paradigms of training (Rosenberg, 2001, p. 28). E-learning can be defined as the use of network technology (broadly, the "Internet") to design, deliver, select, administer, and extend learning. Main components of e-learning can include content delivery in multiple formats, management of the learning experience, and a networked community of learners, content developers and experts (Yu et al., 2010).

If e-learning is referred to as part of an educational system then we should explain the term distance education (e-education). E-learning could be viewed as a part of an educational process within educational system. In this sense e-learning is a part of educational process where the teacher and the student are separated from each other and by means of technology they achieve two-way interaction in order to implement the necessary commutation. E-learning also could be seen as content delivery method in distance education that enables synchronous and asynchronous information exchange over the network (Oncu & Cakir, 2011). Today e-learning has become a viable delivery system for both secondary and higher education (Yu et al., 2010).

The central component in e-learning environment is the learner for whose benefit the environment is provided. Understanding the characteristics of learners in respect to how those characteristics may affect the teaching–learning process in the online environment is very important for designing effective instructions for e-learning environment (Roberts, 2010). The manner to achieve that students' perception of the effectiveness of e-learning course and their satisfaction will be evaluated in this paper.

In order to evaluate the effectiveness of e-learning courses researchers examined different components of e-learning. Malik (2009) created a practical model for examining student satisfaction with e-learning and identified five groups of factors: student, instructor, technical, design, course. Matsatsinis et al (2003) selected three criteria of satisfaction with several sub-levels: interface (web design, user-friendliness, personalization, etc), content (structure, extra links, format, etc) and functionality (response time, reliability, security, etc).

Horvat et al. (2014) examined students perception on e-learning courses on Moodle platform at Faculty of Organizational Sciences and concluded that students who use Moodle have a significantly lower satisfaction

only before an exam in comparison to students who use it on daily basis (Horvat et al., 2014). They have suggested that feedback on quality characteristics from students that do not use Moodle regularly should be considered as it is done in this research.

Cavanaugh et al (2004) identified success factor of distance learning programs, and found that most important ones are: abilities and disabilities of the student, quality of the teacher, demands of the content, design of the distance learning system, course, and other assessments. Likewise, Damnjanovic et al. (2013) defined eight factors (behavioral intention to use in the future, communicativeness, format, information quality, performance outcome, perceived usefulness, satisfaction and system quality) in order to measure effectiveness and use of Moodle. Their results showed that system and information quality did not influence satisfaction, while communicativeness had the highest impact on performance outcome. Satisfaction had a significant effect on behavior intention (Damnjanovic et al., 2013).

2. RESEARCH FRAMEWORK

The aim of this study was to acquire a broad view of students' preferences in e-learning in Serbia, and to investigate which learning experiences contribute most to their satisfaction. The assumption behind the study is that students prefer certain online components more than others and that it is possible to identify which of these are most influential on their attitudes. In accordance with this, the study did not examine specific courses but a diverse sample of students that are engaged in: (1) entirely online studying via Moodle learning environment, (2) traditional offline, face-to face studying with some experience with blended courses (combination of face-to-face and e-learning), (3) taking open online courses outside curricula (edX, Coursera, etc). The important element of e-learning is students‘ perception of the effectiveness of e-learning course and their satisfaction with it. Three dimensions of interest were defined in this study as: e-learning technology, teaching method and knowledge assessment. They were chosen by considering previous research (Mosca et al., 2010; Katz, 2002; Ferguson & DeFelice, 2010; Won & Bravo, 2009) and authors‘ own experience in teaching in e-learning environments.

Learning environment, or technology used for delivering knowledge, is important as satisfaction of students from e-learning is based on the student‘s attitude towards ICT (Malik, 2009). Technology is generally not a barrier to the success of participants in e-learning and most students have necessary skills to fully engage in e-learning environments. Drennan et al. (2005) found that student satisfaction is influenced by positive perceptions towards technology, in terms of ease of access.

Teaching method is the most complex dimension as it comprises of several different aspects, mainly related to interaction. According to several authors (Bouhnik & Marcus, 2006; Katz, 2002; Picciano, 2002), interaction is one of the most important factors of e-learning, and can be analyzed on several levels: interaction with content, teacher, other students and the system. Mijatovic et al. (2013) conducted a research on students, who are using Moodle platform for the first time in their studies and they have concluded that active participation in class and interactive usage of the system had strong positive effect on students' achievement. (Mijatovic et al, 2013). Bouhnik & Marcus (2005) found that one of the things students are dissatisfied with is the lack of contact and interaction with their peers. Jung et al. (2002) found that the students who collaborated with each other expressed the highest level of satisfaction. Nummenmaa and Nummenmaa (2010) came to similar conclusion by finding that students who did not interact with others had more negative emotional experiences. The group interactions initiated by teachers are very effective and students enjoy the learning environment. The teacher role is very important and their timely response positively influences student satisfaction (Malik, 2009). Clearly defined objectives, assignments, and deadlines, need to be present in order to increase student satisfaction as well (Stein, 2004).

We found no research results in literature regarding student preferences in knowledge assessment within e-learning environments, but we believe this dimension might have an impact on students‘ satisfaction and therefore have included it in this study. The details on all three dimensions, their attributes and level are presented later in the text.

3. RESEARCH METHOD

3.1. Conjoint analysis

Conjoint analysis (CA) is a multivariate technique that can be used to understand how an individual‘s preferences are developed. It originated in mathematical psychology (Luce & Tukey, 1964), and was first introduced in marketing research to evaluate consumer preferences for hypothetical products and services (Green & Rao, 1971). Today, it is widely used to understand preferences in various markets, including transportation (Hensher, 2001), telecommunication (Kim et al., 2008), labor market (Popovic et al., 2012), etc. Furthermore, conjoint analysis has been successfully applied within the education industry: Soutar and

Turner (2002) used conjoint analysis to reveal what kind of university was most desirable among students; Hur and Pak (2007) attempted to identify what the preferred subjects for an after-school computer education course in elementary schools were by using conjoint analysis; Won and Bravo (2009) applied conjoint model that compares the relative importance of six course attributes that influence students‘ preferences in order to develop courses to satisfy students‘ needs and enhance teaching effectiveness. Sohn and Ju (2010) used conjoint analysis to effectively recruit high quality students for high school; and Kuzmanovic et al. (2012) used conjoint analysis to identify heterogeneity of the students‘ preferences for various aspects of university teaching. Kuzmanovic et al. (2013b) propose a new conjoint-based approach to students‘ evaluations of teaching which takes into account the students' preferences.

However, only a few studies have used conjoint analysis within e-learning environment as of yet. Van Der Rhee et al. (2007) used discrete choice analysis (type of conjoint analysis) to understand student preferences for e-learning technologies. They conducted a large-scale survey to determine whether students who are technology ready would place higher utility on enrolling in mixed classes and/or whether there exists a participation bias such that students with low learning-goal orientation place higher utility on enrolling in mixed classes. Pomales-Garcia et al. (2009) evaluated the relative importance of six design dimensions in order to understand how these dimensions are described by two groups of stakeholders—students versus researchers. To determine the predicted rank of the design dimensions based on participant ranking results, they used conjoint analysis. Dağhan and Akkoyunlu (2012) studied learning styles of students receiving education via online learning environments, and used conjoint analysis to determine students' preferences concerning the online learning environment. Sun and Wang (2013) used conjoint analysis to find out how to choose different e-learning tools for different learning tasks for the design and development of online courses in higher education. The findings yield helpful insights on the best practices concerning the utilization of information technology for the enhancement of student learning outcomes in online course design.

We used conjoint analysis in this study to elicit students' preferences towards e-learning environment for several reasons. First, conjoint analysis has the advantage over conventional satisfaction models in that it can be used to identify and quantify the trade-offs that respondents are prepared to make between conflicting attributes. Second, conjoint analysis transforms respondents‘ subjective attitudes towards estimated parameters into the form of utility functions, thereby making it possible to observe the consequences for the overall preference of a change in the level of an attribute. Third, conjoint analysis allows the utility estimation for any combination of attributes, including combinations that may not currently be available. Fourth, conjoint analysis allows segmentation based on respondents' preferences. In other words, conjoint analysis is a micro-based measurement technique, i.e. preferences are measured at the individual level. Hence, if preference heterogeneity is present, the researcher can find it. Another reason why we chose conjoint analysis in this study is its cost-effectiveness. Conjoint analysis does not require a large sample size. The reason is that the analysis results in a set of utilities for each respondent.

3.2. Survey procedure

Conjoint experiments involve respondents being asked to express their preferences for various experimentally designed, real or hypothetical alternatives. These hypothetical alternatives are descriptions of potential real-world alternatives, in terms of their most relevant features or attributes (both quantitative and qualitative); hence, they are multi-attribute alternatives. Conjoint analysis produces two important results (Levy 1995): utility of attributes and importance of attributes. Utility of attribute also known as part-worth utility, is a numerical expression of the value consumers place in an attribute level. It represents the relative —worth” of the attribute. Low utility indicates less value; high utility indicates more value.

Lists of attributes describing single alternatives are called profiles or concepts. Typically, the set of relevant attributes is generated by expert opinions, reviewing the research literature and performing pilot research with techniques such as focus groups. The list of attributes may include an attribute currently not available (new feature), but its introduction is under consideration. Two or more levels are defined for each attribute, and these are then combined to create different profiles (Kuzmanovic et al., 2013a). In order to measure the relative importance of key attributes of the e-learning environment with reference to student‘ preference, this study followed three key phases.

Phase 1: Specifying attributes and levels. Conjoint analysis starts with the identification of relevant product/service attributes that are believed to influence a customer‘s preference. They should include those more relevant to potential customer (student) and those that can be influenced or manipulated by the seller/service provider (university). Then, levels must be assigned to them. These must be plausible, actionable and capable of being traded-off one against another. Typically, the set of relevant attributes is generated by expert opinions, reviewing the research literature and performing pilot research. In this paper

eight key e-learning attributes based on literature review and opinions both of students and faculty members are selected (see section 2). The list of selected attributes and their levels is given in Table 1.

Table 1: Key e-learning attributes and respected levels

Dimension	Attribute	Level
I E-learning technology	Customize environment based on preferences	Yes
		No
	Simplicity	Simple environment, no training necessary
		Environment requires training or previous experience
II Teaching method	Lectures	Recorded lecture with slides and sound
		Classroom live broadcasting
	Interactive work (discussions, assignments, case studies etc)	Yes
		No
	Cooperation with other students	Individual assignments
		Group assignments
	Flexibility for pre-exam assignments (clear deadlines or flexible deadlines)	Yes
		No
	Communication with teacher	Online (e-mail, chat, forums, etc)
		Online and face-to-face
III Knowledge assessment	Method of assessment of knowledge	100% of pre-exam assignments and exam in e-learning environment
		70% of pre-exam assignments in e-learning environment and 30% offline exam
		30% of pre-exam assignments in e-learning environment, and 70% offline exam

Once attributes and their respective levels have been selected, the number of combinations or profiles can be calculated. In this research, the selection would produce 384 profiles (2^8x3). Conjoint studies tend to focus on just those attributes that have the greatest influence. Unfortunately, this rarely reduces the number of profiles to manageable proportions, so it is common to use an ‚orthogonal array', a subset of all possible concepts that will allow estimation of the part-worths based on a ‚main effects'. Thus, the orthogonal array allows the conjoint analysis to be conducted on a considerably reduced number of product combinations while still retaining statistical reliability. To reduce this number of profiles to a manageable level, in this study a component of the statistical package SPSS 16.0 (Orthoplan) was used. Thus the 384 possible profiles were reduced to 16. Two control profiles (holdout tasks) were added to the given design. These 2 profiles were not used by the conjoint procedure for estimating the utilities. Instead, the conjoint procedure calculates correlations between the observed and predicted rank orders for these profiles, as a check of the validity of the utilities.

Phase 2: Choosing a presentation method. ‚Full-profile' and ‚trade-off' are the two methods of attribute combinations most widely associated with conjoint analysis. This study used the full-profile approach. Each profile was presented visually in the form of a card. Respondents were asked to rate each profile on an ordered scale ranging from 1 (‚least preferred') to 5 (‚most preferred').

Phase 3: Model specification and the estimation technique selection. Having collected the information on individual preference, the responses need to be analyzed. In this survey the linear additive model was used as a composition norm and assumed that overall evaluation is made up of the sum of contributions of the attribute levels. The overall additive model for K attributes, each one with L_k levels, is given by Eq. (1)

$$U_{ij} = \sum_{k=1}^{K} \sum_{l=1}^{L_k} \beta_{ikl} x_{jkl} + \varepsilon_{ij}, \qquad i = 1,...,I, \;\; j = 1,...,J, \quad (1)$$

where U_{ij} is student i's evaluation of a given profile j, β_{ikl} is the part-worth (estimated in the conjoint analysis) associated to the l^{th} level of the k^{th} attribute (with k = 1,2,..., K and l = 1,2,..., L_k) and x_{jkl} is the independent variable (x_{jkl} = 0 or x_{jkl} = 1), which indicates the presence of the l^{th} level of the k^{th} attribute in the j^{th} profile. ε_{ij} is a error.

The parameters β_{ikl} (part-worth utilities) are estimated by Ordinary Least Squares regression analysis. These utilities provide a quantitative measure of the preference for each attribute level, with larger values corresponding to greater preference. Part-worths are expressed in a common unit, allowing them to be added together to give the total utility, or overall preference, for any combination of attribute levels. The part-worths then constitute a model for predicting the preference of any product profile, including profiles, referred to as simulation cases, which were not actually presented in the experiment.

4. RESULTS AND DISCCUSION

4.1. Demographics and students' satisfaction

Data were collected online through a web-based questionnaire in April 2014 in Serbia. Besides conjoint analysis questions, the questionnaire included demographic data, but also questions related to the attitudes toward online courses. The aim was to determine both level of students' satisfaction and whether there is a difference in preferences among students of different modes of studying. Respondents were students of University of Belgrade, Faculty of Organizational Sciences. In total 121 students completed the questionnaire. However, three responses (2.47%) were excluded since those respondents filled in the questionnaire in a monotonous pattern (e.g. marking all profiles as 1 or 2). Another three (2.47%) were eliminated due to inconsistent responses. After this exclusion, the number of valid questionnaires was 115 (95.04 %). The sample consisted of 39 (33.9%) male and 76 (66.1%) female participants, aged 21.5 (SD = 1.789) in average. When it comes to mode of studying, 70 (60.9%) respondents study traditionally and 45 (39.1%) of them are online students.

Table 2: Student satisfaction with online courses

		Number of respondents	Mean	Minimum	Maximum
Mode of studying	Traditional	66	3.96	2	5
	Online	45	2.88	1	4
	Total	111	3.54	1	5
Open online courses outside curricula	Coursera	15	4.56	3	5
	edX	4	4.75	4	5
	Other	5	4.60	3	5
	Total	24	4.60	3	5

In total, 111 (96.50%) students attended at least one course via Moodle during their studies (see table 2). Traditional students are more satisfied with this learning platform (average score of 3.96 out of 5), than online students (with average score of 2.88). Looking at the range of scores, it is obvious that none of traditional students gave grade 1 to Moodle, and none of the online students gave it grade 5. There are 21 (18.26%) students who took one or more open online courses outside curricula (24 graded courses). Average grade for these courses is 4.60, meaning that all those courses are graded much higher in comparison to core studies. None of open online courses were graded with 1 or 2.

4.2. Aggregated student preferences

To estimate conjoint parameters we used the statistical package SPSS 16.0 (conjoint procedure). The parameters are estimated individually for each respondent in the sample (individual preferences), as well as for the total sample (aggregated preferences). Table 3 shows both the averaged part-worth utilities for each level of each attribute and importance scores for each of the attributes. Higher part-worth utility values indicate greater preference.

The internal and predictive validity of the model was estimated by Kendall‘s tau statistic, which provides measures of the correlation between the observed and estimated preferences. Kendall‘s tau statistic (0.924) shows that there is a strong correlation between the observed preferences and those estimated by the model, which suggests a high predictive validity of the model. A high value of the Pearson coefficient, 0.988, confirms the high level of significance of the obtained results. The Kendall coefficient for two holdout profiles has a value of 1.000, which is an additional indicator of the high quality of the obtained data.

Table 3 shows that method of assessment of knowledge was found to have the most significant influence on students‘ preferences in e-learning environment with a relative importance of 23.76%. The importance of other attributes is by far lower. Attribute concerning existing opportunities for interactive work is second most important one (14.20%), whereas flexibility for pre-exam assignments was regarded as the least-valued attribute (7.69%). Looking at the most important attribute (knowledge assessment), students prefer the option to do all of pre-exam assignments and final exam in e-learning environment. Students also have positive but lower preferences towards the option to do 70% of pre-exam assignments in e-learning environment. The last attribute level (30% of pre-exam assignments in e-learning environment, and 70% offline exam) has a negative impact on their preferences.

Table 3: Averaged part-worth utilities and importance of e-learning attributes

Attribute	Attribute level	Part-worths	Std. error	Attributes importance
Customize environment based on preferences	Yes	0.105	0.023	9.31%
	No	-0.105	0.023	
Simplicity	Simple environment, no training necessary	0.172	0.023	12.36%
	Environment requires training or previous experience	-0.172	0.023	
Lectures	Recorded lecture with slides and sound	0.057	0.023	13.24%
	Classroom live broadcasting	-0.057	0.023	
Interactive work (discussions, assignments, case studies etc)	Yes	0.240	0.023	14.20%
	No	-0.240	0.023	
Cooperation with other students	Individual assignments	0.004	0.023	9.48%
	Group assignments	-0.004	0.023	
Flexibility for pre-exam assignments (clear deadlines or flexible deadlines)	Yes	0.021	0.023	7.69%
	No	-0.021	0.023	
Communication with teacher	Online (e-mail, chat, forums, etc)	-0.120	0.023	9.96%
	Online and face-to-face	0.120	0.023	
Method of assessment of knowledge	100% of pre-exam assignments and exam in e-learning environment	0.126	0.030	23.76%
	70% of pre-exam assignments in e-learning environment and 30% offline exam	0.022	0.035	
	30% of pre-exam assignments in e-learning environment, and 70% offline exam	-0.148	0.035	
Constant		3.165	0.024	
Correlations between observed and estimated preferences				
		Value	Sig.	
Pearson's R		0.988	0.000	
Kendall's tau		0.924	0.000	
Kendall's tau for 2 Holdouts		1.000	.	

4.3. Segment level student preferences

In order to identify whether there are differences among the preferences of certain students groups, an analysis was conducted for the a priori defined segments as well. The a priori segmentation was carried out on the basis of the mode of studying: traditional vs. online. Averaged and segment level importance of attributes are given in figure 1. Although there is no significant difference in importance score among two segments and aggregate data, there are differences in preferred attribute levels (see table 4).

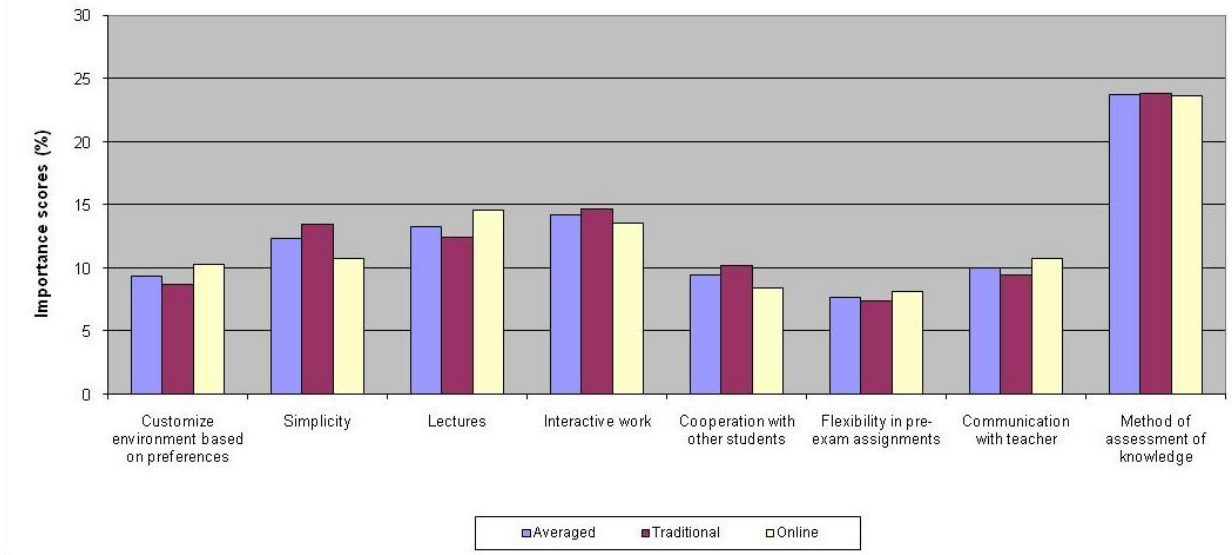

Figure 1: Averaged vs. segment level importance of e-learning attributes

Two segments of students have opposed preferences when it comes to four attributes. Traditional students prefer to listen to recorded lectures with slides and sound, to complete assignments individually, to have flexible deadlines for pre-exam assignments, and to complete the course entirely in e-learning environment. On the other hand, online students want classroom live broadcastings, group assignments, clear deadlines, and as much possible face-to-face tasks. Students have similar preferences towards other four examined e-learning factors.

Table 4: Traditional students‘ vs. online students‘ preferences

Attribute	Attribute level	Part-worths	
		Traditional studying	Online studying
Customize environment based on preferences	Yes	0.101	0.112
	No	-0.101	-0.112
Simplicity	Simple environment, no training necessary	0.203	0.124
	Environment requires training or previous experience	-0.203	-0.124
Lectures	Recorded lecture with slides and sound	0.140	-0.074
	Classroom live broadcasting	-0.140	0.074
Interactive work (discussions, assignments, case studies etc)	Yes	0.251	0.224
	No	-0.251	-0.224
Cooperation with other students	Individual assignments	0.019	-0.018
	Group assignments	-0.019	0.018
Flexibility for pre-exam assignments (clear deadlines or flexible deadlines)	Yes	0.056	-0.035
	No	-0.056	0.035
Communication with teacher	Online (e-mail, chat, forums, etc)	-0.103	-0.146
	Online and face-to-face	0.103	0.146
Method of assessment of knowledge	100% of pre-exam assignments and exam in e-learning environment	0.263	-0.087
	70% of pre-exam assignments in e-learning environment and 30% offline exam	0.013	0.035
	30% of pre-exam assignments in e-learning environment, and 70% offline exam	-0.276	0.052

5. CONCLUSIONS AND FURTHER RESEARCH

The findings in this study represent first empirical insights that examine the preferences of students towards e-learning environment using conjoint analysis in Serbia. Three dimensions of interest were considered in this study: e-learning technology, teaching method and knowledge assessment. The last one was determined to be the most important one for both traditional and online students. At the same time, two groups of students have opposed preferences towards four attributes regarding teaching method and knowledge assessment. E-learning technology produced homogenous preferences. It seems that both groups strive to features of alternative way of studying. The results of our study reveal information that may be useful in directing future research in key factors essential to the adoption and effective implementation of e-learning environment, and provide a guideline for university policy makers in redesigning online mode of studying.

REFERENCES

Bouhnik, D., & Marcus, T. (2006). Interaction in distance-learning courses. Journal of the American Society for Information Science and Technology, 57, 299–305. doi: 10.1002/asi.20277.

Cavanaugh, C., Gillan, J.K., Kromrey, J., Hess, M., & Blomeyer, R. (2004). The effects of distance education on K–12 student outcomes: A metaanalysis. Naperville, IL: Learning Point Associates.

Dağhan, G., & Akkoyunlu, B. (2012). An examination through conjoint analysis of the preferences of students concerning online learning environments according to their learning styles. International Education Sciences, 5(4), 122-138. doi: 10.5539/ies.v5n4p122.

Damnjanovic, V., Jednak, S., & Mijatovic, I. (2013). Factors affecting the effectiveness and use of Moodle: students' perception. Interactive Learning Environments, 1-19.

Drennan, J., Kennedy, J., & Pisarski, A. (2005). Factors affecting student attitudes toward flexible online learning in management education. Journal of Educational Research, 98(6), 331-338.

Ferguson, J.M., & DeFelice, A.E. (2010). Length of online course and student satisfaction, perceived learning, and academic performance. International Review of Research in Open and Distance Learning, 11(2), 73-84.

Green, P.E., & Rao, V.R. (1971). Conjoint measurement for quantifying judgmental data. Journal of Marketing Research, 8, 355-363.

Hensher, D. (2001). The valuation of computer travel time savings for car drivers: Evaluating alternative model specifications. Transportation, 28, 101-118.

Horvat, A., Dobrota, M., Krsmanovic, M., & Cudanov, M. (2014). Student perception of Moodle learning management system: A satisfaction and significance analysis. Interactive Learning Environments, (ahead-of-print), 1-13.

Hur, J.S., & Pak, R.J. (2007). Conjoint analysis for the preferred subjects of elementary school computer education. Journal of the Korean Data and Information Science Society, 18(2), 357-364.

Jung, I,. Choi, S,. Lim, C., & Leem, J. (2002). Effects of different types of interaction on learning achievement, satisfaction and participation in web-based instruction. Innovations in Education & Teaching International, 39(2), 153-62.

Katz, Y.J. (2002), Attitudes affecting college students' preferences for distance learning. Journal of Computer Assisted Learning, 18, 2–9. doi: 10.1046/j.0266-4909.2001.00202.x.
Kim, C., Choe, S., Choi, C., & Park, Y. (2008). A systematic approach to new mobile service creation. Expert Systems with Applications, 35, 762–771.
Kuzmanović, M., Popović, M., & Savić, G. (2012). Using conjoint analysis to elicit students' preferences towards various aspects of university teaching, Proceedings of International Conference on Information Technology and Development of Education - ITRO 2012, Zrenjanin, Serbia, 21-26, ISBN: 978-86-7672-167-2.
Kuzmanovic, M., Radosavljević, M., Vujošević, M. (2013a). Understanding student preferences for postpaid mobile services using conjoint analysis. Acta Polytechnica Hungarica, 10(1), 159-176.
Kuzmanovic M., Savic G., Popovic M., Martic M. (2013b). A new approach to evaluation of university teaching considering heterogeneity of students' preferences. Higher Education 66(2), 153-171. doi: 10.1007/s10734-012-9596-2.
Levy, D.S. (1995). Modern marketing research techniques and the property professional. Property Management, 13, 33-40.
Luce, R.D., & Tukey J.W. (1964). Simultaneous conjoint measurement: A new type of fundamental measurement. Journal of Mathematical Psychology, 1, 1-27.
Malik, M. (2009). Student satisfaction towards e-learning: Influential role of key factors, Proceedings 2nd CBRC, Lahore, Pakistan.
Matsatsinis, N., Grigoroudis, E., Delias, P. (2003). User satisfaction and e-learning systems: towards a multi-criteria evaluation methodology, Operational Research. An International Journal, 3(3), 249-259.
Mijatovic, I., Cudanov, M., Jednak, S., & Kadijevich, D.M. (2013). How the usage of learning management systems influences student achievement. Teaching in Higher Education, 18(5), 506-517. doi:10.1080/13562517.2012.753049.
Mosca, J.B., Ball, D.R., Buzza, J.S., & Paul, D.P. (2010). A Comprehensive student-based analysis of hybrid courses: Student preferences and design criteria for success, Journal of Business & Economics Research, 8(5), 7-21.
Nummenmaa, M., & Nummenmaa, L. (2008). University students' emotions, interest and activities in a web-based learning environment. British Journal of Educational Psychology, 78, 163-178. doi: 10.1348/000709907X203733.
Oncu, S., & Cakir, H. (2011). Research in online learning environments: Priorities and methodologies, Computers & Education, 57, 1098-1108.
Pomales-Garcia, C., Yili, L., & Lopez, A.D. (2009). Student perceptions on the importance of distance learning module design dimensions, Frontiers in Education Conference, 2009, FIE '09, 39th IEEE, 1-5. doi: 10.1109/FIE.2009.5350864.
Popović M., Kuzmanović M., & Martić, M. (2012). Using conjoint analysis to elicit employers‘ preferences toward key competencies for a business manager position. Management – Journal for Theory and Practice Management, 17(63), 17-26, doi: 10.7595/management.fon.2012.0011.
Roberts, R.M. (2010). The digital generation and web 2.0: E-learning concern or media myth? In Handbook of research on practices and outcomes in e-learning: Issues and trends, 93-115, Hershey PA: IGI Global.
Rosenberg, M. (2001). E-learning: Strategies for delivering knowledge in the digital age, NY:McGraw-Hill.
Sohn, S.Y., & Ju, Y.H. (2010). Conjoint analysis for recruiting high quality students for college education. Expert Systems with Applications, 37, 3777–3783.
Soutar, G.N., & Turner, J.P. (2002). Students‘ preferences for college: A conjoint analysis. International Journal of Educational Management, 16(1), 40–45.
Stein, D. (2004). Student satisfaction depends on course structure, Online Cl@ssroom, 4-5.
Sun J. & Wang Y. (2013). Tool choice for e-learning: Task-technology fit through media synchronicity, 2013 Proceedings of the Information Systems Educators Conference, ISSN: 2167-1435 San Antonio, Texas, USA.
Tutty, J.I., & Martin, F. (2009). User generated design: Teaching and learning with web 2.0. In T.T. Kidd, & I.L. Chen, Wired for learning: An educator‘s guide to web 2.0, 43-58. Information Age Publishing.
Van Der Rhee, B., Verma, R., Plaschka, G.R., & Kickul, J.R. (2007), Technology readiness, learning goals, and elearning: Searching for synergy. Decision Sciences Journal of Innovative Education, 5, 127-149, doi: 10.1111/j.1540-4609.2007.00130.x.
Won, D., & Bravo, G. (2009). Course design in sport management education: Addressing students‘ perspectives through conjoint methodology, Journal of Hospitality, Leisure, Sport & Tourism Education, 8(2), 83-96.
Yu, C., Yu, W.C. W., & Lin, C.F. (2010). Computer-mediated learning: What have we experienced and where do we go next? In Yang, H.H., & Yuen, S.C.Y. Handbook of research on practices and outcomes in e-learning: Issues and trends, 1-19, Hershey PA: IGI Global.

IDENTIFYING POTENTIALS OF INFORMAL E-LEARNING 2.0

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Abstract: *The use of Web 2.0 tools has become common nowadays. The research was conducted in order to investigate to what extent students use web 2.0 tools and its applications in their everyday life, for learning or for entertainment, trough informal process. The results show that the use of Web 2.0 tools for learning and/or entertainment among students of Faculty of organizational sciences is widely spread (in more than 90% cases) and that students use tools 2.0 for entertainment more that for learning. With that conclusion we should take into consideration that their habits in using those tools should be considered and integrated in formal learning processes.*

Keywords*: Web 2.0 tools, e-learning 2.0, informal learning*

1. INTRODUCTION

Contemporary learning and education implies the use of Internet and modern technologies. Web 2.0 (O'Reilly, 2005) represents the second generation of the Web (World Wide Web), in which the users are able to actively participate in the creation of content and where two-way communication between the users, cooperation and exchange of information is applied (Yang & Yuen, 2010). Web 2.0 is otherwise often referred to as the 'social web' (Boulos & Wheeler, 2007) or the 'read/write web' (Hemmi, Bayne, & Land, 2009), which refers to a range of software applications that have been variously described as 'dynamic', 'interactive', 'democratic', 'people centric', 'volatile', 'social' and 'adaptive' (Brown, 2012). In the broadest sense it is possible to state that e-learning is every learning mediated by technology. E-learning, which is implemented using Web 2.0 applications, is called e-learning 2.0 (Downes, 2005). The most common tools used for e-learning 2.0 are: Blogs, Wiki-based sites, Shared media, social networks, social groups, bookmarking and others. In this paper the e-learning 2.0 as a form of informal learning will be analyzed.

From the educational perspective learning could be formal, non-formal and informal, depending on where purposeful learning activity took place (Rubenson, 2011; Anđelković Labrović, Bijelić, & Milosavljević, 2014). Informal learning is learning resulting from daily life activities related to work, family or leisure. It is not structured (in terms of learning objectives, learning time, or learning support) and typically does not lead to certification. It may be intentional, but in most cases it is unintentional, incidental or random (Rubenson, 2011). In relation to the definition as represented in authors' experience in working with students, it appears that whether they are learning retaliated to their modules or anything else that they are interested in many of their learning activities are more similar to informal learning.

Authors believe that a lot of non-formal and informal learning activities are already incorporated in the way of students learning. So we wanted to identify how students informally learn using Web 2.0 tools and applications. The main hypothesis on which it rests is that students use various tools 2.0 in their daily lives and it is important to determine to what extent they are used for learning and how much for entertainment, especially since we cannot claim that thought entertainment informal learning doesn't happen as well.

2. LITERATURE REVIEW

Clark et al. (2009) explored how adolescents use Web 2.0 technologies for formal and informal learning. Students have identified 30 different Web 2.0 sites including the popular MSN (88%), followed by Bebo (67%) and Facebook (59%). All tools are used for various activities during lessons, in their free time as well as to support school activities, except that Bebo is not used for school activities. In fact 45% of students use Web 2.0 technologies to work in schools while 100% of them to work outside of school. 82% of students use social networking sites. Most of the students focused on the free time, entertainment and social networking activities while only 41% of students directly mention schoolwork, homework or research. For school-related activities most mentioned Microsoft Office (52%) and Internet sites such as Google (27%) and Wikipedia (6%) used for research and support for school work (Clark, Logan, Luckin, Mee, & Oliver, 2009). This study showed that Web 2.0 technologies not used to its full potential and that for students to use Web 2.0 technology as a tool for formal learning additional training need to be provided. Similarly, Cigognini et al.

(2011) concluded that students need support, guidance and educational interventions to make the best possible way using social media to support learning objectives (Cigognini, Pettenati, & Edirisingha, 2011).

Hemi et al. (2009) investigated the use of Web 2.0 and social technologies for teaching and learning within the formal educational process of higher education in the three modules, two at the undergraduate and one online graduate studies. In one module a wiki is uses to support teaching and learning, while in the second, blog is used in order to increase participation in discussions in class. At the online postgraduate studies used a wide range of technologies of social media including Facebook, Delicious, blogs, wikis and Second Life (virtual world) to support a variety of learning activities. The results showed that social media caused the pedagogical shift to more common forms of testing, and that their use puts more emphasis on the importance of self-regulation group (Dabbagh & Kitsantas, 2012; Hemmi, Bayne, & Land, 2009).

Vaughan et al. (2011) conducted a research on how students use Web 2.0 technologies to support group work outside of class time. The research results showed that students rather participate in activities that they know that will be assessed by the teacher and that are part of their formal learning process. As opposed to informal learning where researchers were surprised by relatively small number of students that use Blogs, Wikis and other Web 2.0 applications for group work outside of class (Vaughan, Nickle, Silovs, & Zimmer, 2011).

Huang et al. (2013) investigated the role of computer anxiety in influencing female college students' perceptions toward Web 2.0 applications for learning. The research revealed certain significant differences between genders on six Web 2.0 applications (blog, wiki, social networking tool, online video sharing tool, online game and immersive video environment). Overall they have concluded that females felt more anxious while using Web 2.0 applications than males, except for using social networking tools and online video sharing tools (Huang, Hood, & Yoo, 2013).

3. RESEARCH

The research was conducted in order to explain that students use Web 2.0 in their everyday life, for learning or for entertainment, in informal process. Main research objectives were to test students' knowledge of Web 2.0 tools and to identify the extent, to which students informally use Web 2.0 tools to learn and in which they use them for entertainment.

Main research questions are:

- Which Web 2.0 tools are most commonly used among college students for learning?
- Which Web 2.0 tools are most commonly used among college students for entertainment?
- Is there a significant difference in using Web 2.0 tools for learning in relation to the use of Web 2.0 tools for entertainment?

3.1. Overview of participants

The participants were students of the Faculty of Organizational Sciences (FOS), in all fields of study (management and Information systems and technologies) and of all years of study (1-4). Completing the questionnaire was anonymous, and students were informed that the results will be used strictly for research purposes. There were 402 valid questionnaires collected, out of which there were 93 first-year students, 100 second-year students, 94 third year students, 113 fourth year students and 2 graduate students. In further considerations to take into account students of all years except graduate level accounting for a sample of 400 respondents. Analysis of available data was performed using SPSS statistical software version 17.0.

The sample of 400 students is represented by 159 students of men, which was (39.8%) and 241 women (60.3%). Distribution by year of study in relation to gender is shown in the following table (Table 1).

Table 1: Distribution of respondents by year of study in relation to gender

		Gender		
		Male	Female	Total
Year of study	First	40	53	93
	Second	34	66	100
	Third	35	59	94
	Forth	50	63	113
Total		159	241	400

3.2. Research Method

Survey is used to test knowledge of Web 2.0 tools and to analyze how students use these tools for learning and/or entertainment. Analysis of the results of respondents' answers to all research questions was done by groups of tools in relation to their application (for entertainment and/or for learning). Web 2.0 tools and applications were presented in a survey trough following eleven groups of tools: blogs, wikis, shared media, shared workspaces, social networks and micro-blogging, social groups, bookmarking, tagging, web search engines, web aggregators and forums. The 5-point scale was used (never, ones a month, ones a week, few times per week, everyday) to show the frequency of using certain Web 2.0 tools.

To check the reliability of questionnaire the Cronbach's alpha coefficient was used as indicator of internal consistency. Internal reliability is assumed for correlation coefficients greater than 0.7 (Cronbach, 1951) Checking was done for the eleven groups of tools which can be used for entertainment, and eleven groups of tools which can be used for studying (N = 22). Calculated Cronbach's alpha coefficient had a value of 0.839. For data analysis descriptive statistics were used: frequency count to identify percentages in using Web 2.0 tools for learning and/or entertainment and Wilcoxon Signed Ranks Test was used to test potential differences between using Web 2.0 tool for learning and for entertainment.

3.3. Results

Using frequency of certain Web 2.0 tools for learning is observed and the results are presented in the table below (Table 2). Mostly used as a learning tool are Web Search Engines with 97.5%. 69.5% of students are using Web Search Engines every day what could also be connected to the results of daily use of bookmarking of 33.2 %. Then, the students in a very high percentage use forums (93.5%) out of which 77.6% use them on a weekly basis. Likewise, wiki tools are very highly ranked with 92.4% (65.4% on a weekly basis). It is assumed that such a large percentage of using wiki tools exists because most students use Wikipedia. It is particularly interesting to point out that if you ignore the dynamics of the use of certain tools (in the sense that it is used once a month, once a week, several times a week or daily) students use most of the tools in more than 50% of cases when learning is concerned (see details in table 2 row *USES* (2+3+4+5)). It is interesting to point out that most of the students did not use tagging (70.9%) and web aggregators (65%) for learning purposes. A significant number of students pleaded that 47.6% of them have never used blogs to study. Regarding tagging and aggregation it is assumed that the reason for low use could be precisely in the lack of knowledge about how these tools can be used as a learning means, as for the blogs is assumed that the reason could be seen purely as a student's preference for a certain tool. Also, often happens that students do not differentiate Web sites that are blogs from other type of web sites.

Frequency of use of Web 2.0 tools for entertainment is presented in the table below (Table 3). Regarding the group of tools that are used the least a situation is very similar as for the tools that are not used by the students for learning. As in previous case aggregation with 67% and tagging with 54.6% is pointed out. In the domain of using Web 2.0 tools for entertainment purposes Shared work spaces appeared as a group of tools that is not used in 53.5% of cases. Among the tools that are used primarily for entertainment Shared media tools stand out with 96.6%. 95.1% of them are used on a weekly basis, while 76.3% of them every day. The following are Web search engines (96.4%), as was the case among the tools for learning. High position among the tools used for entertainment, as opposed to learning, occupy Social networking and micro-blogging services with 90.2%, of which 87.1% is at weekly level and 69.2% is used on daily basis. It should be noted that most of the tools are used in over 60% of cases for entertainment.

Looking at all groups of Web 2.0 tools that students use for learning and/or entertainment it should be noted that there is no group of tools that is not used at all. Over 90% of students use wikis, shared media, social networking tools, search engines and forums. It is these results that demonstrate that students use above mentioned tools 2.0 on their own initiative in accordance with their wishes, knowledge and potentials. The presented results can be interpreted as another indicator that points to an existing habit for the use of particular tools 2.0 for learning outside the formal learning context, as well as the need for their use for learning at universities (educational institutions).

Table 2: The use of Web 2.0 tools for learning

Frequency of using Web 2.0 tools for learning												
		Blogs (%)	**Wikis (%)**	**Shared media (%)**	**Shared workspaces (%)**	**Social networks and micro-blogging (%)**	**Social groups (%)**	**Bookmarking (%)**	**Tagging (%)**	**Web Search Engines (%)**	**Web aggregators (%)**	**Forums (%)**
1	Never	47.6	7.6	19.0	41.1	38.0	46.1	21.1	70.9	2.5	65.0	6.5
2	Ones a month	27.5	27.0	23.5	23.7	11.7	14.8	18.5	12.7	2.5	17.1	15.8
3	Ones a week	14.8	28.2	17.5	15.4	12.2	16.9	11.9	8.1	7.4	9.0	20.6
4	Few times per week	8.7	28.5	13.0	13.4	13.8	10.4	15.2	3.9	18.0	4.9	29.9
5	Everyday	1.5	8.7	27.0	6.4	24.2	11.7	33.2	4.4	69.5	4.1	27.1
TOTAL		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Uses (2+3+4+5)		52.4	92.4	81.0	58.9	62.0	53.9	78.9	29.1	97.5	35.0	93.5
Uses (3+4+5)		24.9	65.4	57.4	35.2	50.3	39.1	60.4	16.4	94.9	17.9	77.6

Table 3: The use of Web 2.0 tools for entertainment

Frequency of using Web 2.0 tools for entertainment												
		Blogs (%)	**Wikis (%)**	**Shared media (%)**	**Shared workspaces (%)**	**Social networks and micro-blogging (%)**	**Social groups (%)**	**Bookmarking (%)**	**Tagging (%)**	**Web Search Engines (%)**	**Web aggregators (%)**	**Forums (%)**
1	Never	37.7	18.6	3.4	53.5	9.8	35.1	17.8	54.6	3.6	67.0	18.1
2	Ones a month	22.9	26.8	1.5	20.4	3.0	11.3	10.9	17.7	1.5	13.2	20.7
3	Ones a week	17.4	18.9	2.8	11.0	5.3	17.0	12.9	10.8	3.1	9.9	16.1
4	Few times per week	15.1	24.9	16.0	6.5	12.6	15.2	17.0	8.7	9.4	4.7	19.1
5	Everyday	7.0	10.8	76.3	8.6	69.2	21.4	41.4	8.2	82.4	5.2	26.0
TOTAL		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Uses (2+3+4+5)		62.3	81.4	96.6	46.5	90.2	64.9	82.2	45.4	96.4	33.0	81.9
Uses (3+4+5)		39.5	54.6	95.1	26.1	87.1	53.6	71.3	27.7	94.9	19.7	61.2

Based on statistical analysis using Wilcoxon Signed Ranks Test (Table 4) it could be concluded that there is a significant difference in the use of Web 2.0 for learning and for entertainment in all groups of tools except Web aggregators (Z has values ranking from -3.476 to -12.673, $p<0.001$. These results for Web aggregators can be additionally explained because in most cases students do not use aggregator neither for learning nor entertainment (look at table 2 and table 3). Analyzing the other groups of tools 2.0 it is obvious that students are using Wikis, Shared workspaces and Forums more for learning and Blogs, Shared media, Social networks and micro-blogging, Social groups, Bookmarking, Tagging and Web Search Engines for entertainment. With these results, we can emphases once more that students use Web 2.0 tools for entertainment more than for learning (Table 4).

Table 4: Comparative overview of the frequency use of Web 2.0 tools for learning and entertainment

Using frequency		Year of study 1+2+3+4	
		Z	p
Blogs	Entertainment - Learning	-6.667[b]	0.000
Wikis	Entertainment - Learning	-3.476[c]	0.001
Shared media	Entertainment - Learning	-13.166[b]	0.000
Shared workspaces	Entertainment - Learning	-4.245[c]	0.000
Social networks and micro-blogging	Entertainment - Learning	-12.673[b]	0.000
Social groups	Entertainment - Learning	-6.664[b]	0.000
Bookmarking	Entertainment - Learning	-5.340[b]	0.000
Tagging	Entertainment - Learning	-7.186[b]	0.000
Web Search Engines	Entertainment - Learning	-3.913[b]	0.000
Web aggregators	Entertainment - Learning	-.788[b]	0.431
Forums	Entertainment - Learning	-5.815[c]	0.000

b. Based on negative ranks.

c. Based on positive ranks

4. CONCLUSION

Looking at the research results it could be concluded that students use all groups of Web 2.0 tools for learning or for entertainment. Over 90% of students use wikis, shared media, social networking tools, search engines and forums.

Web Search Engines with 97.5% are mostly used for learning, and after that, students use forums (93.5%) and wiki tools (92.4%) in a very high percentage. For entertainment, Shared media tools stand out with 96.6%. The subsequent are Web search engines with 96.4% and Social networking and micro-blogging services with 90.2%.

It is these results that demonstrate that students use above mentioned tools 2.0 on their own initiative in accordance with their wishes, knowledge and potentials. Also it was shown that students use Web 2.0 tools for entertainment more than for learning with what has been proven that these results are precisely indicators that their habits for the use of these tools 2.0 should be considered as pattern for designing formal learning processes within educational systems.

REFERENCES

Anđelković Labrović, J., Bijelić, A., & Milosavljević, G. (2014). Mapping students' informal learning using personal learning environment . Management , in-press.

Boulos, M., & Wheeler, S. (2007). The emerging Web 2.0 social software: an enabling suite of sociable technologies in health and health care education. Information and Libraries Journa Health , 24 (1), 2-23.

Brown, S. A. (2012). Seeing Web 2.0 in context: A study of academic perceptions. Internet and Higher Education , 15 (1), 50-57.

Cigognini, M. E., Pettenati, M. C., & Edirisingha, P. (2011). Personal Knowledge Management Skills in Web 2.0-Based Learning. In M. J. Lee, & C. McLoughlin, Web 2.0-Based E-Learning: Applying Social Informatics for Tertiary Teaching (pp. 109-127). Hershey: IGI Global.

Clark, W., Logan, K., Luckin, R., Mee, A., & Oliver, M. (2009). Beyond Web 2.0: mapping the technology landscapes of young learners. Journal of Computer Assisted Learning , 25 (1), 56-69.

Cronbach, L. J. (1951). Coefficient Alpha and the Internal Structure of the Tests. Psychometrics , 16, 297-334.

Dabbagh, N., & Kitsantas, A. (2012). Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. The Internet and Higher Education , 15 (1), 3-8.

Downes, S. (2005). eLearn Magazine , 2005 (10).

Hemmi, A., Bayne, S., & Land, R. (2009). The appropriation and repurposing of social technologies in higher education. Journal of Computer Assisted Learning , 25, 19–30.

Huang, W.-H. D., Hood, D. W., & Yoo, S. J. (2013). Gender divide and acceptance of collaborative Web 2.0 applications for learning in higher education. Internet and Higher Education , 16 (1), 57-65.

O'Reilly, T. (2005, September 30). O'Reilly Spreading Knowledge of innovators. Retrieved December 1, 2011, from O'Reilly Spreading Knowledge of innovators: http://oreilly.com/pub/a/web2/archive/what-is-web-20.html?page=1

Rubenson, K. (2011). Adult Learning and Education. Kidlington: Elsevier.

Vaughan, N., Nickle, T., Silovs, J., & Zimmer, J. (2011). Moving to their own beat: exploring how students use web 2.0 technologies to support group work outside of class time. Journal of Interactive Online Learning , 10 (3), 113-127.

Yang, H. H., & Yuen, S. C.-Y. (2010). Handbook of research on practices and outcomes in e-learning: Issues and trends. New York.

"FRESHMAN" TO "POSTGRAD" CHALLENGE: DIFFERENCES IN COLLEGE EXPERIENCES, SATISFACTION AND LIFESTYLES AMONG STUDENTS OF FOS

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Abstract: *This paper investigates the differences in GPA, funding status, alcohol consumption, sport involvement, college experience satisfaction and overall life satisfaction among first, second, third, fourth and postgraduate college students. Research was conducted in the summer semester of 2013 and data was gathered using a questionnaire with the sample of 507 students from the Faculty of Organizational Sciences, including both student courses. The results show that GPA level is higher in fourth-year and postgraduate students groups. Secondly, second-year students displayed far less involvement in sports, while the fourth-year ISAT students displayed significantly lower satisfaction with their college experience than any other group. 85% of students consume alcohol, which is a similar percentage when compared to students from Harvard Business School. Finally, about 80% of students assessed their overall life satisfaction as high and very high, and no significant differences were found between students from different year of study.*
Keywords*: College experience satisfaction, year of study, overall life satisfaction, academic performance, sport involvement, alcohol consumption*

1. INTRODUCTION

Academic predictors such as behavioral experience (behavior at college, grades in college) and social experience (perception of college climate) are the main components of students` college experience and satisfaction (Suld, Shaffer, & Riley, 2008). Higher education is associated with life benefits that students may have, but also with the life satisfaction that occurs as a result of factors such as job security, (household income), health, mental health, happiness, and other results that appear as an output related to educational achievement (Salazar, 2013). Individuals with higher educational level tend to have more developed social networks and contact with the world, which implies an increase in happiness and life satisfaction (Chen, 2011).

In the literature, differences among college students population are usually inspected from demographic aspect, such as gender, race, country of origin, or different psychosocial variables such as life satisfaction or various personality traits. For example, one study from the USA proves that college major choice varies substantially by gender, race, and ethnicity among college graduates and it investigates whether these differences are present at the start of the college career (Dickson, 2010). Another study discusses the influence of personality traits such as the Big Five and the narrow personality traits on certain areas of college experience (Lounsbury, Fisher, Levy, & Welsh, 2009). Similar study also focuses on the relation between emotional intelligence and a number of 'life skills' (academic achievement, life satisfaction, anxiety, problem-solving and coping). Other studies are also focused on differences between students coming from different countries and cultural background in various fields, such as in motivation to study abroad (Salisbury, Paulsen, & Pascarella, 2010) or social network usage (Kim, Sohn, & Choi, 2011).

The decisions that students make in this period of life are very important and have a vast impact on their maturity process and future. The period of emerging adulthood (young people aged 18 to 25 years) is characterized by big transitional changes (like completion of high school, enrollment to university and first employment), which represent a relatively acute stressors and have large impact on their well-being (Gall, Evans, & Bellerose, 2000). Furthermore, Stone et al. suggests that in this particular period of emerging adulthood, people`s wellbeing appear to be the lowest when compared to any other period in the life span (Stone, Schwartz, Broderick, & Deaton, 2010).

Further analysis of literature leads to the conclusion that there are evident distinctions among population of college students, but only few studies are oriented on discovering the differences between students from different year of study (YOS).This also represents the aim of this paper- to discover and analyze the differences between students by grouping them according to YOS in order to get more information about the changes during students' life span. One of the few study using similar approach is the one conducted by Kjeldstadli et al. (2006) which indicates that medical college students from first-year were as satisfied as

students from other universities, but reported less satisfaction in their graduation year. Put in other words, it appears that life satisfaction of students seems to decrease with the increase of years spent in medical school.

Additionally, students who have a positive college experience are more likely to be satisfied with the college or university than students who do not have a positive college experience (DeShields, Kara, & Kaynak, 2005). Therefore the second aim of this study is to provide information for colleges and universities (in this case- Faculty of Organizational Sciences) about the changes in students experience, satisfaction and habits over time, in order to align their organizational structure, processes and procedures to students and to become more customer-oriented. This type of information could enable the educational institutions to establish and to maintain competitive advantage on the higher education marketplace, as well.

The initial hypothesis of this paper is formed on the statement that college students during their studies cope with different challenges that influence their experience and lifestyle, and that it is possible to identify different trends in student's behavior during their college life span. The value of this paper is that it provides the insight about the changes and influences of college experiences on habits, grades, lifestyle and satisfaction of students from different YOS. It could prove particularly useful for educational and organizational staff of FOS, as well as students and other parties with the research focus in the given area.

2. RESEARCH DESIGN AND PROCEDURE

Research was conducted in the period from March to July 2013, during the summer semester with the sample of 507 students from Faculty of Organizational Sciences (FOS). Sample consists of students enrolled to both undergraduate and postgraduate studies, from all 3 study programs (Management, Information Systems and Technology (ISAT) and Information System and Technology- distance learning program although this particular e-learning group has negligible effect because it constitutes for only 2,6% of the respondents). Having in mind that FOS has about 4200 enrolled students in total, sample size of 507 students, can provide adequate information about the observed population.

Original survey was conducted for the purpose of determining relation between 6 life satisfactions components and academic performance, sports involvement and demographic and behavioral characteristics. Data is collected using questionnaire with 31 questions that was published both in paper and online form. Majority of respondents provided their answers through the online survey form which can be found on https://docs.google.com/forms/d/1XDKTVpW8eF6JlBTeT6sWlqStu4ce-EceP1wsWUXR99I/edit?usp=drive_web, in Serbian language, native language of respondents. For the purpose of this particular study, information about student's current grade point average (GPA), funding status, sports involvement, alcohol consumption, college experiences satisfaction and overall life satisfaction are taken from this database and analyzed. College life satisfaction and overall life satisfaction have been measured as integral part of Brief Multi-Dimensional Students' Life Satisfaction Scale (BMSLSS) developed by Züllig et al. (2009). Information about the characteristics of the students involved in the survey is given in the following table:

Table 1: Sample characteristics

Characteristics	N (%)
Year of study	
First	121 (23, 9%)
Second	90 (17, 8%)
Third	127 (25, 0%)
Fourth	117 (23, 1%)
Post-graduate (Masters and PHD studies)	52 (10, 3%)
Sex	
Male	213 (42, 0%)
Female	294 (58, 0%)
Core curriculum	
Management	350 (69, 0%)
Information systems and technologies (ISAT)	144 (28, 4%)
Information systems and technologies- distance learning	13 (2, 6%)
Status	
State scholarship	342 (67, 5%)
Self-financing	165 (32, 5%)

Afterwards, students are categorized according to their year of study into 5 groups- first-year students, second-year students, third-year students, fourth-year students and postgraduate students (includes Masters and PHD students at FOS). Cross sectional analysis is the method used for obtaining the results about the differences among given students groups. Beside Table 1 that contains descriptive statistics and graphical presentations (Figures 1 to 6), Kruskal Wallis nonparametric test is applied to determine if statistically significant differences exist among students from different YOS, using software IBM SPSS Statistics 22. Year of study is the grouping variable (5 groups), while test variables[1] are:

a) Student`s current GPA[2] (4 groups: 1) 6-6.99 2)7-7.99 3) 8-8.99 4) 9-10),
b) Student`s status (2 groups: 1) state scholarship or 2) self-financing),
c) Sport`s involvement (2 groups: 1)yes or 2)no),
d) Alcohol consumption (4 groups : 1) not at all 2) low 3) medium 4) high)
e) College experiences satisfaction (5 groups: 1)very dissatisfied 2) dissatisfied 3)moderately satisfied 4)satisfied 5)very satisfied)
f) Overall life satisfaction (5 groups same as college experiences satisfaction variable)

3. RESULTS

Firstly, the output from IBM SPSS Statistics 22 with the respective values of Kruskal Wallis test statistics is given in the following table:

Table 2: Test Statistics [a,b]:

	Status	GPA	Alcohol consumption	Sport involvement	College experiences satisfaction	Overall life style satisfaction
Chi-Square	36.129	18.806	8.838	12.063	4.314	5.035
df	4	4	4	4	4	4
Asymp. Sig.	.000	.001	.065	.017	.365	.284

a. Kruskal Wallis Test; b. Grouping Variable: Year of study

Secondly, diagrams and tables for every 6 variables (parameters) analyzed, are presented, alongside with brief explanation.

First parameter we analyzed was the grade point average (GPA). Comparing the GPA level throughout the students from different YOS, we found that the highest GPA (in average) is noted within the postgraduate group of students (Master and PhD study program) with 8.73 out of 10. We also noticed a difference between fourth year students compared to the students attending the first three years of Faculty of Organizational Sciences – 8.47 compared to 8.28-8.30.

Table 3: GPA

Year of study/GPA	*6-7*	*7-8*	*8-9*	*9-10*	*Total Responses*	*Average Grade*
First	**3**	**24**	**49**	**25**	**101**	**8.28**
Second	**1**	**29**	**39**	**16**	**85**	**8.3**
Third	**1**	**47**	**52**	**27**	**127**	**8.28**
Fourth	**1**	**35**	**50**	**29**	**115**	**8.47**
Postgraduate		**5**	**29**	**18**	**52**	**8.73**
Total Responses	**6**	**140**	**219**	**115**	**480**	**8.36**

[2] 37 respondents did not entered correct value of GPA and are excluded from respective analysis

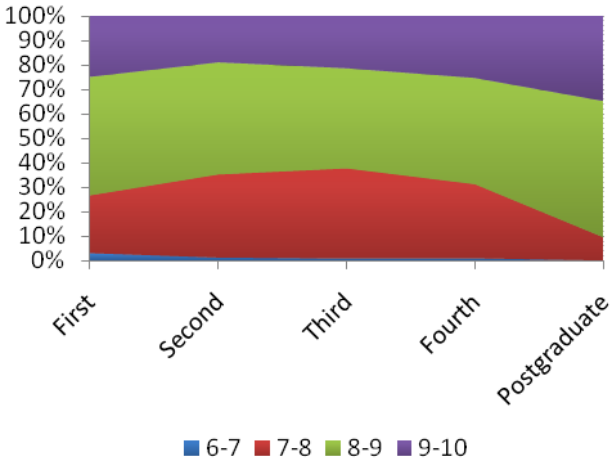

Figure 1: Grade point average (GPA)

Data in the table 3 show student status cross-referenced with the year of study of students. The difference between some of the years was to be expected considering the fact that number of awarded state scholarships increases for 20% in every advancing year of study (with the exception of postgraduate students). It means that for example, second-year students are awarded with 20% more scholarship than first-year students and 20% less than third-year students. This is the actual reason for detected statistically significant difference.

Table 4: Student`s status

Year of study/Status	*State scholarship*	*Self-financing*	*Total Responses*	*Percent of students with scholarships*
First	**59**	**62**	**121**	**48.8%**
Second	**66**	**24**	**90**	**73.3%**
Third	**98**	**29**	**127**	**77.2%**
Forth	**91**	**26**	**117**	**77.8%**
Postgraduate	**28**	**24**	**52**	**53.8%**
Total Responses	**342**	**165**	**507**	**67.4%**

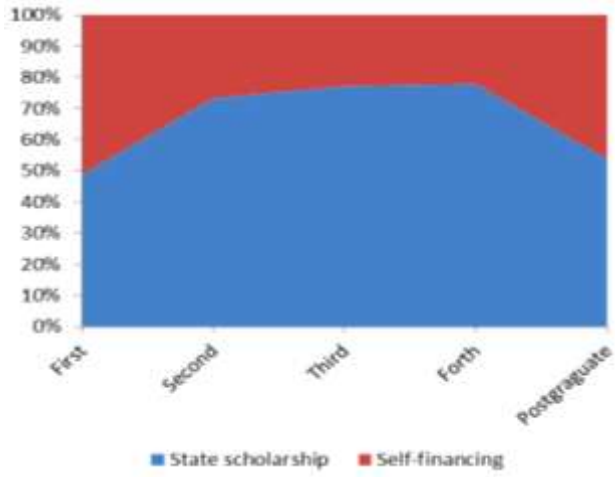

Figure 2: Status

Sport involvement parameter shows a significant drop for second-year students– about 15% fewer students engaged in sports activities, than students from other YOS. We will be discussing about the possible cause of this drop, but it is certain further research is necessary to confirm any assumptions about the potential cause for this drop.

Table 5: Sport involvement

Year of study/ Sport involvement	*Yes*	*No*	*Total Responses*	*Percent of positive answers*
First	**91**	**30**	**121**	**75.2%**
Second	**50**	**40**	**90**	**55.6%**
Third	**89**	**38**	**127**	**70.1%**
Forth	**85**	**32**	**117**	**72.6%**
Postgraduate	**40**	**12**	**52**	**76.9%**
Total Responses	**355**	**152**	**507**	**70.0%**

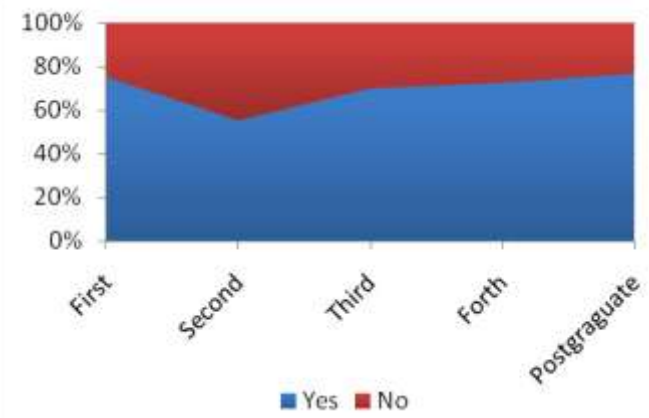

Figure 3: Sport involvement

By analyzing college satisfaction parameter it can be seen that in general, students are happy with their college experience and that they evaluated it as high (with average value of 3.88 out of 5). Third and fourth year students were less satisfied, than the rest of the students involved in the research

Table 6: College experience satisfaction

Year of study/College experience satisfaction	*Very low*	*Low*	*Medium*	*High*	*Very high*	*Total Responses*	*Mean value [1-5]*
First	**2**	**4**	**26**	**57**	**32**	**121**	**3.93**
Second			**20**	**49**	**21**	**90**	**4.01**
Third	**2**	**9**	**37**	**48**	**31**	**127**	**3.76**
Forth	**2**	**8**	**24**	**58**	**25**	**117**	**3.8**
Postgraduate		**1**	**14**	**22**	**15**	**52**	**3.98**
Total Responses	**6**	**22**	**121**	**234**	**124**	**507**	**3.88**

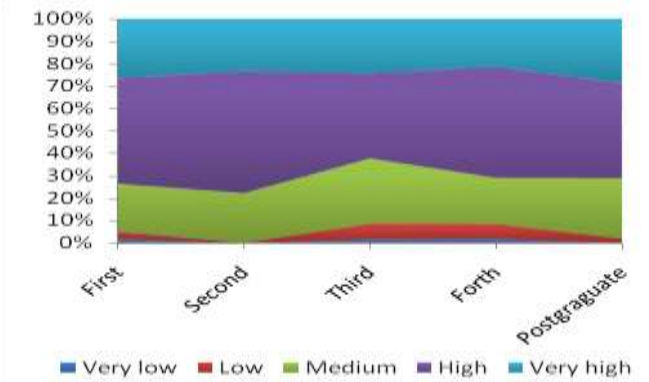

Figure 4: College experience satisfaction

Alcohol consumption parameter displays almost similar percent of students consuming alcohol per YOS. The highest alcohol consumption is noted among third-year students with about 40% rating their consumption of alcohol as high or medium.

Table 7: Alcohol consumption

Year of study/Alcohol consumption	*No*	*Low*	*Medium*	*High*	*Total Responses*	*Mean value [scale 0-3]*	*Percent of students consuming*
First	**20**	**62**	**30**	**9**	**121**	**1.23**	**83.5%**
Second	**16**	**44**	**28**	**2**	**90**	**1.18**	**82.2%**
Third	**15**	**61**	**36**	**15**	**127**	**1.4**	**88.2%**
Fourth	**16**	**65**	**27**	**9**	**117**	**1.25**	**86.3%**
Postgraduate	**12**	**30**	**6**	**4**	**52**	**1.04**	**76.9%**
Total Responses	**79**	**262**	**127**	**39**	**507**	**1.25**	**84.4%**

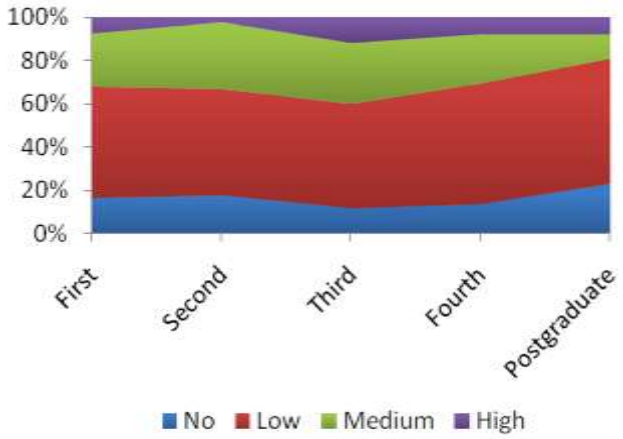

Figure 5: Alcohol consumption

The next set of data represents the parameter of overall life satisfaction. We have noticed that the second-year students have expressed slightly higher satisfaction with life, with the mean value being 0.12 higher than the postgraduate students (who have expressed second highest satisfaction with overall life among sample).

Table 8: Overall life satisfaction

Year of study/Life satisfaction	*Very low*	*Low*	*Medium*	*High*	*Very high*	*Total responses*	*Mean value [scale 1-5]*
First		**5**	**14**	**72**	**30**	**121**	4.05
Second		**1**	**8**	**51**	**30**	**90**	4.22
Third	**1**	**3**	**17**	**77**	**29**	**127**	4.02
Fourth			**20**	**70**	**27**	**117**	4.06
Postgraduate			**7**	**33**	**12**	**52**	4.1
Total responses	**1**	**9**	**66**	**303**	**128**	**507**	4.08

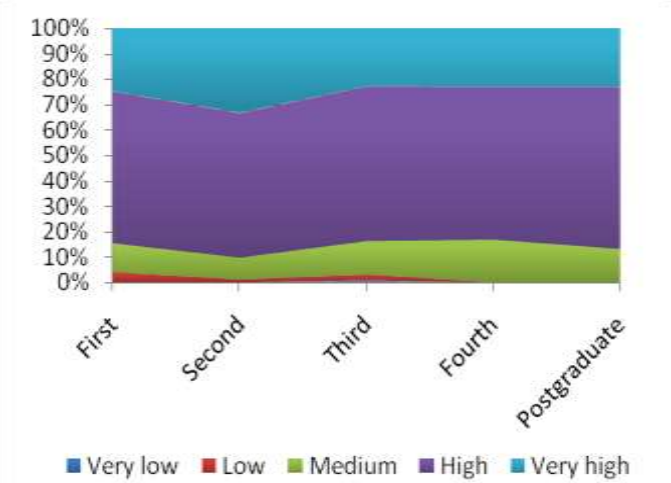

Figure 6: Overall life satisfaction

4. DISCUSSION

From the obtained results it can be concluded that statistically significant differences (with significance level $p<0.05$) are found within status, GPA and sport`s involvement parameters among students from different YOS. No statistically significant differences are found within alcohol consumption, college experiences satisfaction and overall life satisfaction student`s groups (Table 2).

Concerning the ***year of study/GPA*** parameter, there are significant differences in the mean value scores between fourth-year students comparing to all others- 8.47 compared to 8.28 to 8.30 (Table 3, Figure 1). There could be many reasons for this result. Firstly, it may result from the fact that only the most successful students reach the fourth YOS. On the other hand, it can be assumed that students attending higher YOS are more familiar with the materials and syllabuses of the courses and therefore achieve better results. From another point of view, it could be assumed that the fourth year at FOS is less challenging and easier to complete. All these assumptions could represent the future direction of this research and require further analysis in order to determine the actual cause.

Speaking about ***year of study/status*** parameter we can see that there is a much smaller percentage of students with state scholarship in first YOS compared to others (Table 4, Figure 2).. One of the possible reasons for this is that largest number of students drop out or fail at the first year. Still, the actual reason for this is as mentioned previously, that number of awarded state scholarships increases for 20% in every advancing year of study which can be seen from the FOS official documents, too. Also, on postgraduate studies (Master of Science programme) reduced number of state scholarships is awarded.

Physical activity represents one of the factors with positive effects on the quality of physical and mental health (Martin, Church, Thompson, Earnest, & Blair, 2009). Experts in the field of education and health intuitively believe that physically more active students perform better in school (Castelli, Hillman, Buck, & Erwin, 2007). Looking at obtained results and particularly ***year of study/sport involvement parameter***, we can conclude that there is a noteworthy drop considering sport involvement for second-year students– 15% fewer students compared to students from other YOS (Table 5, Figure 3). Still there is no difference in their GPA compared to first and third YOS. With that on mind, a possible explanation could be that after finishing first year, students decide to devote significantly more time to studies and have less time for spare time activities such as sport involvement. Another possible explanation could be that the whole generation of students currently enrolled in second year is not particularly interested for sport activities.

Year of study/college experience satisfaction represents another important parameter included in analysis. No significant differences in college experiences satisfaction are noted among students from different YOS. It should be emphasized that in general, students rated their college experiences satisfaction as high or very high, which is a remarkable result for FOS (Table 6, Figure 4). But by further inspection, it can be noted that third and fourth year students have slightly below average satisfaction. Further analysis of selected parameter according to core curriculum, provides an insight in differences among students from Management and ISAT departments. It is noted that fourth-year students of ISAT have lowest satisfaction with college experiences (mean value at 3.48 out of 5). This can lead to conclusion that decrease of satisfaction with college experiences is more expressed among ISAT students in their final years of study.

Looking at ***year of study/alcohol consumption*** parameter, it is interesting to notice that the percentage of students who consume alcohol is almost the same for all YOS (84.4%), except postgraduate with slight lesser percentage- 76.9% (Table 7, Figure 5). This data can look a bit discouraging, but comparing our results with study from Harvard's College Alcohol Study (Wechsler & Nelson, 2008), it can be seen that alcohol consumption is almost identical for FOS and Harvard students (84% for Harvard Business School). However, we noted that the number of students who declared their consumption of alcohol as high or medium is highest for the third-year students.

By analysing **y*ear of study/life satisfaction*** parameter no significant differences among students from different YOS are noted. In general, students expressed high level of overall life satisfaction. It is important to emphasize that the average student of Faculty of Organizational Sciences is satisfied with his life (Table 8, Figure 6). Second-year students expressed slightly higher level of satisfaction. Already mentioned study from Kjeldstadli et al. (2006), highlights that the life satisfaction of medical students is decreasing during their studies, and that they were as satisfied as other students in the first year of study, but reported less satisfaction in their graduation year. When compared to FOS, overall life satisfaction does not differ significantly among students from different YOS, indicating that this trend is not present in technological and business schools which include FOS, as well.

We encourage further analysis, based on our data, which will further develop each of the segments that were the subject of our research.

5. LIMITATIONS AND CONCLUSION

One of the main limitations of this research is the homogeneity of the sample, because it includes only students from Faculty of Organizational Sciences, as a part of University of Belgrade. Sample that would include other colleges and universities would be far more heterogeneous and would enable us to make comparisons between different educational institutions. On the other hand, this characteristic of sample enables us to make valid conclusions about the student`s population at FOS, such as the inconsistency of second-year students in sport involvement, when compared to other students groups. By further analysis and repeated surveys in future, the actual origin of this inconsistency could be determined. In other words, we could make sure if this inconsistency is the result of trend among every second-year student`s generation at FOS, or just the case with this particular generation enrolled in the year 2011. Secondly, another limitation closely related to previous one is the non-experimental type of research i.e. time-invariant sample. Respondents have filled questionnaire in only one iteration, and certain external events (such as the beginning of exam period, reduced leisure time and increased stress level) could have affected their answers regarding time-variable parameters such as college experiences satisfaction or alcohol consumption level.

Nevertheless, cross-sectional analysis of the data provides useful information about the differences in academic performance (GPA), habits, lifestyles and satisfaction between students from different YOS. Based on the initial statement we can conclude that students' college experiences, overall life satisfaction and alcohol consumption level do not differ significantly among students of first, second, third fourth YOS and postgraduate students. On contrary, these students groups displayed statistically significant differences within average grade (GPA), scholarship status and sport involvement parameters.

REFERENCES

Castelli, D. M., Hillman, C. H., Buck, S. M., & Erwin, H. E. (2007). Physical fitness and academic achievement in third- and fifth-grade students. *Journal of Sport & Exercise Psychology*, *29*(2), 239–52.

Chen, W. (2011). How Education Enhances Happiness: Comparison of Mediating Factors in Four East Asian Countries. *Social Indicators Research*, *106*(1), 117–131. doi:10.1007/s11205-011-9798-5

DeShields, O. W. J., Kara, A., & Kaynak, E. (2005). Determinants of business student satisfaction and retention in higher education: applying Herzberg's two-factor theory. *International Journal of Educational Management*, *19*(2), 128–139. doi:10.1108/09513540510582426

Dickson, L. (2010). Race and Gender Differences in College Major Choice. *The ANNALS of the American Academy of Political and Social Science*, *627*(1), 108–124. doi:10.1177/0002716209348747

Gall, T. L., Evans, D. R., & Bellerose, S. (2000). Transition to First-Year University: Patterns of Change in Adjustment Across Life Domains and Time. *Journal of Social and Clinical Psychology*, *19*(4), 544–567. doi:10.1521/jscp.2000.19.4.544

Kim, Y., Sohn, D., & Choi, S. M. (2011). Cultural difference in motivations for using social network sites: A comparative study of American and Korean college students. *Computers in Human Behavior*, *27*(1), 365–372. doi:10.1016/j.chb.2010.08.015

Kjeldstadli, K., Tyssen, R., Finset, A., Hem, E., Gude, T., Gronvold, N. T., … Vaglum, P. (2006). Life satisfaction and resilience in medical school--a six-year longitudinal, nationwide and comparative study. *BMC Medical Education*, *6*(1), 48. doi:10.1186/1472-6920-6-48

Lounsbury, J. W., Fisher, L. A., Levy, J. J., & Welsh, D. P. (2009). An Investigation of Character Strengths in Relation to the Academic Success of College Students. *Individual Differences Research*, *7*(1), 52–69.

Martin, C. K., Church, T. S., Thompson, A. M., Earnest, C. P., & Blair, S. N. (2009). Exercise Dose and Quality of Life, *169*(3), 269–278.

Salazar, A. M. (2013). The Value of a College Degree for Foster Care Alumni: Comparisons with General Population Samples. *Social Work*, *58*(2), 139–150. doi:10.1093/sw/swt014

Salisbury, M. H., Paulsen, M. B., & Pascarella, E. T. (2010). Why do All the Study Abroad Students Look Alike? Applying an Integrated Student Choice Model to Explore Differences in the Factors that Influence White and Minority Students' Intent to Study Abroad. *Research in Higher Education*, *52*(2), 123–150. doi:10.1007/s11162-010-9191-2

Stone, A. A., Schwartz, J. E., Broderick, J. E., & Deaton, A. (2010). A snapshot of the age distribution of psychological well-being in the United States. *Proceedings of the National Academy of Sciences of the United States of America*, *107*(22), 9985–90. doi:10.1073/pnas.1003744107

Suldo, S. M., Shaffer, E. J., & Riley, K. N. (2008). A social-cognitive-behavioral model of academic predictors of adolescents' life satisfaction. *School Psychology Quarterly*, *23*(1), 56–69. doi:10.1037/1045-3830.23.1.56

Wechsler, H., & Nelson, T. F. (2008). What we have learned from the Harvard School Of Public Health College Alcohol Study: focusing attention on college student alcohol consumption and the environmental conditions that promote it. *Journal of Studies on Alcohol and Drugs*, *69*(4), 481–90. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/18612562

Zullig, Keith J.; Huebner, E. Scott; Patton, Jon M.; Murray, K. A. (2009). The Brief Multidimensional Students' Life Satisfaction Scale-College Version. *American Journal of Health Behavior*, *33*(5), 483–493. doi:10.5993/AJHB.33.5.

MANAGING STUDENTS' VOCATIONAL TRAINING AT THE MEDICAL COLLEGE OF PROFESSIONAL STUDIES AS A METHOD OF GAINING SKILLS

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Abstract: *In near future, education should take an important place, even in Serbia, in the conditions of "endless" transition. In such context, the area of the education management is of high importance. Professional training in each of the educational segments is particularly significant, especially in the professional college education. The most common remark on the subject of education in Serbia in general is the low level of practical training received by the pupils/students at all levels of education (secondary, higher, academic and master education). This paper shall present the results which show good practice of a college. It is a Medical College of Professional Studies in Belgrade. Today, students of this College have practical training that meets the request of the Bologna process to the largest extent, it being formally and essentially implemented, which is confirmed by the presented results.*

Keywords*: practical training, medical nurses, skills, practical knowledge*

1. INTRODUCTION

It is essential that students work on self-improvement and aim for the development and improvement of their knowledge and skills. Considering the fact that students – medical nurses are entrusted with patient care and the ability to provide such care from day one of their employment, it is important that during their studies, they learn and perfect all of the required activities, theoretically as well as practically, Authors Krasulja and Janjušić (2013) have noted that „global competition, fast and sudden changes, impose the need for continuous improvement so that individuals could ensure the prospect of better employment in an almost unpredictable environment" (Janjušić, 2013, p.45). Employers require practical knowledge and skills, and the higher education institutions should provide to their students precisely that, along with the theoretical knowledge, in order for them to become competitive at the labour market.

If we complement this with the fact, as the authors Vasiljević Blagojević and Perčić state in their research (2010), that students, when choosing their higher education institution, state good practice as one of the best factors of their decisions, we can conclude that practical training is of key importance in the areas of recruiting staff and leading students to a certain educational institution.

Ever since the beginning of the institutionalized education, terms such as practical training and practical work are used in professional training as an irreplaceable method of gaining the required knowledge, know-hows, skills and habits. Ranković Vasiljević (2004) emphasizes that this refers particularly to the education of medical nurses, starting from secondary school, through higher education institutions and later on (Ranković Vasiljević, 2004, p. 69). Practical training has become highly important factor for the connection of theoretical knowledge gained at lectures with their practical application. By using the practical training during the studies, the students have the possibility to gain practical work experience and to apply theoretical knowledge which they gained at theory classes.

In observation of the historical development of medical nurses' education worldwide and domestically, it was noted that practical training actually preceded the theoretical training, although this seems impossible today. Namely, ever since Florence Nightingale and her first school, nurses were taught procedures, activities, techniques, interventions, without previously adopted theoretical knowledge, which are the imperative of any professional education today.

Ranković Vasiljević (2003) emphasizes that, with the development of educational systems, a change occurred in application of didactical principles in the education and teaching process, thus the theory began to precede the practical training (Ranković Vasiljević, 2003, p. 93). Nevertheless, there has always been a need for a special kind of training of future medical nurses in their future career, which differed from the so-called „school-type learning", and which took place in healthcare institutions without teachers' direct supervision. This kind or type of work whose aim is to gain skills is referred to as the practical training.

In analysis historical documents on education of medical nurses, we came across the Rules on summer practical training for students of the School of Medicine and pupils of medical middle schools, dated June 16, 1950, which regulated the need for such practical training and its goal. Within the programme „Basic professional nursing studies“, the Medical College of Professional Studies in Belgrade has foreseen practical training in the duration of 1800 classes in the course of three academic years.

In this paper, we shall show how important the practical training was from students' perspective and whether and to which extent it helped them to gain more specific skills.

2. COMPOSITION

Ranković Vasiljević (2004) state that education represents a process of gaining knowledge, know-hows, development of skills and habits, as well as adoption of the behavioural rules' value system, shaping personalities and making them apt for life in a community (Ranković Vasiljević, 2004, p. 21). Education unifies knowledge and know-hows. Vilotijević (1999) states the following definition of knowledge: „Knowledge is a system of facts and generalization of reality, which the students adopted, permanently preserved in their consciousness and which they can apply in practice“ (Vilotijević, 1999, p. 108). Knowledge represents collected and generalized historical productive-working experience of mankind. Thus, knowledge is the foundation for constructive life and progressive work of a modern man. Working qualifications of any man is dependent on the broadness and depth (extensity and intensity) of knowledge (Vilotijević, 1999, p. 108). A person in possession of a solid knowledge can improve the productiveness of social work in general and contribute to the progress of his/her society. Ranković Vasiljević (2004) concludes that “know-hows are methods of performing certain activities which, unlike skills and habits, do not need to be preceded by certain exercises” (Ranković Vasiljević, 2004, p. 122). One can master a single know-how, without having gained a certain skill yet. Know-hows are in specific relation with the abilities. Gaining know-hows is conditioned by existence of certain abilities. Together with adoption, know-hows assist in the development of abilities.

A skill is psychomotor ability, gained by frequent repetition of selected, rational and successful movements. In the skill-gaining process, the student should learn through insight instead through attempts and mistakes. It enables one to perform a certain activity easier, faster and more accurately. A skill is also one of the stages in the habit-forming process. It precedes habits and is a prerequisite for formation of habits. The authors Djordjevic & Trnavac (2011) state that a habit “through continuous repetition, is an automatic reaction enabling an individual to perform a certain activity with the least required strength, fast and accurately” (Djordjevic & Trnavac, 2011, p. 201). A habit is the last stage, i.e. the final result of practicing. A habit follows the formation of skills and it is an automatic skill. It is difficult to determine where skills end and where habits begin, since habits are skills of a higher quality. Only when a required skill for performance of an activity is formed (e.g. writing skill), such skill can become automatic by further practice and it can turn to a habit.

By a teaching process which accepts didactic requests, gradual gaining of knowledge, know-hows, skills and finally habits, is achieved. Formation of skills and habits, without previous knowledge and know-hows would result in creation of “semi-experts”, which would to work but would not know why are they working, why the exactly like that and with what purpose. During the teaching process, the student gains certain knowledge, know-hows, skills and habits which are predetermined by a certain goal, tasks and contents of the curriculum. Depending of many factors, originating from students, teachers, school, family and social environment, a different level of knowledge is achieved. In healthcare teaching at the Medical College of Professional Studies in Belgrade, contents of the curriculum to be adopted at the levels of knowledge, know-how, skill and habit, are determined through programmes.

The purpose of learning is to have the student change his/her behaviour. The author Woolfolk (1998) concludes that learning is successful if it leads to a permanent change in behaviour. Behaviour and learning should not be equated, although the results of learning are concluded based on the behaviour (Woolfolk, 1998, p. 186). Teaching should be structured as early as in the planning phase, so that it surely leads to the achievement of the learning goal – “resulting behaviour” should differ from the “initial” behaviour, i.e. concordant with the goal set. Teacher selects and prepares the teaching materials with the intention to make understanding and adopting of the new material easier for the students. He/she is the organizer of teaching, which manages the process of the simultaneous upbringing and education of students.

2.1 PRACTICAL TRAINING

Practical training is a form of professional work which, in medical education, dates since the beginning of the institutionalized education. Practical training should make the transfer from academic schooling to the professional work of a medical nurse easier. The goal of the practical training is to make students more familiar with the practical activity through practical work. Thus, students get the opportunity to apply knowledge and abilities gained by learning theory, mainly in separate disciplines. At that, they should gain insight into technical, organizational, commercial and social occurrences and their mutual interconnections in healthcare institutions which are determined as the teaching centres.

Until the last educational reform, known as Bologna process, practical training was conducted for the students from the department of medical nurses / technicians. In the last several years it was conducted as pregraduate training, with the duration of 100 to 200 hours.

The Study programme, accredited on April 29, 2007, practical training with the duration of 1800 hours was determined. Together with the active teaching classes, this programme comes very near to the requests set in terms of education by the European Union, ICN (International Council of Nurses) and other associations. Today, according to the newest accredited 2012 programme, the number of practical training classes at the Department of Professional Medical Nurse has been increased to 2400. In this manner, the European requirements in terms of education of nurses have been fully complied with.

Practical training is attended by students during all three academic years; namely half of these hours are realized in healthcare institutions in Belgrade, and half in institutions the students select themselves. During the sixth semester, the students attend practical training in twice as many hours, in order for them to be able to graduate until June. Practical training is organized in the areas of primary health protection – public health and healthcare in secondary and tertiary health protection.

Students' work, as per fixed weekly schedule, is controlled by professional medical nurses, as a rule by head nurses in institutions which are teaching centres. If a student is employed, he/she can complete the practical training in an appropriate institution, that is, in the institution he/she is employed in – as per the College programme.

3. RESEARCH

The goal of the conducted research is to determine the importance of the practical training within the skill-gaining process in students – future professional medical nurses.

Tasks of the research are as follows:

- Determine the level of mastery in certain nursing interventions, for the students at the third year of studies, as per estimates of the students themselves;
- Determine how do students estimate methods of gaining skills – during regular classes or practical training
- Analyse the students' opinion regarding the practical training;

The following methods were used in this research: descriptive method, which we used to describe all of the relevant procedures for gaining skills in the nursing activities and to discuss the results of the research. For the purpose of preparing this paper, only a part of the obtained results shall be presented; and the scientific research by means of the poll used to learn the subjects' opinions regarding the subject matter of the research.

Specially structured questionnaire was used as an instrument of the research when determining levels of gained skills and manner of their acquiring in the course of school education.

Population consists of students from the Medical Nurse Study group at the Medical College of Professional Studies in Belgrade, academic year 2013/2014, and the analysed sample is 150 third year students.

Research was conducted in November 2013 at the Medical College of Professional Studies in Belgrade. Data are processed by means of simple statistical procedures; they are shown in tables and graphs and expressed in absolute and relative numbers.

4. RESULTS AND DISCUSSION

A part of the questionnaire for the assessment of the level of mastery consists of a list which includes 24 nursing interventions, next to which students were to mark the level of mastery, by marking one of the provided grades (0-5). Next to each intervention, the subjects were to mark the type of classes (active classes – practical training) which enabled better practicing of the given procedure.

Authors Konjihušić and Kocev state that determining the needs for care is the first and very important stage of a healthcare process (Konjikušić & Kocev, 2005, p. 48). It includes organized and systematic collection of data on the reactions of patients to the illness or other life situation, as well as validity assessment of the gathered information and recording of all relevant data. Assessment of conditions and determination of the need for care should provide a solid database for making a nursing diagnosis and implementation of all subsequent process stages. In order to perceive and determine the needs of a patient for care, a nurse should know what the needs are, what the basic human needs are and how are those to be satisfied in circumstances of impaired health or limitations due to illness, inability and/or ignorance.

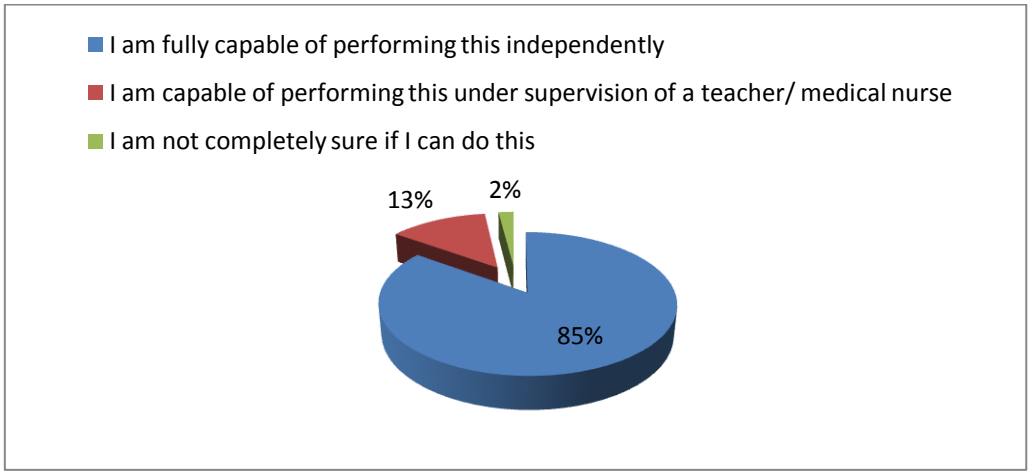

Figure 1: Assessing the patient's condition and determining the need for healthcare

Healthcare process is studied by the students in the second semester of the first year of studies, and they continue to apply it in regular classes and practical training during the whole time of studies. A large percentage of students (85%) deem that they are fully capable of assessing the patient's condition and determining the need for healthcare. More than half of the subjects-students deem that they achieved such result due to regular classes, while one quarter of them deems that active classes and practical training were equally beneficial in mastering of the given skill (15% of the subjects deem that both practical training and classes helped them, while 6% did not answer this question).

The frequency in which a medical nurse should change the patient's position shall depend on the condition assessment, i.e. on the need for care determined at the first stage of the healthcare process. One should also consider that the goal is not to have the medical nurse do everything for the patient, but to teach him/her to help himself/herself in line with his/her abilities, that is, to actively participate. Positioning of a patient appropriately and the regular change of the position are very important for prevention of complications which occur due to lying (thrombosis, thrombophlebitis, pulmonary embolism, joint contractures, muscle atrophy, obstipation, and decubitus). All of these complications put patient's health condition at risk, slow the treatment and rehabilitation processes down and have major impact on the patient's quality of life, and they increase the costs of treatment and rehabilitation for the healthcare service and the society in general.

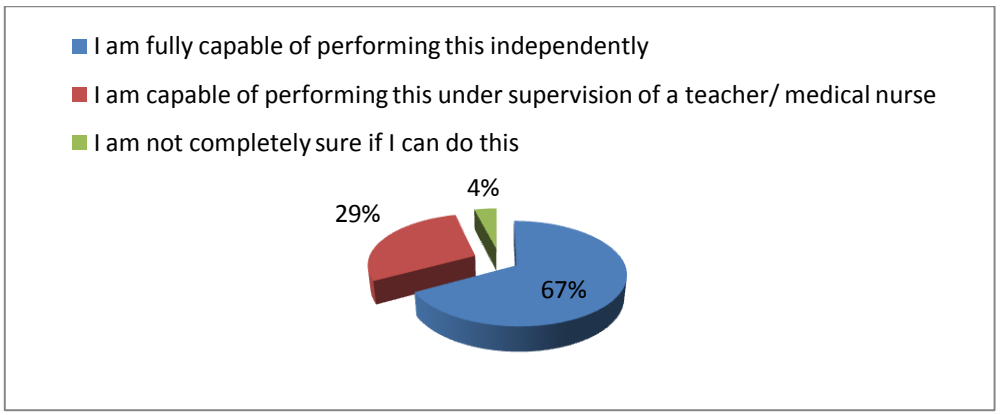

Figure 2: Changing the patient's position in bed

Graph 2 shows that more than two thirds of subjects are able to perform the intervention of changing the patient's position with full independence. Most of the subjects 54% estimate that they acquired this skill at the practical training, although this procedure is learned and exercised in theory classes in schools as well. 31% of subjects deem that regular classes enabled them to independently perform the above intervention (9% of subjects deem that both practical training and classes helped them, while 6% did not answer this question).

Maintaining patient's personal hygiene represents an important part of the treatment and care. It is of the outmost importance to pay special attention to skin and mucous membranes. Numerous functions are performed through skin and while it is unharmed, it represents the best protection against infections. The author Terzić (2006) states that the skin of immobile patients gets dirtier, that is, it is more exposed to the harmful impact of excretions, it endures pressure, humidity, which are good predisposed factors for development of infections and decubitus (Terzić, 2006, p. 29).

Pupils in secondary medical schools are familiarized with patients' personal hygiene as early as during the first grade, while the students, through laboratory classes of healthcare 1 during the first semester repeat and consolidate acquired knowledge, know-hows and skills.

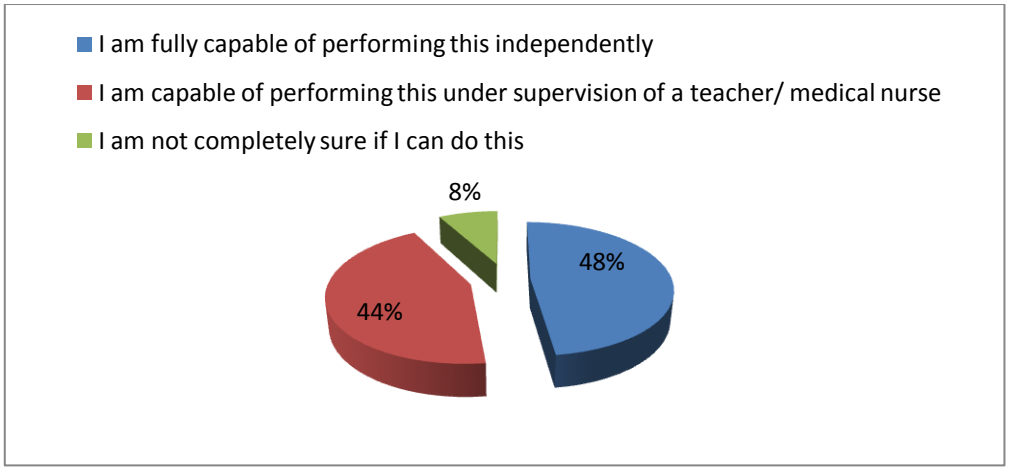

Figure 3: Personal hygiene of immobile patients

Graph No. 3 clearly shows that 48% of students are able to independently, and 44% under supervision, maintain patients' personal hygiene. Subjects also claim that 25% gained the above skill in active classes, while almost 60% claims it occurred at the practical training. Such result could be expected, since the experience of one's own ability for a certain job becomes more realistic in realistic situations, which, in this case, is hospital environment and work with patients.

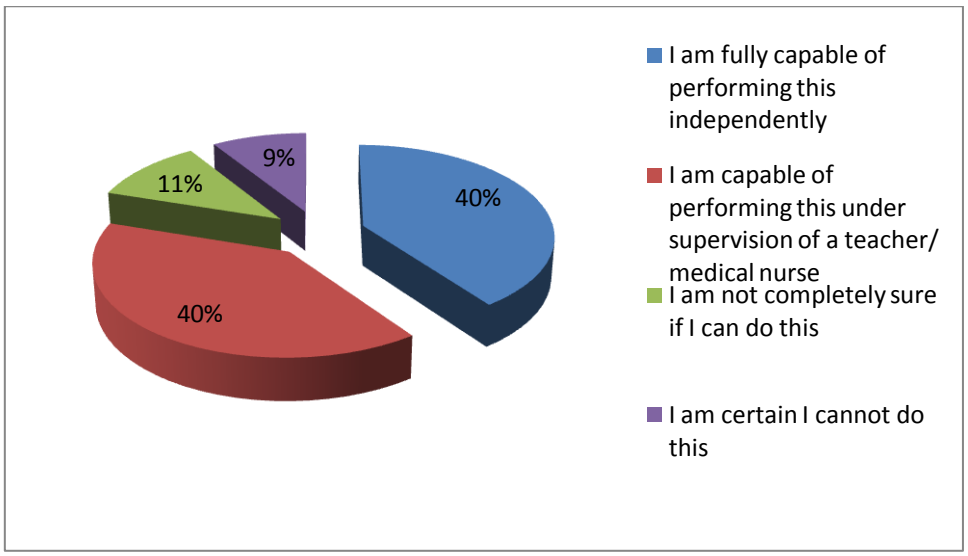

Figure 4: Prevention of decubitus

The author Matic (2001) states that decubitus represents local damage, i.e. necrosis of tissue, which occurs due to pressing of body parts onto the underlying surface, where circulation and insufficient blood flow in these parts of the body, referred to as predilection sites, occur: nape, shoulder blades, lower back, hips, knees, ankles, heels, elbows (Matic, 2001, p. 210). Prevention of decubitus implies monitoring of patient's condition and treatment of the main disease, solving collaborative issues, solving potential problems, patient's activity – active and passive exercises, using auxiliary devices.

The Graph No. 4 shows that 40% of subjects deem that they are able to perform this intervention independently or under supervision. The opinion on their level of mastery is somewhat lower in almost one fifth of the subjects, which certainly tells us about the need to pay more attention to work in relation with decubitus, in active classes as well as in practical training. Regardless of the level of mastery, only one third of subjects deem that they gained their knowledge and skills in active classes, and 40% in practical training, while one fifth of the subjects deems that both forms of teaching are equally beneficial in terms of gaining the aforementioned knowledge and skills.

Vital functions are studied in detail in the second grade of the secondary medical school; monitoring of vital functions is afterwards practiced during the whole secondary school as well as during higher education.
Over 50% of subjects are able to independently monitor vital signs, which is the expected result, while the same percentage of the subjects deems that they acquired this skill in practical training (one can conclude from this that they had not gained this skill during the secondary school education).

Central venous pressure (CVP) is measured in a simple manner. In patients with indicated monitoring of CVP, central venous catheter (CVC) is advanced so that the catheter tip is placed in the right prechamber or near the prechamber inside the proximal inferior vena cava. It is the indicator of the circulating blood volume, state of the vasculature capacity and cardiac function. Values are read directly by means of a transfuse and reader, i.e. on the monitor, expressed in mm of mercury column, or they are read, from a liquid column which is connected by means of a CVC system to the infusion system, and expressed in cm of a water column. Normal values of CVP range from 6 – 12 cm of water column or 2 – 6 mm of Hg column.
Only 6% of subjects deem that they can independently perform this intervention, and as much as one quarter of subjects are only informed about this intervention. Considering that as much as 36% of subjects didn't provide an answer, one can conclude that they don't even know what CVC is, this being the reason they failed to answer this question.

Intramuscular application is application of medicines into the gluteus and thigh muscle tissue. Water solutions, suspensions in water and oil solutions can also be administered in this manner. This is one of the most common nursing interventions in practice and the obtained result was the expected one. Namely, 94% of subjects deem themselves fully capable for independent intramuscular application of medicines, while the remaining 6% of subjects deem that they are able to perform this intervention independently under supervision. During the assessment of this intervention, the high percentage of subjects also recognizes practical training as the type of classes which enabled them to exercise the procedure (above 65%).

5. CONCLUSION

On grounds of the available literature, which was studied for purposes of this paper, analyses of the data obtained from student polls and personal, long-term experience in working with students, and considering the goal and the tasks of the research, we have come to the following conclusions:

- Aside from exercises, practical training is the most important skill-gaining method, especially for the medical nurse profession;
- Practical training completion requires high level of organization, on the end of the higher education institution but equally on the end of the healthcare institution which the practical training is conducted in;
- Practical training organization implies compliance with the existing Programme, which is concordant with the Study programme as a whole;
- Practical training completion requires professional supervision by adequately educated and motivated medical nurses from the teaching centres, which have the support of the institution management for that activity;
- Students understand practical training as a type of classes which enables them additionally to gain the skills for the professional work.

The results reported and commented so far indicate importance of practical training of nurses during the studies. Future studies could extend the group of factors that may influence the skills level. For instance, previous education may also be relevant. Additionally, we would recommend analysis whether knowledge and skills were gained in practical training of a quality level appropriate for future employers. Overcoming the gap between the expectations of institutions/future employers and the quality of gained knowledge and skills of graduates should be emphasized.

The essence of a successful practical training is in the following and complying with the Rules which detail the programme of practical training for each year of studies. Based on the practical training log, records are kept and frequency of the conducted nursing interventions from the practical training programme is controlled. What is imposed as necessary is intensification of communication with the nurses – co-workers for practical trainings, in order to adhere to the process in all stages of work. Regular work assessment by means of student polls is also important, and this is an obligation envisaged in the Quality Standard from the accreditation material.

Considering that practical training of students of the Medical College, Department of Professional Medical Nurses is recognized by this research as well as very significant, work on its modernization and improvement is the primary task. For purposes of appropriate preparation of students for exercises and practical training, demonstration and initial exercise until the basic skill level is reached, should be performed on the model in the school cabinet. We expect that in the future, with the increase of patients' rights, completion of the initial exercises in healthcare institutions, i.e. on patients during practical training, will become much more difficult, which must not lead to a reduced level of knowledge and skills of future generations of professional medical nurses.

REFERENCES

Kekuš, D. (2006). Zdravstveno vaspitanje: za studente Više medicinske škole(1th ed.). Beograd: Divna Kekuš.

Konjikušić, V., & Kocev, N. (2005). Zdravstvena nega u procesu rehabilitacije (1th ed.). Beograd: Čigoja štampa.

Krasulja, N., & Janjušić, D. (Aprile, 2013). Learning and Development. Paper presented at the Globalistation Challenges and social-economic environment of the EU, Slovenia.

Matić, Đ. (2001). Zdravstvena nega u internoj medicini (2nd ed.). Beograd: Ma De Jan.

Ranković Vasiljević, R. (2004). Metodika i organizacija zdravstvene nege (2nd ed.). Beograd: Viša medicinska škola.

Ranković Vasiljević, R. (2003). Metodika nastave zdravstvene nege (2nd ed.). Beograd: Viša medicinska škola.

Terzić, N. (2006). Zdravstvena nega u hirurgiji. Lazarevac: N. Terzić.

Trnavac, N., & ĐorĎević, J. (2010). Pedagogija (12th ed.). Beograd: Naučna knjiga.

Vasiljević Blagojević, M., Perčić, K., & Nikolić, S. (October, 2010). The importance of frequency parameters to the choice of the higher education institution. Paper presented at the SED 2010, Uzice.

Vilotijević, M. V. (1999). Didaktika. Beograd: Naučna knjiga.

Woolfolk, A. E. (2001). Educational psychology (8th ed.). Boston: Allyn and Bacon.

USING „WHITE-BOX“ CLASSIFICATION ALGORITHMS FOR PREDICTING STUDENTS’ PERFORMANCE

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Abstract: *In order to successfully manage the learning process it is necessary to collect and analyze a large number of data that could potentially affect the students' performance and achievements. Data mining involves techniques for finding and describing structural patterns in data, as a tool for helping to explain data and make predictions from it. Educational Data Mining (EDM), is engaged in the development of methods for exploring the unique types of data that come from the educational context. This paper analyzes the impact of specific administrative and demographic data on actual students' performance in the course Introduction to programming that is performed in Faculty of Electrical Engineering in East Sarajevo. Some models for predicting students' performance in the final exam was developed.*

Keywords*: Educational data mining, students' performance, classification algorithms, WEKA*

1. INTRODUCTION

In order to successfully manage the learning process it is necessary to collect and analyze a large number of data that could potentially affect the students' performance and achievements. An efficient method for analyzing large amounts of data is using data mining. Data mining involves techniques for finding and describing structural patterns in data, as a tool for helping to explain data and make predictions from it (Witten, 2011). It is desirable for discovered patterns to be useful, understandable and to provide new knowledge.The main goal of data mining techniques is to find and describe the structural patterns in the data in order to attempt to explain connections between data and create predictive models based on them (Witten, 2011). Input data for applying data mining techniques are presented in the form of a set of examples, and the output can be expressed in the predictive or descriptive form of the analyzed data structure. Data mining is a multi-disciplinary field involving machine learning, statistics, databases, artificial intelligence, information retrieval, and visualization (Liu, 2007). There are four the most common tasks used in data mining applications: supervised learning (or classification), unsupervised learning (or clustering), association rule mining, and sequential pattern mining. Each of them is characterized by different styles of learning.

Data mining process involves three main steps:

- Pre-processing – the raw data must be cleaned in order to become suitable for mining. Data cleaning includes removing noises and abnormalities, handling too large data, identifying and removing irrelevant attributes, and so on. Data cleaning is procedure that usually consumes a lot of time and it is very labor-intensive but it is absolutely necessary step for successful data mining.
- Data mining – the process of applying data mining algorithm that will produce patterns or knowledge.
- Post–processing – Among all discovered patterns or knowledge, it is necessary to discover ones that are useful for the application. For making the right decision there are many evaluation and visualization techniques that can be used.

Data mining can be applied to explore and analyze data that come from different types of educational environments (Romero, Ventura, 2013). This new developing field, known as Educational Data Mining (EDM), began to develop intensively in recent years. It is engaged in the development of methods for exploring the unique types of data that come from the educational context (Romero, 2008). EDM analyzes data generated by any type of information system supporting learning or education. These data are not restricted to interactions of individual students with an educational system but might also include administrative data (e.g., school, school district, teacher), demographic data (e.g., gender, age, school grades), student affectivity (e.g., motivation, emotional states), etc. (Romero, Ventura, 2013). The main objective is to extract implicit and useful patterns or to obtain useful knowledge about the ways students learn and factors that affect their learning. Applying data mining methods and techniques on data that come from educational systems it is possible to discover new and useful knowledge. That knowledge can help teachers to get proper understanding of student’s performance and to identify different learning capabilities. Different data mining models can be implemented to evaluate student's performance and obtained

knowledge can be used to provide feedback and necessary guidance for teachers in order to improve the teaching process through more quality and easier management.

In recent years a lot of research in the field of educational data mining was performed and various types of mining algorithms applied on educational datasets have been proposed. An overview of the current state and the progress made in the development and implementation of educational data mining is given in (Romero, Ventura, 2013). Comparative analysis of various data mining techniques and algorithms has been shown in (Garg, Sharma, 2013). An investigation of data mining techniques for evaluating quality of a course and analyzing a connection between course learning material and the test for the final exam has been done in (Dimić, Prokin, Kuk, Spalević, 2010). Prediction of the achieved success and the final grade in the exam can be performed applying data mining algorithms. In (Affendey, 2010), the ranking of factors that influence the prediction of academic performance in order to identify students who will need to study harder to pass the exam was performed by the application of data mining methods. An experiment with pattern classification for student performance prediction is performed in (Ai, Laffey, 2007). The obtained results illustrate that recognition for a certain class on a large dataset can be obtained by a classifier built from a small size data set. Applying different data mining classification techniques for predicting the marks in the final exam of the students that use Moodle courses has been shown in (Romero et al, 2010). Using clustering analysis comparing of two algorithms for measuring the potential of students' academic skills has been done in (Dewi, Utomo, Yulianto, 2013). In (Ramesh, 2013), an analysis of the factors that influence students' performance in final examinations and a suitable data mining algorithm for predict the grade of students has been done. The obtained results reveals that type of school does not influence students' performance and parents' occupation plays a major role in predicting grades. The impact of the certain e-learning tools on the achievement of students' objectives is discussed in (Kickul, 2002).

In (Romero, Ventura, 2007) a survey about the application of data mining to web-based electronic courses and learning content management systems was performed. As a result, a general model that represents the whole process of application of data mining techniques in educational systems was created, Figure 1.

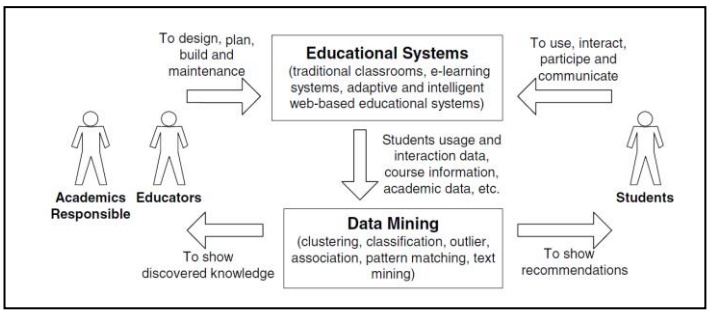

Figure 1: Application of data mining in educational systems

This paper analyzes the impact of specific administrative and demographic data on actual students' performance in the course Introduction to programming that is performed in Faculty of Electrical Engineering in East Sarajevo. Some models for predicting students' performance in the final exam was developed. The models were created using a decision tree and instance based classifiers. Presented experiments were performed using WEKA data mining tool (Weka). The influence of input attributes on the performance of the model was analyzed and higher accuracy of the generated model was achieved by application of appropriate techniques.

The rest of this paper is organized as follows. The process of data collection and preprocessing are described in second section. Classification algorithms implementations is described in the third section, while in the fourth section simulation results of proposed experiments are shown. Finally, fifth section provides conclusion remarks and outlines directions for future work.

2. DATA COLLECTING AND PREPROCESSING

For the purposes of this study, administrative and demographic data of students who have attended the Introduction to Programming course were collected and their impact on students' performance was analyzed. This course is performing during the summer semester of the first year of study at the Faculty of Electrical Engineering in East Sarajevo. Randomly sampling, the data of the two generations of students from all three study programs that are running at the Faculty have been taken into account. Open source data mining tool WEKA (Weka) was used to apply the learning methods to a dataset and analyze their output to extract useful information about the data and their impact on students' performance. The data collected, which represent

the attributes for data mining process performing, include city from where students came (*city*), high school they graduated (*school*), average mark of subject mathematics (*matav*) and informathics (*infav*) in high school, graduated average mark in high school (*hsav*), points obtained on the faculty qualification exam (*test*) and obtained mark in the course Introduction to Programming (*mark*). The last attribute was used as a class attribute.

To be able to apply data mining techniques, it was necessary to preprocess input data. In the initial stage of preprocessing step is identifing and discarding the attributes that have no predictive value (the index number, name, and so on). By manually discretization process (Romero et al., 2013) a numerical values which represented the final grade of class attribute '*mark*' were transformed into nominal values in accordance with the specific needs of the individual experiments performing.

Two experiments were conducted and their results are shown in this paper. First experiment was performed over 6 distinct values of the class attribute: *five, six, seven, eight, nine* and *ten*. In the second experiment class atribute has 3 distinct values (five=*weak*, six, seven and eight=*good*, nine and ten=*excellent*). Excel .csv file is formed of these data and then exported to WEKA data mining tool. Data preprocessing is a procedure that usually consumes a bulk of time and requires a lot of work, but it is an absolutely necessary step for the successful application of data mining techniques and algorithms.

3. CLASSIFICATION ALGORITHMS IMPLEMENTATIONS

One of the most common tasks used in data mining applications is the classification. Classification is type of machine learning analogue to human learning from past experiences to gain new knowledge in order to improve our ability to perform real-world tasks (Liu, 2007). Computers using machine learning learns from data which are collected in the past and represent past experiences. In most cases classification is used for learning a target function that can be used to predict the values of a discrete class attribute, e. g. classification is one type of predictions methods. The goal of prediction is to infer a target attribute, predicted variable, from some combination of other aspects of the data or another attribute. Classification here means the problem of correctly predicting the probability that an example has a predefined class from a set of attributes describing the example. In classification learning, the learning scheme is presented with a set of classified examples from which it is expected to learn a way of classifying unseen examples (Weka).

There are many methods and measures for estimation the strength and the accuracy of a classification/predictive model (Liu, 2007). The main measure is the classification accuracy which is the number of correctly classified instances in the test set divided by the total number of instances in the test set. Some of the common methods for classifier evaluation are holdout set, Multiple Random Sampling and Cross-Validation. One of a number of different evaluation metrics is F-measure. F-measure is used if a single measure to compare different classifiers is needed (Weka). For more detailed analysis of the distribution of instances of the class attribute confusion matrix can be used. It contains information about actual and predicted results given by a classifier for all class attribute' values.

While conducting above mentioned experiments, three different types of classification algorithms provided by Weka were used: two rules-based algorithms – JRip and NNge, and one tree-based algorithm - J48. All these algorithms were executed using their default parameters' values. Every machine learning algorithms have been applied separately on all data set. These algorithms have been selected because they are considered so called „white-box–classification algorithms. These algorithms provide an explanation for the classification result and are preferred to „black-box–data mining models which are usually more accurate but less comprehensible. The classification results obtained by „white-box–classification algorithms can be used directly for decision making. Obtained models can explain their predictions at a higher level of abstraction by IF-THEN rules. These types of rules can be more comprehensible and easily interpreted by non-expert data mining users, such as teacher or course instructor. In this way it is possible for a teacher or course instructor to analyze and use obtained classification output in order to detect certain classes of students and factors that may affect their performance.

For evaluation of classifier 10-fold cross validation testing technique was used. That is a standard method for predicting the error rate of learning techniques performed over a fixed sample of data. During the evaluation process the data set is divided into 10 subsets. Then the classification algorithms are fed with these data subsets. The left-out subsets of the training data are used to evaluate classification accuracy. When seeking an accurate error estimate, it is standard procedure to repeat the cross-validation process 10 times - that is, 10 times tenfold cross-validation and average the results. This involves invoking the learning algorithm 100 times on datasets that are all nine-tenths the size of the original. Getting a good measure of performance is a computation-intensive undertaking (Witten, 2011).

The decision tree is a very popular method for classification and decision making. It is a decision making technique used to solve many problems. It predicts outcomes using a series of questions and rules for data classification. The decision tree branching occurs as a result of meeting the requirements of classification issues. Each question will divide data into subsets that are more homogeneous than the senior set. If the question has two answers, then the response to the question arise two subsets (binary tree). Subsets arise according to number of questions answers. Therefore the classification of certain data are carried out. Predicting the behavior of a particular client can be made on the basis of its belonging to a particular event (which is classified based on a number of issues and conditions), for which we know how it acts. During the construction of decision trees is important to know the right questions. In this paper, J.48 decision tree, which is an implementation of C4.5 algorithm in WEKA data mining tool (Weka), is used.

Instance based classifiers rely on using directly the examples from the training set as concept models without constructing abstractions. They proved to be effective but the absence of an associated compact explicit model limits their —readability. On the other hand, the rule based approaches can provide comprehensible rule sets. The hybrid variants, based on the concept of generalized exemplars, combine the idea of distance based classification with that of best matching rule. The generalized exemplars are sets of instances which can be interpreted as rules and which allow to decrease the model size and to increase the robustness to noise of instance based classifiers. Instance-based classifier Non-Nested Generalized Exemplars (NNGE) is based on algorithm introduced by Brent, 1995. It examines generalized exemplars as a method of improving the classification performance of instance-based learners. It has been shown that generalising exemplars results in improved classification performance over standard nearest neighbor. The only thing that may pose a problem is that the algorithm tends to produce rules that test a large number of attributes. Because of this they are not very intelligible to people.

JRip is Weka's implementation of the RIPPER rule learner. It is a fast algorithm for learning "IF-THEN" rules. RIPPER is an acronym for *repeated incremental pruning to produce error reduction*. Classes are examined in increasing size and an initial set of rules for a class is generated using incremental reduced-error pruning. An extra stopping condition is introduced that depends on the description length of the examples and rule set. The description-length *DL* is a complex formula that takes into account the number of bits needed to send a set of examples with respect to a set of rules, the number of bits required to send a rule with *k* conditions, and the number of bits needed to send the integer *k*—times an arbitrary factor of 50% to compensate for possible redundancy in the attributes. Having produced a rule set for the class, each rule is reconsidered and two variants produced, again using reduced-error pruning—but at this stage, instances covered by other rules for the class are removed from the pruning set, and success rate on the remaining instances is used as the pruning criterion. If one of the two variants yields a better description length, it replaces the rule. Next we reactivate the original building phase to mop up any newly uncovered instances of the class. A final check is made, to ensure that each rule contributes to the reduction of description length, before proceeding to generate rules for the next class. (Witten, 2011)

4. SIMULATION RESULTS

Using above described classification algorithms, results obtained performing the first experiment (six values of class attribute) are shown in Table 1.

Table 1: Classifier evaluation

Algorithm	Correctly Classified Instances - CCI	F-measure	Number of rules
J.48	22.86%	0.20	56
JRip	26.67%	0.16	4
NNge	22.86%	0.23	48

From Table 1 it can be seen that all generated models have very small accuracy and consequently very small F-measure value. Among all classifiers JRip perform the most accurately prediction, 26.67% correctly classified instances (CCI). It also has the smallest number of rules, 4. Generated rules are quite comprehensible, but as it can be seen in Table 2, there are very small number of instances that are correctly predicted (numbers in parentheses indicate the number of totally classified instances of one class / number of incorrectly classified instances of that class).
Detailed distribution of predicted values for every class attribute can be presented in the form of the confusion matrix. Confusion matrix is a two-dimensional matrix with a row and column for each class. Each matrix element shows the number of test examples for which the actual class is the row and the predicted class is the column. Good results correspond to large numbers down the main diagonal and small, ideally

zero, off-diagonal elements (Witten, 2011). Six values of class attributes *mark* are indicated by letters a=five, b=six, c=seven, d=ten, e=eight and f=nine. The results obtained using all three classifiers are shown in Table 3.

Table 2: JRIP rules

JRIP rules:
(test >= 38) => mark=ten (6.0/2.0)
(city = pale) and (test >= 29) => mark=ten (3.0/0.0)
(infav <= 2.5) => mark=six (2.0/0.0)
=> mark=five (94.0/68.0)

Table 3: Confusion matrix

Predicted class																		
J48						***JRip***						***NNge***						
a	***b***	***c***	***d***	***e***	***f***	***a***	***b***	***c***	***d***	***e***	***f***	***a***	***b***	***c***	***d***	***e***	***f***	***Real class***
13	6	3	1	1	2	**24**	0	0	0	*1*	*1*	***9***	*4*	*2*	*2*	*5*	*4*	***a=five***
8	**4**	3	1	0	1	15	**0**	2	0	*0*	*0*	*4*	***5***	*4*	*2*	*1*	*1*	***a=six***
7	5	**3**	2	3	4	17	1	**3**	0	*1*	*2*	*3*	*5*	***4***	*2*	*8*	*2*	***c=seven***
3	1	0	**4**	2	0	9	0	0	**1**	*0*	*0*	*2*	*0*	*1*	***4***	*2*	*1*	***d=ten***
8	2	1	1	**0**	2	11	0	1	2	**0**	0	3	1	3	4	**1**	2	***e=eight***
8	0	3	2	1	**0**	11	0	2	1	0	**0**	2	3	5	1	2	**1**	***f=nine***

From confusion matrix it can be seen that there is an unbalance in the distribution of the value of output classes and the accuracy of small classes is less than the accuracy of the higher class. In the case of unbalanced data sets, examples of small classes are more difficult to train. The problem with unbalanced data arises because learning algorithms tend to overlook less frequent classes (minority classes), paying attention just to the most frequent ones (majority classes). As a result, the classifier obtained is not able to correctly classify data instances corresponding to poorly represented classes. One of the most frequent methods used to learn from unbalanced data consists of re-sampling the data (Romero et al., 2010). To solve this problem, in this paper re-sampling was performed using Resample Weka filter for supervised learning. The result of applying this filter has shown that the difference in the values of attributes decreased. Results obtained by applying above mentioned algorithms on re-sampled data are shown in Table 4.

Table 4: Classifier evaluation (re-sampled data)

Algorithm	**Correctly Classified Instances - CCI**	**F-measure**	**Number of rules**
J.48	56.19%	0.55	54
JRip	54.29%	0.52	12
NNge	70.48%	0.70	33

The generated models performed on re-sampled data enable more precise predictions. Obtained results show that all classifiers applied on re-sampled data have significantly better accuracy compared to results presented in Table 1. NNge classifier in this case obtained the best result, 70.48% correctly classified instances and F-measure of 0.70. It can be concluded that accuracy is significantly increased on resampled data but the number of rules generated by the best classifier in this case is very huge and incomprehensible. The number of rules generated by JRip classifier is 12 and they are shown in Table 5. From Table 5 it can be seen that the most relevant attribute for classification was city. Although the number of correctly classified instance is much higher than in the previous case still there are a significant number of instances whose values are misclassified.

The second experiment again compared the same three classification algorithms using all the available data but now applying pre-processing discretization data task on the class attribute. Discretization divides the numerical data into categorical classes that are easier for the teacher to understand. The manual discretization method (where cut-off points have to be specified) has been applied to the *mark* attribute, where three intervals and labels have been used (*weak*: if value is 5; *good*: if value is 6, 7 and 8 and *excellent*: if value is 9 and 10). Repeating above performed simulation obtained results on unbalanced data set are presented in Table 6.

Table 5: JRIP rules

JRIP rules:
(school = tehnicar racunarstva) and (matav >= 4.8) => mark=nine (4.0/1.0) (city = nevesinje) and (hsav <= 4.6) => mark=nine (2.0/0.0) (school = masinska) => mark=nine (2.0/0.0) (test >= 40) => mark=ten (6.0/0.0) (test >= 25) and (hsav >= 4.8) and (school = gimnazija) => mark=eight (9.0/1.0) (city = zvornik) and (school = tehnicar racunarstva) and (test >= 10) => mark=eight (6.0/0.0) (city = bratunac) => mark=six (9.0/1.0) (city = sokolac) => mark=six (7.0/2.0) (city = cajnice) => mark=six (4.0/1.0) (matav >= 4.75) and (test <= 14) => mark=seven (10.0/0.0) (city = ugljevik) => mark=seven (2.0/0.0) => mark=five (44.0/21.0)

Table 6: Classifier evaluation

Algorithm	**Correctly Classified Instances - CCI**	**F-measure**	**Number of rules**
J.48	53.33%	0.45	2
JRip	57.14%	0.55	3
NNge	46.67%	0.46	36

In this case, the best classification result was obtained using JRip classifier, 57.14% CCI, but J.48 classifier also obtained approximately good result. The rules generated by these two classifiers are shown in Table 7.

Table 7: J48 and JRIP rules

J48 pruned tree:	**JRIP rules:**
test <= 26: good (77.74/33.0) test > 26: excellent (27.26/14.26)	(test >= 26) and (hsav >= 4.7) => mark=excellent (19.0/7.0) (test <= 8) => mark=weak (17.0/6.0) => mark=good (69.0/26.0)

Important conclusion that can be made analyzing the Table 7 is that both the classifier detected the same value of test attribute as a limit for the separation excellent and good class. But still, the number of incorrectly classified instances is relatively huge.

Confusion matrix was used for a more detailed analysis of the class attribute distribution, Table 8.

Table 8: Confusion matrix

Predicted class									
J48			***JRip***			***NNge***			
a	***b***	***c***	***a***	***b***	***c***	***a***	***b***	***c***	***Real class***
0	23	3	**10**	15	1	***7***	*16*	*3*	***a=weak***
1	**47**	7	5	**42**	8	*14*	***34***	*7*	***b=good***
0	15	**9**	1	15	**8**	*6*	*10*	***8***	***c=excellent***

After re-sampling, the generated models enable more precise predictions. Results obtained by applying above mentioned algorithms on re-sampled data are shown in Table 9.

Table 9: Classifier evaluation (re-sampled data)

Algorithm	**Correctly Classified Instances - CCI**	**F-measure**	**Number of rules**
J.48	67.62%	0.66	41
JRip	64.76%	0.64	9
NNge	80%	0.80	22

In this case NNge classifier made a very good prediction, 80% correctly classified instances. The number of generated rules is also significantly reduced. Some rules with the highest coverage (number in parentheses) are shown in Table 10.

Table 10: NNge classifier rules generated

NNge classifier rules generated :
class good IF : city in {cajnice,mostar,trebinje,insarajevo,nevesinje,foca,milici,rudo} ^ school in {gimnazija,tehnicar racunarstva,tehnicar elektronike} ^ 2.0<=matav<=5.0 ^ 2.5<=infav<=5.0 ^ 3.2<=hsav<=4.7 ^ 6.0<=test<=26.0 (28)
class good IF : city in {pale,rogatica,kalinovik} ^ school in {gimnazija} ^ 3.5<=matav<=5.0 ^ 3.5<=infav<=5.0 ^ 3.8<=hsav<=5.0 ^ 11.0<=test<=24.0 (13)
class weak IF : city in {sokolac,visegrad,ilidza,zvornik,gacko} ^ school in {gimnazija} ^ 3.3<=matav<=4.8 ^ 4.5<=infav<=5.0 ^ 3.9<=hsav<=4.9 ^ 7.0<=test<=35.0 (11)
class excellent IF : city in {trebinje,pale,bugojno} ^ school in {gimnazija,tehnicar racunarstva} ^ 3.3<=matav<=5.0 ^ 4.5<=infav<=5.0 ^ 4.1<=hsav<=5.0 ^ 29.0<=test<=49.0 (7)
.
.
.

Although very complex, these rules can be easily interpreted and implemented with the goal of grouping students for better adjustment of teaching materials to their affinities.

NNge confusion matrix is shown in Table 11.

Table 11: Confusion matrix

Predicted class			
NNge			
a	***b***	***c***	***Real class***
16	6	2	*a=weak*
7	**54**	1	*b=good*
2	3	**14**	*c=excellent*

Analyzing confusion matrix of the NNge classifier can be concluded that the largest number of miss predictions was made in the class b. Miss prediction among classes a and c is relatively small. One of the reasons for that may be the fact that class b covers the largest range of obtained marks. This may refer to the future research in which the experiments could be performed with a different redistribution of value within the class.

5. CONCLUSION

The choice of the classifier for generating predictive model is a complex task. The whole data mining process is almost always iterative: it usually takes many rounds to achieve final satisfactory results. The selection of a correct data mining algorithm depends on not only the goal of an application, but also on the compatibility of the data set. Performed experiments have shown that different algorithms obtain the best classification accuracy depending on the different preprocessing tasks like discretization or rebalancing.

This paper describes the analysis of the three white-box classifiers for creating rules and identifying the factors that influence predicting of students' performance in the course Introduction to Programming at Faculty of Electrical Engineering in East Sarajevo. Experiments were performed on two types of the values of class attribute, with and without the applied method of discretization. Several experiments were performed using available administrative and demographic data about students to try to obtain more accuracy and better rules. Rebalance preprocessing techniques have also been used on the original data to test again if better classifier models can be obtained. The two standard measures for evaluation of the accuracy of the predictive model (the number of correctly classified examples and F-measure) were applied. Confusions matrix was used for a more detailed analysis of the class attribute distribution. From the obtained results it can be seen that generated predictive models with re-sampled data enabled more precise predictions.

The aim of future research is to explore the possibility of including the additional parameters in the analysis by which it could be achieved better predictive results and use of other classification algorithms for creating more precise predictive model.

REFERENCES

Affendey LS et al. (2010) Ranking of Influencing Factors in Predicting Students' Academic Performance, Information Technology Journal 9 (4): 832-837

Ai J and Laffey J (2007) Web Mining as a Tool for Understanding Online Learning, MERLOT Journal of Online Learning and Teaching 3(2): 160-169

Dewi, A. O. P. Utomo, W. H. Sri Yulianto J. P., (February 2013) –Identification of Potential Student Academic Ability using Comparison Algorithm K-Means and Farthest First", International Journal of Computer Applications (0975 – 8887) Volume 63– No.17

Dimić, G. Prokin, D. Kuk, K. Spalević, P. (2010), –The Use Of Data Mining Methods for Analyzing And Evaluating Course Quality in the Moodle System", INTERNATIONAL SCIENTIFIC CONFERENCE, GABROVO

Garg, S. Sharma, A.K. (2013) —Comparative Analysis of Data Mining Techniques on Educational Dataset", International Journal of Computer Applications (0975 – 8887) Volume 74– No.5

Kickul J and Kickul G (2002), New pathways in e-learning: The role of student proactivity and technology utilization, 45rd Annual Meeting of the Midwest Academy of Management Conference, Indiana, USA

Liu B (2007) Web DataMining - Exploring Hyperlinks, Contents, and Usage Data, © Springer-Verlag Berlin Heidelberg

Moodle, Available: https://moodle.org/

Prema M and Prakasam S (2013) Effectiveness of Data Mining - based E-learning system (DMBELS), International Journal of Computer Applications 66(19): 31-36

Ramesh V et al. (2013) Predicting Student Performance: A Statistical and Data Mining Approach, International Journal of Computer Applications 63(8): 35-39

Romero C and Ventura S (2007) Educational data mining: A survey from 1995 to 2005, Expert Systems with Applications 33, 135–146

Romero C et al. (2008), Data mining in course management systems: Moodle case study and tutorial, Computers&Education, Elsevier 55(1):368–384

Romero C and Ventura S (2013) Data mining in education, WIREs Data Mining Knowl Discov, 3(1): 12–27

Romero C et al. (2013), Web usage mining for predicting final marks of students that use Moodle courses, Comput. Appl. Eng. Educ., 21: 135–146

Weka software tool, Available: http://www.cs.waikato.ac.nz/ml/weka/

Witten IH et al. (2011) Data mining: practical machine learning tools and techniques, Morgan Kaufmann, Amsterdam

LANGUAGE POLICY AND PLANNING IN EUROPE AND SERBIA IN THE CONTEXT – AN OVERVIEW

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Abstract: *The increasing trend of globalization, international trade and global communication has led to the rise in the need for foreign language learning. Plurilingualism, the command of several languages by an individual is set as a goal for the European environment. Therefore, language policy and planning need to be developed accordingly. This paper gives an overview of relevant European institutions and important documents which have now become an indispensable part of European language policies. The paper also analyzes the situation in Serbia with regards to language policy and planning and the use of these widely-accepted documents.*

Keywords*: language policy and planning, plurilingualism, CEFR, Language Portfolio*

1. INTRODUCTION

The increasing trend of globalization, international trade and global communication has led to the rise in the need for foreign language learning. The need for understanding, communication and cooperation is making it a necessity for people to become proficient in several foreign languages. Nation states are investing resources and staff into implementing curricula which foster language learning and are many themselves multilingual. English has for long established itself as a *ligua franca* in both economic and educational environments. The threat of English-only situation is driving the need to facilitate learning of other languages and promote plurilingualism. In Europe, numerous stakeholders have invested resources and research to meet this aim. This paper will give an overview of language policies in Europe and some of the most important documents regulating and directing them, and attempt to connect it to the situation in Serbia.

2. TERMINOLOGY AND RELEVANT BODIES

According to Filipović (2009), **language policy and planning** are most commonly defined as an organized, targeted and long-term activity of public bodies on different aspects of status, form and domain of the use of a specific language variety. This is an incomplete definition of language policy and planning, since it can be managed outside state institutions, applying different theoretic and methodological activities (p. 54).

As for Europe and its language policy and planning, Bugarski in Filipovic (2009) introduces the term interactive model which means that there is no longer coexistence, but rather interaction or cooperation among speakers of different languages on equal grounds which would provide membership in the European family under a common roof. This interactive model is represented by various documents by the Council of Europe, including the *European Common Framework of Reference.*

Breidbach (2003) perceives “European communicative integration as a political concept which calls for structuring through language education policies” (p. 7).

Concepts important for discussing language policy and planning are multilingualism and plurilingualism and how they should be treated. According to the Council of Europe “**Multilingualism** refers to the presence in a geographical area, large or small, of more than one 'variety of language' i.e. the mode of speaking of a social group whether it is formally recognised as a language or not; in such an area individuals may be monolingual, speaking only their own variety.” Therefore, multilingualism does not include individuals speaking more than one language, which is the aim for the “House of Europe” for the future. On the other hand, “**Plurilingualism** refers to the repertoire of varieties of language which many individuals use, and is therefore the opposite of monolingualism; it includes the language variety referred to as 'mother tongue' or 'first language' and any number of other languages or varieties. Thus in some multilingual areas some individuals are monolingual and some are plurilingual.”

When discussing language policy and planning in Europe, numerous actors are included, but this paper will be limited to three major bodies – Council of Europe, European Commission, and European Centre for Modern Languages which is a Council of Europe institution also supported by the European Commission.

European Commission sees its role in developing language learning policies in Europe by retooling education systems in member States, gathering data to formulate benchmarks in language learning and promoting multilingualism with the aim of improving employability within the EU. Following the change of the labour market and skills necessary, the EU is investing in education system reforms to cater for these changes. They have supported vast analyses of the current state of affairs and provided several instruments to support transparency and recognition of knowledge, skills and competences. As for language skills, the European Commission is working closely with the European Centre for Modern Languages. According to the first European Survey on Language Competences (http://ec.europa.eu/languages/policy/strategic-framework/documents/language-survey-technical-report_en.pdf) "Member States must reform their education systems based on new methodologies for teaching both the first and second foreign languages". The survey included students of lower and upper secondary education and provided an extensive overview of the current state of affairs.

Council of Europe, with headquarters in Strasbourg, aims at promoting linguistic diversity and language learning, and operates under the European Cultural Convention. It currently includes 47 member States; Serbia joined in 2003. The Council promotes policies designed to promote plurilingualism, linguistic diversity, mutual understanding, social cohesion and democratic citizenship in an ever more globalized world. The importance of languages is underlined through the existence of the Language Policy Division in Strasbourg and the European Centre for Modern Languages in Graz, Austria. Policy makers, test designers and teachers have all been influenced by the work of the Council's Language Policy Division, starting from the series of publications between 1975 and 1990 listing the linguistic means necessary to communicate efficiently with speakers in another language, i.e. "the threshold level". The products of several decades of work are two major documents – the Common European Framework of Reference (CEFR) and the European Language Portfolio.

According to data by the European Commission, the data on Educational attainment and outcomes of education – Language skills, show that in the 28 member countries of the European Union in 2011, the self-reported level of foreign language skills on the first and second stage of tertiary education is as shown in Table 1.

Table 1: First and second stage of tertiary education (levels 5 and 6) in 2011

Languages / Countries	No languages	1 language	2 languages	3 languages or more
European Union (28 countries)	11.6%	36.7%	33.7%	17.9%

Eurostat

Table 1 shows that the overall knowledge of foreign languages in the EU is on a satisfactory level. However, it is far from the plurilingual aim. On the other hand, despite not having substantial data on the information in Serbia, the authors are of the opinion that the numbers are far lower (not including speakers of minority languages).

Neuner (2002) indicates that linguistic diversity for a plurilingual individual is the overall guideline for the European language policy so as to be able to interact with other Europeans, thus formulating a threefold objective of such a policy (p. 8):

- pragmatic (facilitate mobility of citizens)
- intercultural (overcome prejudice and develop multicultural interest and tolerance)
- socio-political (protect and support linguistic and cultural diversity)

According to the author, English holds "the first place among foreign languages offered in the curriculum in almost all Member States of the Council of Europe, not only in compulsory education (school level) but also in institutions for adult education and lifelong learning" (p. 10). The author continues to point out that this dominance of the English language represents a danger to the concept of European language policy. Finally, the author proposes limiting the time for learning English and allocating the rest of the time for foreign language learning to other languages.

The following chapter will give an overview of the two main documents aimed at aiding language learning – Common European Framework of Reference and Language portfolio.

3. COMMON EUROPEAN FRAMEWORK OF REFERENCE AND LANGUAGE PORTFOLIO

Common European Framework of Reference (CEFR) is a benchmark document for curriculum design and language policy creation which is the result of over twenty years of research in the field of language planning, learning and assessment done by the Council of Europe. Its aim is to provide a common framework for the design of curricula and syllabi, teaching materials and language testing and assessment. It was officially adopted in 2001 and is now translated into over 39 languages. The primary purpose of the document is to serve as a prescriptive tool and help stakeholders in the field of language learning to describe and compare their teaching options, all with the aim of transparency and comparability. Therefore, according to the Council of Europe's *Tools for Language Teaching*, the document proposes:

- a common methodology for analysing and describing situations and choices in language teaching and learning;
- a common terminology for all languages and educational contexts;
- a common scale of levels of language proficiency to assist with goal-setting and learning outcome assessment.

The CEFR describes foreign language proficiency in six levels (A1, A2, B1, B2, C1, C2). This helps to compare tests and knowledge level across languages, and recognise language qualifications, which helps both educational and occupational mobility. For example, holders of the Cambridge ESOL language certificates of B2 level and higher, are eligible for attending undergraduate, graduate and post graduate courses across Europe and beyond.

The document also gives a detailed overview of "can do" descriptors for all aspects of language competence (Reading, Writing, Listening and Speaking). Table 2 shows a segment of the Global scale (for a proficient user).

Table 2: Common Reference Levels – Global scale

Proficient user	C1	Can understand with ease virtually everything heard or read. Can summarise information from different spoken and written sources, reconstructing arguments and accounts in a coherent presentation. Can express him/herself spontaneously, very fluently and precisely, differentiating finer shades of meaning even in more complex situations
	C2	Can understand a wide range of demanding, longer texts, and recognise implicit meaning. Can express him/herself fluently and spontaneously without much obvious searching for expressions. Can use language flexibly and effectively for social, academic and professional purposes. Can produce clear, well-structured, detailed text on complex subjects, showing controlled use of organisational patterns, connectors and cohesive devices

In addition to principles for teaching and learning which are set out in Chapters 5, 6 and 8 of the CEFR, the Council of Europe has produced several other documents to assist in assessment, such as the Manual for Language Test and Development (2011) and Relating Language Examinations to the Common European Framework for Reference of Languages: Learning, Teaching, Assessment, A Manual (2009).

All of the listed documents do not aim at telling practitioners what to do or how to do it, but rather give guidelines and provide support in line with the specific needs of the users.

Filipovic (2009) lists several reasons for and against the implementation of CEFR. Those against it underline that it is a result of a specific political and ideological position which sees economic power and political influence as an understatement of the explicit aims of this document. Those criticizing the document emphasize that it insists on language equality only formally, while the political reality of the countries it is addressing hinders systematic implementation of its guidelines. Also, many authors within the EU point to a discrepancy between the declarative support to plurilingualism and the support for imperialistic language policies which strengthen the already strong languages. On the other hand, as the author states, those who are for the implementation of the *Framework* actually have an active position in the process of educating the professional and the general public on the importance of plurilingualism and the positive aspects of being competent in a great number of languages. Therefore, if the recommendations of the Framework are responsibly and objectively incorporated in language policy and planning they can help to protect minority languages and promote linguistic and cultural diversity.

European Language Portfolio is a document which helps language learners keep track of their learning process. Its aim is to support plurilingualism and allow users to record their language learning achievements. It consists of three parts – Language Passport, Language Biography and Dossier. The Europass Language

Passport was developed by the Council of Europe and the European Union. Both the standard and the Europass Language Passport contain a record of a learner's progress. The Language Biography helps the learner note down the experience and reflect on the learning of a specific language. Finally, the Dossier serves to keep track of personal work. The Portfolio is the property of an individual learner and it is linked to the CEFR, enabling it to be widely acknowledged. Every Language Portfolio must be accredited by the European Language Portfolio Validation Committee, thus ensuring that the standards and all the necessary criteria are met.

4. SERBIA IN THE CONTEXT

When discussing the pros and cons of the implementation of CEFR, Filipovic (2009) reflects on the language policy and planning in Serbia. The author feels that there is no clear direction or aim of these processes. She proposes an overall analysis of which foreign languages should be taught and for how long, the language content that should be taught, methods in language learning and a strategic and scientific grounds on which language policy and planning should be founded. Only after such an extensive analysis should an overall language policy be designed. This should provide future generations with the possibility to be included in the professional life of a plurilingual Europe.

The authors found vague data on Serbia in the context of the implementation of CEFR. However, in a Survey on the use of CEFR conducted in 2007, Serbia was among the 30 respondents. This survey indicated that CEFR was referred to in a number of official documents at state or regional level, such as primary, secondary or higher education curricula, teacher training, assessment, etc. In addition, CEFR proved to be most useful in curriculum design. In general, the CEFR seems to have a major impact on language education. Countries who responded to the survey indicated that the Framework is well known by the institutions in question and well accepted by teachers. In some countries the CEFR was used in developing both strategic language policy documents and practical teaching materials. In others, it is referred to in curriculum planning. Some respondents stress that the CEFR has made the communicative approach to language teaching more action-oriented.

On the other hand, some respondents state that the CEFR has had a moderate impact. It has contributed to coherence and transparency; however, it does not impact the teaching profession at the school level. These countries feel that the full potential of CEFR is yet to be realised. In addition, they feel that the document needs more clarification.

The survey provided information about the countries' comments on the CEFR:

- there is a need for a concise and reader-friendly summary of the CEFR and of the basic principles of its approach
- national syllabi need to be calibrated to the CEFR
- tests calibrated to the CEFR levels for different age groups need to be developed
- a forum for an exchange of good practice related to the use of the CEFR is necessary.

Since the Survey does not provide specific information on individual respondent countries, it is difficult to say where Serbia stands on these points. However, the feedback gives valuable information on potential problems or suggestions on the implementation of CEFR.

5. CONCLUSION

Without any discussion on whether Serbia should enter the European Union or not, the authors see Serbia as a part of the European academic space since it is a part of the Bologna reform. Therefore, language learning and language policies should be a matter of central interest to all stakeholders in education if students of all levels of education are to be provided with the possibility of participating in this academic space and in the ever growing globalization of economy. The authors suggest further research in the field of language policy implementation, standardization with the adopted European practices and provision of teachers, learners and policy makers with a more in-depth knowledge of both the possibilities and shortcomings of the abovementioned documents and processes, all with the aim of improving cooperation, mutual understanding and development.

REFERENCES

Breidbach, S. (2003). Plurilingualism, democratic citizenship in Europe and the role of English, retrieved from http://www.coe.int/t/dg4/linguistic/Source/BreidbachEN.pdf

Council of Europe (2001a). Common European Framework of Reference, retrieved from http://www.coe.int/t/dg4/linguistic/source/framework_en.pdf

Council of Europe (2001b). Common European Framework of Reference for Languages: Learning, teaching, assessment, Structured overview of all CEFR scales http://www.coe.int/t/dg4/education/elp/elp-reg/Source/Key_reference/Overview_CEFRscales_EN.pdf

Council of Europe, Language Policy Division http://www.coe.int/t/dg4/linguistic/Division_EN.asp

European Commission http://ec.europa.eu/languages/policy/strategic-framework/index_en.htm

Eurostat, retrieved from http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do

Filipović, J. (2009). Moć reči, Ogledi iz kritičke sociolingvistike, Zadužbina Andrejević, Beograd

Goullier, F. (2006) Council of Europe Tools for Language Teaching, retrieved from http://www.coe.int/t/dg4/linguistic/Source/Goullier_Outils_EN.pdf

Martyniuk W., and Noijons J., The use of the CEFR at national level in the Council of Europe Member States (2007), retrieved from: http://www.coe.int/t/dg4/linguistic/Publications_EN.asp

Neuner, G. (2002). Policy Approaches to English, retrieved from http://www.coe.int/t/dg4/linguistic/Source/NeunerEN.pdf

RANKING OF CRITERIA TEACHERS USE WHEN SELECTING TEXTBOOKS

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Abstract: *Due to non-existing norms and criteria in primary educational system of the Republic of Serbia, each teacher has the right to choose the appropriate textbook on the basis of their own criteria and ratings. That may lead to the selection of a textbook which is not of a high quality. Our objective in this paper is a clear determination of criteria which we have to use when selecting textbooks for primary schools in the educational system of Serbia. In the period between 29th of October and 11th of November, teachers were given an internet questionnaire to rate the most important criteria they rely on when choosing a textbook, using grades 1 to 3. Using the results of the questionnaire, we will try to pinpoint the most important criteria. The latest research has helped us find out that the authors' assumption that the criteria, which help teachers choose a textbook, are actually appropriate for the age of the children who learn from them. They also assume that there are around seven most important criteria which can be applied to any subject. On the basis of previous research on this subject, we expect to conclude that the teachers of the Serbian educational system are mostly guided by the criteria which are oriented on students and that they don't use more than 10 criteria.*

Keywords*: Textbook, Teacher, Entropy, Student, Ranking, Average score, Criteria.*

1. INTRODUCTION

Definition of the importance

Due to non-existing norms and criteria in primary educational system of the Republic of Serbia, each teacher has the right to choose the appropriate textbook on the basis of their own criteria and rating. That may lead to the selection of a textbook which is not of a high quality. Furthermore, we don't know which criterion is the most important when opting for a textbook, therefore, some publishers don't pay attention to important segments when publishing a textbook. It's necessary to focus on the essence – the segment which helps teachers to choose the appropriate textbook for teaching.

Summary

In their study named ''Rhetorical form, selection, and use of textbooks'', the University of Illinois discovered that teachers and administrators, ''tended to perceive the ideal textbook to be well-organized/systematic, informational, appropriate in content to school objectives, and readable on or below grade level'' (Crismore, A., 1989). Another study conducted by Manto Sylvia Ramaligela identified 7 important criteria for textbook evaluation and selection: content, connectedness, language, format, context, activities and teaching strategies (Ramaligela, M. S., 2010). Solomon Olorundare from University of Ilorin also conducted a study named ''Textbook selection: A critical process in the education enterprise''. Professor Olorundare singled out these four criteria: adequacy of the textbook: process, adequacy of the textbook: content, material presentation and teaching ability of the textbook (Olorundare, S. A., 1998).

Study named ''Selecting an E-(text) book: Evaluation criteria'' (2012) by Mariusz Marczak concluded a list of categories of evaluation criteria used when selecting an e-textbook. The categories were: layout and design; content and functionalities (Marczak, M., 2012). These results show us that evaluation criteria regarding textbooks vary depending on their purpose and their form.

Hypothetical paragraph

The latest research has helped us find out that the authors assume that the criteria, which help teachers to choose a textbook, are actually appropriate for the age of the children who learn from them. They also assume that there are about seven most important criteria, which can be used for any subject.

Subject

In the period between 29th of October and 11th of November, teachers were given an internet questionnaire to rate the most important criteria they rely on when choosing a textbook, using grades 1 to 3. Using the results of the questionnaire, we will try to pinpoint the most important criteria in this section. In addition, we will use the methods from the theory of decision making such as entropy, average score, total score and variance to determine values and confirm findings that will be shown in this paper. We will also make a ranking list to see which criteria are the most important for the primary school teachers in the Republic of Serbia.

Objectives

The social objective is a clear determination of criteria which we have to use when opting for primary school textbooks in the educational system of Serbia. That will help us improve their quality.

The scientific objective represents the scientific qualification of the criteria which are used for the selection of textbooks, emphasizing the most significant of them with the aim of enhancing the quality of classes.

Hypothesis

Teachers of the Serbian educational system are mostly guided by the criteria which are oriented on the students, and they don't use more than 10 criteria.

Table 1: The structure of the sample by school administration

School administration	Number of respondents	Percentage of respondents
Sombor	27	3,7%
Novi Sad	142	19,5%
Zrenjanin	73	10%
Belgrade	119	16,3%
Valjevo	47	6,4%
Požarevac	36	4,9%
Kragujevac	30	4,1%
Jagodina	24	3,3%
Zaječar	27	3,7%
Užice	36	4,9%
Čačak	18	2,5%
Novi Pazar	11	1,5%
Kraljevo	16	2,2%
Kruševac	26	3,6%
Niš	67	9,2%
Leskovac	27	3,7%
Kosovska Mitrovica	3	0,4%
Ranilug	1	0,1%
Total:	**730**	**100%**

2. SAMPLE

The study included 770 examinees. The sample consists of 730 of them since the responses of the remaining 40 examinees were not taken into account for failure to fulfill basic conditions. Basic terms that are defined in the questionnaire are: respondents must be class teachers or subject teachers, citizens of the Republic of Serbia, and must fill in certain fields that are marked as required.

- The structure of the sample by years of service

Most of respondents have between 11 to 20 years of service (43%), followed by respondents from 21 to 30 (29%), then respondents with 1 to 10 years of service (23%), and, lastly, the respondents with 31 to 40 years of service (5%).

- The structure of the sample by Level of Education

When it comes to the structure of the sample by Level of Education, the situation is the following: number of those with a bachelor's degree is by far the largest (76.9%), followed by a significantly smaller number of those with a master's degree (13%), and those with a higher level of education (7%), whereas only 4 respondents, or 0.01% have obtained a PhD.

- The structure of the sample by the professional title

The data shows that, by far, the most respondents do not have a professional degree (96%), only 3% have a degree of pedagogical advisor, and 1% are ranked as high pedagogical advisors, three of the respondents hold the title standalone and one respondent holds the title of a higher pedagogical advisor, which makes 0.4% and 0.1% of the total respondents respectively.

- The structure of the sample in relation to whether the respondents are employed in the classroom or subject teaching

In relation to whether respondents work as elementary or subject teachers, it can be seen that there is approximately the same number of respondents who are employed as elementary teachers (49%) and those who are employed as subject teachers (51%).

- The structure of the sample by school administration

The study involved respondents from 210 municipalities of the Republic of Serbia, for easier and more user friendly display, points are classified by school administration. The sample consists of respondents employed in schools in total of 18 school districts. Most of them are those whose schools belong to the school administration Novi Sad (19.5%), followed by Belgrade (16.3%) and Zrenjanin (10%). The least number of respondents are from the school administration Kosovska Mitrovica and Ranilug (0.4, or 0.1%). These results can be seen in Table 1.

3. METHODOLOGY

Textbooks selection criteria

This research includes the evaluation of entropy, as well as the analysis of the variance, average scores and total scores. Method used to rank the criteria in this study is shown below on Chart 1. The method was taken from (Bahraminasab, M., Jahan, A., Mustapha, F., Sapuan, S. M., & Ismail, M. Y. (2012)).

In this paper, parameters of entropy, mean and total values are used for the measurement or quantification criteria.

In order to better understand the responses obtained by questionnaire or teachers' criteria concerning the selection of textbooks, we used the technique of the theory of decision-making called entropy, the measure of dispersion, of order/disorder rate. Entropy provides insight into the actual behavior of the system, meaning, if the survey provides insight into the dissipation of the vote compared to multiple choice. In addition to entropy, respondents have been observed through the average and total scores.

After the application of this method for all the criteria, we can see important criteria in relation with which there is agreement among the respondents, as well as where you can draw the line between very important criteria and those that are less important. This result can be confirmed with an overview of average and total score criteria.

In the process of calculating the entropy for the sake of obtaining these results, we used the following formula:

$$H(x) = -\sum_{i=1}^{n} p(x_i) log_b p(x_i) \qquad (1).$$

The process of calculation is proceeded as follows:

Rating 1 - *Number of votes 7*; **Rating 2** - *Number of votes* 64; **Rating 3** - *Number of votes 659.*

$$H = -\left(\frac{7}{730} * log_3\frac{7}{730} + \frac{64}{730} * log_3\frac{64}{730} + \frac{659}{730} * log_3\frac{659}{730}\right) \qquad (2).$$

The obtained result (for concision criteria) looks like this: Entropy **(H = 0.3188902)**.

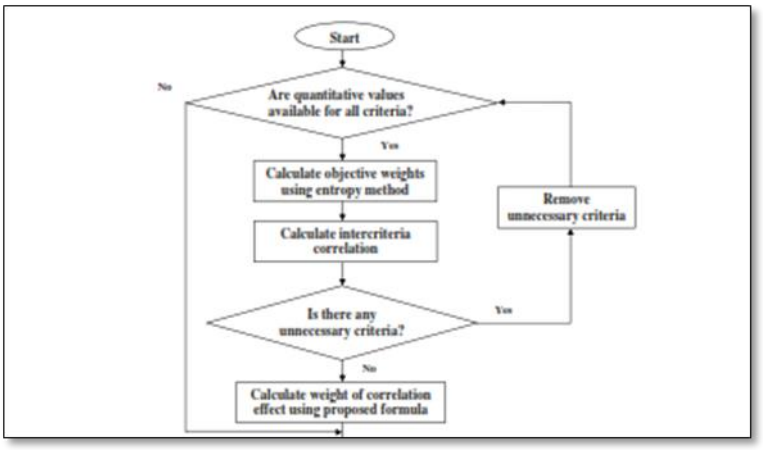

Chart 1: A framework for weighting of criteria in ranking stage of material selection process (Bahraminasab, M., Jahan, A., Mustapha, F., Sapuan, S. M., & Ismail, M. Y. (2012)).

Average score and Entropy

Table 2 shows that there is no difference in the results when taking into account the average score of criteria and obtained values of entropy. It is clearly seen that the results are identical, except that the difference obtained by using entropy convincingly indicates these results.

The results show that criteria named below are, based on the rating of respondents, teachers' most important criteria in the selection of textbooks:

- Language adjustment to the students' age
- Encouraging students to think creatively
- Methodical approach by author
- The opportunity for students to work independently
- Page overview
- Didactic approach by author
- Conciseness in presentation of content

And the least important criteria for teachers in the selection of textbooks:

- Parts of the textbook set are in a blindfold
- Parts of the textbook set are separated
- Price

Table 2: Ordering of criteria in relation to the importance of entropy and average score

	Average score	Entropy
Language adjustment to the students' age	2.971	0.115
Encouraging students to think creatively	2.958	0.160
Methodical approach by the author	2.951	0.177
The opportunity for students to work independently	2.915	0.270
Page overview	2.912	0.277
Didactic approach by the author	2.901	0.301
Conciseness in presentation of content	2.893	0.319
Encourage students' interest in scientific field	2.788	0.494
Additional materials for teachers are available	2.782	0.514
Occupational character of textbooks	2.778	0.521
Multimedia of textbook set	2.711	0.599
Illustrations quality	2.684	0.623
Design quality	2.538	0.725
Price	2.527	0.773
The quality of paper and printing	2.447	0.791
Prolixity in presentation of content	2.356	0.850
Parts of the textbook set are separated	2.110	0.953
Parts of the textbook set are set in a blindfold	1.986	0.994

In order to get the most data from this analysis, the criteria were sorted in groups, depending on their nature. To clarify, selected criteria (Language adjustment to the students' age, Encouraging students to think creatively, Page overview, The opportunity for students to work independently) were sorted in group named Criteria oriented on student. The same sorting method was used to create the remaining three groups:

Criteria oriented on author (Didactic approach by author, Conciseness in presentation of content, Methodical approach by author, Prolixity in exposure of content).

Oriented on the physical quality of textbook (Illustrations quality, Design quality, The quality of paper and printing, Multimedia of textbook set, Parts of the textbook set are in a blindfold, Parts of the textbook set are separated, Price).

Oriented on teacher or scientific field (Encourage students' interest in scientific field, Additional materials for teachers are available, Occupational character of textbooks). The result of this grouping shown with entropy and average score can be seen in Chart 2 and Chart 3.

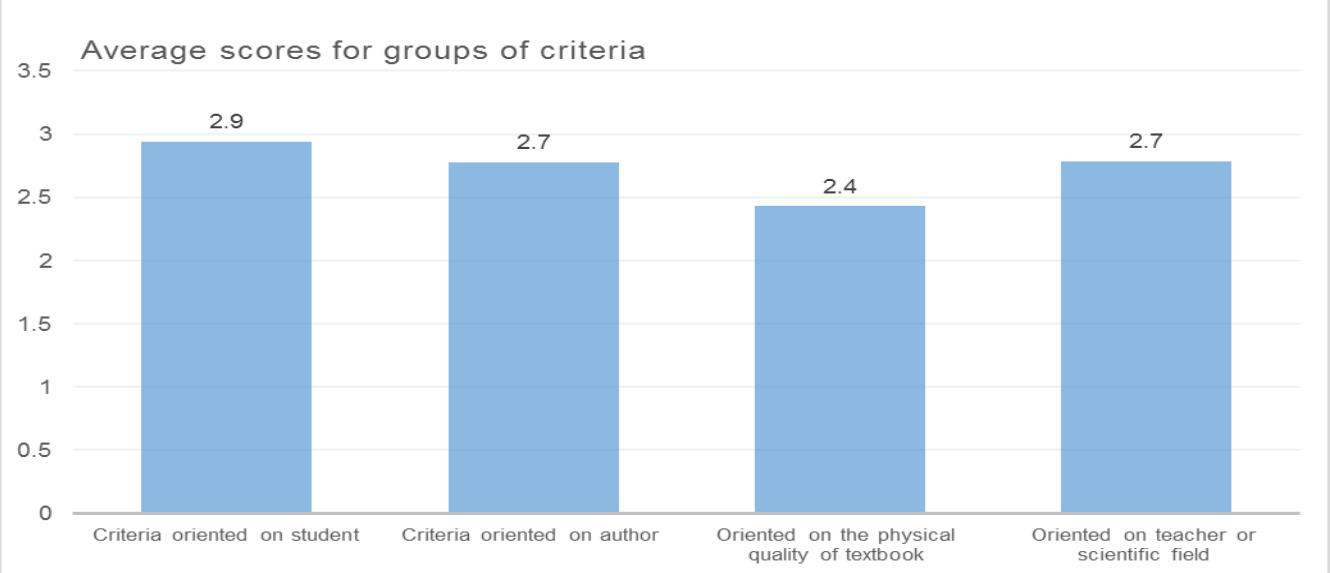

Chart 2: Average scores for groups of criteria

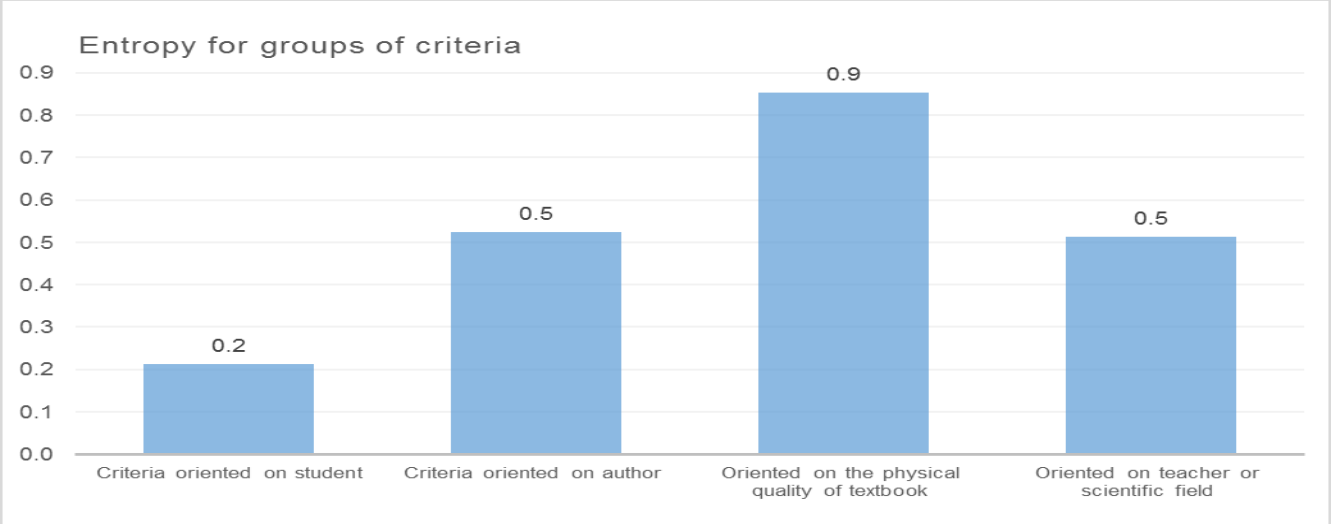

Chart 3: Entropy for groups of criteria

4. CONCLUSION

After using entropy method it became absolutely clear that these seven criteria are, based on the rating of respondents, teachers' most important criteria in the selection of textbooks: Language adjustment to the students' age; Encouraging students to think creatively; Methodical approach by author; The opportunity for students to work independently; Page overview; Didactic approach by author; Conciseness in presentation of content.

And the least important criteria for the teachers in the selection of textbooks: Parts of the textbook set are in a blindfold; Parts of the textbook set are separated; Price.

In order to get the most data from this analysis, the criteria were sorted in groups, depending on their nature. This showed us that teachers tend to use the criteria which are more focused on students and their ability to understand the subject presented in a textbook. This confirms our hypothesis that teachers of the Serbian educational system are mostly guided by the criteria which are oriented on students.

On the basis of the number of the criteria that have been pinpointed as the most important in the selection of textbooks, the other hypothesis, that teachers of the Serbian educational system don't use more than 10 criteria, is also confirmed.

We advise that any research which could follow up on the conclusions made in this study, should involve the application of AHP method for criteria that were offered and were pointed out in this paper as the most important.

REFERENCES

Bahraminasab, M., Jahan, A., Mustapha, F., Sapuan, S. M., & Ismail, M. Y. (2012). A framework for weighting of criteria in ranking stage of material selection process. The International Journal of Advanced Manufacturing Technology, No. 58. pp 411–420.

Crismore, A. (1989). Rhetorical form, selection, and use of textbooks. Study conducted by University of Illinois at Urbana-Champaign. Retrieved from https://www.ideals.illinois.edu/bitstream/handle/2142/17887/ctrstreadtechrepv01989i00454_opt.pdf

Frédéric, A., & Humphreys, P. (2008). Encyclopedia of Decision Making and Decision Support Technologies. Vol. 1, pp 76- 84. Informatlon Science reference. Hershey, New York.

Gray, R. M. (2013). Entropy and Information Theory. First Edition, Corrected. Stanford University. Springer-Verlag. New York.

Ilić, M., Pribićević, I., & Maksimović, M. (2014). Kriterijumi kojima se nastavnici rukovode prilikom izbora užbenika. Study conducted by Zavod za udžbenike i nastavna sredstva & Savez učitelja Republike Srbije.

Belgrade.Retrieved from http://www.surs.org.rs/images/dokumenti/mart2014/Kriterijumi%20za%20izbor%20udzbenika%20rezultati%20istrazivanja.pdf & http://zavod.co.rs/image/data/pr/Izvestaj_istrazivanje_01032014.pdf

Makgato, M., & Ramaligela M.S. (2012). African Journal of Research in Mathematics, Science and Technology Education. Vol. 16, No. 1.

Marczak, M. (2012). Selecting an e-(text)book: Evaluation criteria. The Journal of Teaching English with Technology Vol. 13, No. 1. pp 21- 41. Retrieved from http://www.tewtjournal.org/pastissues2013.htm#

Olorundare, S. A. (1998). Textbook Selection: A critical process in the Education Enterprise. Journal of Educational Theory and Practice. Vol. 4, No. 1 & 2. pp 1 – 10.

Olorundare, S. A. (1988). Evaluation of Science Instructional Materials, Ilorin Journal of Education. Vol. 9. pp 103 – 120

Ramaligela, M. S. (2010). A comparative study on how Technology teachers evaluate, select and use commercially prepared Technology textbooks. MEd dissertation at University of Pretoria. Retrieved from http://upetd.up.ac.za/thesis/available/etd-06132011-111219/unrestricted/dissertation.pdf

Suknović, M., & Tummala, M. R., & Čupić, M. (2001). Odlučivanje: Formalni pristup, Faculty of Organizational Sciences, Belgrade.

Suknović, M., & Čupić, M. E. (2003). Višekriterijumsko odlučivanje: Formalni pristup, Faculty of Organizational Sciences, Belgrade.

Vuković, N. (2007). Statističko zaključivanje, Faculty of Organizational Sciences, Belgrade.

LEADERSHIP SKILLS OF A HIGH SCHOOL PRINCIPALS A FIELD STUDY

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Abstract: *Completing the mission of pre-university education institutions is of fundamental importance for the evolution of Albanian society and every society in general. One of the important actors in this context is the school principal; his leadership and vision are substantial components that need skill. In the framework of limited resources and relatively rigid structures, management skills of school principals allow for a combination of all factors within and outside the institution to create a value-added service. The complex situation is increasingly presenting social challenges related to individual performance and governing institutions. These individuals must be teachers, principals and leaders of mentally natural processes as well that occur within schools. But how do they actually occur? How many of these individuals are "equipped" with the qualities needed to fulfill their role as leaders? This article gives a description of a research performed on school principals about their leadership skills in Tirana (municipality and district).*

Keywords: *leadership skills, university education, mission, long-term performance, JEL: M19*

1. INTRODUCTION

University education in Albania has been involved in significant changes for several years. New concepts such as school-based management, the school principal being the manager and leader at the same time, the free choice of textbooks from the school itself, etc., have come along with significant changes in curricula. All efforts lead to the decentralization of Albanian education system and assimilation to knowledge for the purpose of creating an open society. These new concepts require significant structural changes and organizational reform and the role of all actors involved in the process, as well.

Time requires new standards and parameters of evaluation. The quality of education depends on how school is managed, as well as on the abundance of resources available. In the context of significant changes, the re-conceptualization of the role of all actors involved in the process is also being considered. In this paper we focus only on the school principal as a very important central figure for coordinating all the actors and factors that determine the school performance.

The perfect role of the school principal is that of an innovative pedagogical leader and a proactive manager all the while. The complex role of the school principal can be played only when creativity is a lifestyle, not a sporadic quality displayed occasionally. Overcoming the individual and collective understanding of the school principal as a midterm operational director should be associated with an individual social investment in developing his management capacity. It certainly requires a coordination of promotion and selective processes for the subtle position of the school principal, and the creation of a long-term training system based on the school and individual level, too. However that may sound absurd, creating a mentoring system for the growth and development of potential leaders, accompanied where appropriate with specific training for concrete capacity building of management, it seems to the authors of this paper as a valuable measure for long-term rewards. But how is the school principal capacity as a leader presented? Due to inability to manage financial incentives, what is his strength level of motivation and inspiration? What qualities of leader are actually presented? Due to inability to study the entire community of 1980 directors of pre-university education system in Albania, the aim of this paper is to identify the leadership capability of school principals in Tirana.

In the academic year 2011-2012 Tirana region had 171 schools of pre-university education system, 86 in the city and 85 in the districts.

2. THEORETICAL BASIS

Since 1950 when researchers at Ohio State University identified the dimensions called "initial structuring" and "consideration" for the first time, the two dimensional model of leadership behavior has influenced on its behavior studies. The researchers aimed at "determining by means of factor analysis procedures of the smallest number of dimensions that describe adequately the behavior of the leader" (Korman, 1966).

Initial Structuring concerns the extent to which a leader tends to define and structure his role and of his followers, with the efforts to achieve their objectives. This includes the morals that attempt to organize work, work relationships and objectives. The leader resulting with a high level in this dimension can be described as a person who "assigns specific tasks to group members", "expects employees reach certain standards of behavior and certain work", "emphasizes the importance of implementing time ".

Consideration is defined as the extent to which an individual has a tendency to build working relations that are characterized by mutual trust, respect for their dependents' ideas and regard to their feelings. The leaders give attention to their followers" contentment, their status and satisfaction. A leader that results in high levels in this dimension is characterized by: helping subordinates for their personal problems, friendship and goodwill, fair and equal treatment to subordinates and predisposition to communicate. These behavior dimensions of leaders have influenced the research in the field of leadership and have been comprised by other theories of school behaviorism and theories of the case. In fact, many researchers continue to use the two dimensional structure to make the leadership measurements functional (Hall, Workman & Marchioro, 1998; Kuntonbutr 1999 SCANDURA, Von Glinow, 1999 Low, B artolo, Furlonger 2000).

Another concept of understanding leadership and its behavior is the *transactional leader* against the *transformative* one. The *transactional* leader directs and motivates his followers towards the realization of their objectives, clarifying roles and task requirements. Besides this type of leader who is based on everyday relationships to achieve the objectives, there is also another type of leader who inspires his followers to overcome their personal interests for the good of the organization and who is likely to have a great and extraordinary impact. This is called the *transformational leader.* This leader changes the way his followers think and feel, by making long-term problems be viewed in a new different perspective; he regards the followers" interests and needs to be developed; is able to inspire, encourage and excite followers to try harder to reach common targets toward a new required state, described from his vision.

Since 1995, when psychologist Goleman stirred the minds of academics and management by publishing "Emotional Intelligence" book, the concept of emotional intelligence (EI) defined as "the ability to motivate yourself and cope with difficulties, to control impulses and restrain pleasure, to self-control humor and prevent disruption from reversing thinking, to have emotional sensitivity to others and hope " has drawn researchers attention as a prerogative that a successful leader should have. Trying to understand more clearly what personal skills generate an uncommon performance, Goleman, Boyatzis and McKee have been encouraged to analyze data from almost 500 models of competences built for various organizations including academic institutions. The list of components that generate altogether an exceptional performance in top level brings attention mostly to initiative, cooperation, empathy, intellect, cognitive skills such as the ability to understand it all and to see beyond the moment, etc. The estimation of technical indicators and cognitive skills (some of which are actually used as a way to show intelligence quotient, IQ) and the comparison to each of the components characterizing the exceptional performance of the case leaders, highlighted that IE-based skills play an increasingly important role the higher the level of hierarchy is, in contrast to technical skills that are playing a less important role. (Goleman, Boyatzis, McKee, 2008).

Therefore, the higher the hierarchy level of leaders with exceptional performance, the more it is noted that IE was the performance explanatory. When compared to average performance leaders at high hierarchy levels, it is noted that approximately 85% of the difference in their profiles attributes to EI factors rather than cognitive skills such as technical expertise, etc. One of the reasons that can explain this is that individuals have strong selection criteria mainly based on IQ until they reach senior management levels. After meeting all criteria and the required post graduate education levels (MBA, etc.) according to some certain levels of IQ standards, almost all those who reach high levels of hierarchy have an approximate comparable intelligence level with each other. On the other hand, the deficiency of emotional intelligence test draws extensive variations between individuals at this hierarchy level. In this context, when it comes to exceptional performance of high-level executives, superiority goes better than intelligence in simple terms.
The IE report of cognition skills of reality depends on how each of them is measured and the unique requirements of each organization. But Goleman, McKee and Boyatzic believe that EI contributes 80 to 90% (sometimes even more) of the competencies that distinguish an exceptional leader from the common one.

3. METHODOLOGY

3.1 The Cluster Study

Thinking about what skills of leader school principals of pre-university education have, the authors collected preliminary data on the number and structural composition of potential subjects under study. Several persons committed to preschool education leadership were interviewed. This preliminary study figured out that the cluster was very big and unattainable beyond the authors‟ possible capacity. Consequently, the group studied was limited within the territorial boundaries of the authors‟ residency (in Tirana). Due to relevant leading authorities‟ approval there were interviewed 62 public school principals in the municipality of Tirana and 63 public school principals in Tirana district. From a particular cluster of 171 schools (86 in the municipality and 85 in the district), 73 per cent of the interviewees represent a big sample. Practically, there were 72% of pre-university education schools interviewed in Tirana municipality and 74% in Tirana district.

The interview‟s questionnaires were carefully outlined to identify the structuring and consideration skills, and the emotional intelligence features. The paper and pencil interviews were conducted concurrently in one day in each subgroup (in the city and district) under the supervision of the respective author. For the sake of preserving the anonymity there was no other data recorded except the interview‟s questionnaires. Considering the data collection method there is a high probability for outspoken answers.

3.2 The research Instrument

The interview was conducted by carefully structured questionnaires. The instrument "How Good Are Your Leadership Skills?" is a certified questionnaire to identify the supervisor‟s individual leadership skills. The questionnaire contains 18 questions according to Likert scale 1-5 (where 1 defines *never,* and 5 *often).* The questionnaire has been arranged and translated as an attachment below:

1. Questions 2.8 both measure *Self confidence*
2. Questions 10.17 both measure *Positive Attitude*
3. Questions 5.15 both measure *Emotional Intelligence*
4. Questions 6.14 both measure *Creating a challenging vision for the future*
5. Questions 9.12 both measure *People Motivation*
6. Questions 4.11 both measure *Being a good model*
7. Questions 3.13 both measure *Effective Management of Performance*
8. Questions 1, 7, 16, 8 suggest *Providing support and incentives* for subordinates.

The questionnaire was applied to both groups of school principals in the city and district.

3.3 Analysis and Findings

There were several types of analysis conducted on the collected data. Each group data was carried separate and it was evaluated once separately and then all together. In the following there are comments for both groups and relevant graphic data in cases of any differences between these two subdivisions.

The questionnaire contains assertions in English and Albanian in order to minimize the differences in translation perception. The questionnaire was applied to a total of 125 school principals of pre-university education level in Tirana. Following there are some of the findings.

3.4 Regression Analysis

In attempt to notice any polarization of these two-dimension characteristics where normally a structuring and consideration leader operates (or in simple terms, the concern to perform a good job and keep helpful relations of your leadership), two statements were arbitrarily considered as dependent variables by the authors and the other assertions were allocated respectively in the role of independent variables. Specifically, question 4 was considered a dependent variable for the *structuring* dimension (task-oriented) and statement 7 as a dependent variable for the *account* dimension (people -oriented). Statements 1, 3,6,11,13,14,18 were related to structuring, statements 5, 9, 12, 16 were related to consideration. According to the overall group calculation, the regression indicators are:

TASKORINTED=1.363+0.158SUBDIVISION-0.029RESULT-
0.179DIFFERENCE+0.069STRUCTURING+0.136IMPLEMENTATION+O.17PLANNING+0.187SPECIALIZATION

The determination coefficient is ($R^{2)}$ 0.079. This shows that 7.9% is explained by the regression variables that we have taken into consideration, which it also means that the model significance level is low and this regression is inadequate to explain the model.

To better prove the interpretation of regression and variables, it is used Durbin-Watson test with the value of about 2. In this case it has the 2:03 value. This indicates that the variables used in the model are important for determining the *task oriented* and there is no autocorrelation between them.

MAINTENANCE = 3969 - 0.416CONSOLATION + 0.222MORALITY - 0.548 ENCOURAGEMENTS - 0:41 INCREASE.

The determination coefficient is ($R^{2)}$ 0.017. This indicates that 1.7% is explained by the regression variables that we have taken into consideration, which it also means that the model significance level is low and this regression is inadequate to explain the model. To better prove the interpretation of regression and variables, it is used Durbin-Watson test with the value of about 2. In this case it has the 1.905 value. This indicates that the variables used in the model are important for determining the *people oriented-consideration* and there is no autocorrelation between them. According to the questionnaire, the regression analysis indicates that the *consideration* dimension (concerning people) is stronger in this group surveyed. Studies have shown that followers prefer *considerate* leaders, but they are much more efficacious when working with *structuring* leaders (Judge, Piccolo, Ilies, 2004). Seeing that the questionnaire does not correspond to the leader two-dimension-analysis, the author developed a simple percentage processing suggested by the authors of test.

4. ANALYSIS OF QUESTIONNAIRE CONTENT

4.1 Personal Characteristics

1. Self-confidence, Self-confidence is one of the characteristics that determine success in any of the individual's activities. Individuals with high self-confidence are usually inspiring; generally people prefer joining sides of people who believe in themselves and in what they do. If a leader is a positive and optimistic person who tries to do his best in every situation, it will be much easier to motivate people to do their best. According to previous studies, self-confidence is so far considered one of the key positive features of a leader (Stogdill 1948, Mann 1959; Zaccaro, 2007; Sternberg, 2007).

Figure 1: Results for self confidence - Tirana District school principals

From questionnaires completed by school principals of Tirana, it is proved that 51% of respondents" self-confidence has been estimated at maximum levels. So they believe in what they do and what they aim to achieve. However, this feature has not proved homogeneous in both groups under study. If we had analyzed this feature focusing on the differences between the two community groups studied, we will note that (Figure 1 and Figure 2): Self-confidence of school principals in the district of Tirana is only 40% at high levels (5 *), while self-confidence of school principals in the city was 63% at high levels. So there is a high percentage of self-confidence at maximum levels of school principals in the municipality of Tirana, given that the number of the respondents in both groups was almost equal (63 questionnaires in the district of
Tirana and 62 questionnaires in the municipality of Tirana).

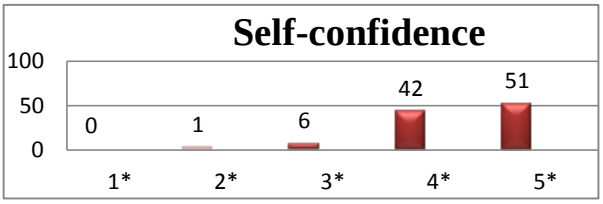

Figure 2: *Results for self confidence - Tirana District and municipality school principals*

2. ***Positive Attitude*** Being positive means much more than wearing a happy face to the world. People with a positive approach can manage a situation realistically and they are prepared to make the necessary changes to overcome any problem. People with a negative approach on the other hand, are often oppressed by stress, the pressure of the situation and the fear of unsolvable situations. This affects on the choice of improper strategies or their improper implementation by engaging in activities that often lead to failure. From the analysis of the questionnaires conducted, we notice that only 9% of the respondents have a low-grade estimation of positive attitude (Chart 3), (or in other words it means that they have no positive attitude at all) and 91% of interviewees have a high or above average estimation. By comparing the two groups (Appendix A) we notice that 13% of school principals in the district of Tirana have a low-grade estimation, whereas only 5% of the respondents in the municipality of Tirana have e low-grade estimation. Generally speaking, district school principals have the highest percentage of low positive estimation.

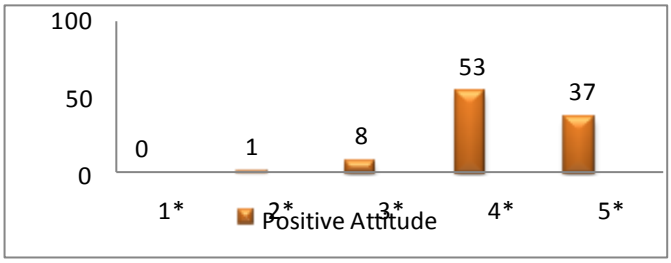

Figure 3: Results for positive attitude for the whole community. Rounded data

4.2 Emotional Intelligence

When someone is upset, I try to understand how this person feels. I feel intimidated when someone criticizes me. According to the authors of the questionnaire, these are two questions that might account for emotional intelligence of those who test. In fact, the authors of this article elaborated the questionnaire considerably by classifying some of the questions under the category of emotional intelligence. A simple percentage processing of answers given to questions 5 and 15 (Figure 4) indicates that 61% of respondents have a maximum self-esteem about the IE feature. Along with the first results between the two groups of respondents, this feature is consistent and there are no significant changes in the results of the two subgroups (city-district).

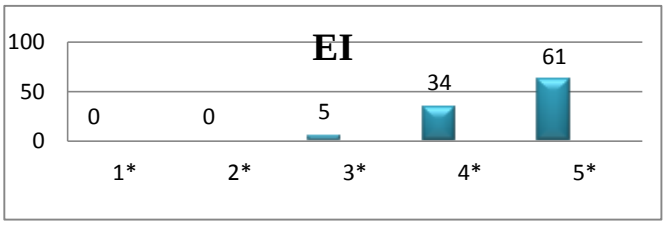

Figure 4: The result of emotional intelligence for the whole community

In regard to the assessment received by school principals in the district of Tirana, it is noted that personal characteristics as confidence, positive attitude and emotional intelligence (according to the authors of the test), are at high estimation levels (according to Likert scale, on level 4 and up), to over 88% of the study sample. These findings on personal features of the study sample are promising and serve as a necessary condition for the school principals to be successful leaders at their schools, despite the limitations public schools confront in meeting their objectives.

4.3 Transformational Leadership

Transformational leadership is that type of leadership which changes goals, values, needs, beliefs and aspirations of followers.

1. Creating a challenging vision for the future. The ability of leaders to create in their mind the image of a desirable future state of their organization and their capacity to convey this image to all the followers is one of the characteristics of a transformational leader.

Referring to the data (Figure 5), we see that 70% of respondents have an average and low-grade assessment of the ability to create a vision for the future.

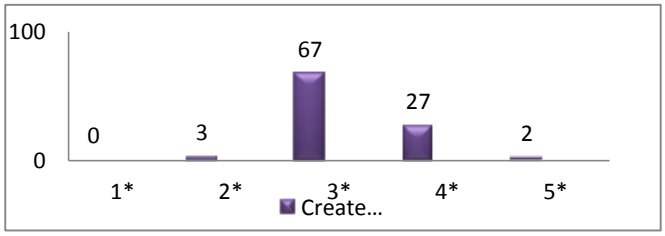

Figure 5: The results for the ability to create a vision for the whole community

The question that naturally arises is: do we want school principals to be transformational leaders? By identifying their role defined within the framework of public service with delineated boundaries and less possible options, the authors" idea was that the school principal should be adapted to the role of a transactional leader. In this context, the above result fits with the logic of the role and can be seen as likeable. Furthermore, other researchers" studies indicate that organizational culture influences the leader"s degree of being transformative (Waldman, Yammarino 1999; Shamir, House, Arthur 1993).

However, school principals are leaders with vision. A vision is a picture of the future of the organization and the results that leaders want to achieve (Grant, 1991). A vision is not a vague desire, dream or hope. Vision comes from the future; it energizes and informs the present.
Vision is important because:

- *The organization inspires action.* A powerful vision attracts on ideas, people and other resources. It creates energy and makes changes happen. It inspires individuals and organizations to continue to give their best.
- *It is a practical guide* for making plans, setting goals and objectives, making decisions, and coordinating and evaluating the work of any project, large or small.
- *And it helps organizations and focused groups stay together*, especially when dealing with complex projects in difficult times.

A director must be a transactional leader, particularly to focus on clarifying roles, the monitoring of progress towards achieving the objectives and giving rewards and penalties as a response to performance (Antonakis, House). Within this framework a leader needs the power that comes from expertise in the relevant field. Using the techniques of strategic analysis for their schools, will help the directors to be not only visionaries, but also realistic about what their schools can achieve. Therefore, the environmental analysis techniques, PESTEL, Porter and SWOT (r Port, M., 1985, Lynch, R. 2006) can help leaders guide their organizations towards the fulfillment of this vision; identify challenges they will have to face and strategic options as well (of course within the framework established by the regional education directors). The authors consider this training course as valid.

2. Motivation of people. A transactional leader must know how to articulate his vision and make the followers want and see the future as described in the vision. Encouraging others to act on achieving the work objectives, motivating followers to achieve individual and institutional performance standards, are areas that define directors leadership capability. The community analysis (Chart 6) indicates that 58% of school principals surveyed consider that they have the maximum ability to motivate followers. As a self-reported indication, (this feature) relies mostly on individual perception and it is more favorable to suggest self-confidence than their leader"s actual behavior.

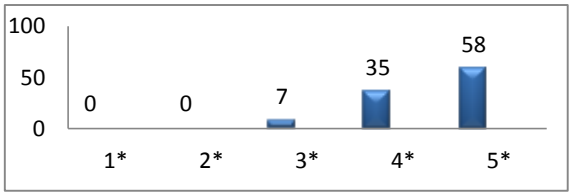

Figure 6: The results of the motivation for the whole community.

3. Setting a good model. Good leaders lead by setting examples. They do what they say and show what they do; they are reliable and highly integrated. They engage in everyday activities if necessary and keep in contact with what happens in the organization. True leaders do not run out of office; they demonstrate actions and values that are expected to be demonstrated by their teams as well. Studies show

that followers expect ever more their leaders to be experts at work and they become willingly subjects of the authority of their expert leaders.

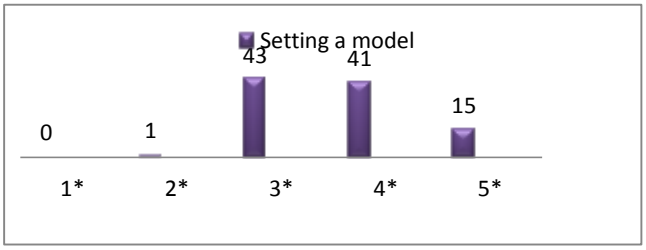

Figure 7: The results on the ability to set a good model for the followers - whole community

In the community research it is noted (chart 7) that only 15% of respondents have a maximum estimation of their ability to set models for their subordinates. On the other hand, this maximum estimation in these two groups relates to respectively 10% of school principals in the district and 20% of school principals in the city. Just as the ability to create inspiring vision and the ability to set a good model for followers, too, indicate that 44% of respondents admit to have an average or below average estimation of their ability. But in contrast to the characteristics of having a vision (not necessarily at high levels) a low-rate perception on personal pattern as a model of behavior is not a good indicator. We can even say that it is an indication that may cancel all the aforesaid values at some perspective.

4. Effective management of performance. Effective leaders tend to define their own role and structure and of their followers", in an effort to achieve the objectives. This includes behavior that attempts to organize work, work relationships and objectives. The leader with high-level-results in this dimension can be described as a person who "assigns specific tasks to group members", "expects employees reach certain standards of behavior and work", "emphasizes the importance of implementing deadlines "," relates performance to rewards ", etc.

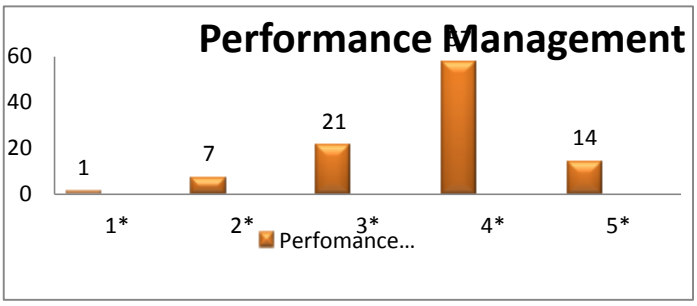

Figure 8: Result s on effective management capability of performance for the whole community

With regard to effective management of performance, 57% of respondents have a satisfactory estimation of this ability, while 14% of the respondents have the highest estimation (Chart 8). Nearly 30% have an average or below average estimation level of this capability.
These results were predictable by the authors of the study. In general, the feeling of being an insignificant factor in the performance management of subordinates, mainly due to not possessing sufficient instruments for material rewards or promotion regarding performance is a phenomenon that occurs frequently in the mindset of public institution directors. Public school principals cannot discount for this stereotype. We believe that directors" training plays an important role in changing the meaning and enhancing their understanding of the different elements of reward and non-material value on their subordinates in the Albanian context (Koli, Dumani, 2000; Kasimati, 2011).

5. Support and promotion of subordinates. To be motivated, men need more than a list of tasks to be performed every day. They need interesting, non monotonous and challenging jobs to develop their skills, have tangible results and deserve gratitude for what they do (Herzberg 1959). Fortunately, teachers" job is one of the most motivating in this context for as much as it has all these features. Teachers „leaders have no obligation of motivation rather than harmonize all factors in order that work motivation comes along with performance satisfaction.

Unfortunately, the analysis of the results observed (Chart 9) indicates that 23% of respondents have a satisfactory estimation of the ability to provide support and encouragement to subordinates, and only 2%

have a maximum estimation level of this ability. Meanwhile, all the rest (75%) of the respondents have an estimation level of their ability to develop average and below average support.

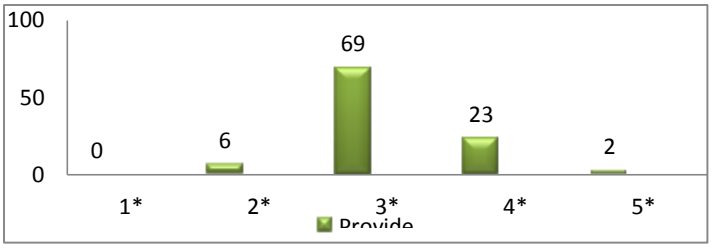

Figure 9: Results on the ability to provide support – whole community

The authors of this study think that low skilled perception in this feature is explained within the context of leaders‟ perceived role in public organizations already interpreted.

5. CONCLUSIONS AND RECOMMENDATIONS

Based on personal perceived and self-reported characteristics, this article aims simply to identify some features of pre-university school principals in Tirana district for the position of potential leaders. The study does not account on personal effectiveness or institution indicators under school principals‟ administration. Neither is described the way their followers (subordinates) perceive their leaders. The concentration of the community surveyed in only one region (the capital) does not necessarily generalize the outcome of data processing.

According to House (1996) effective leaders possess and make use of more than one administration method. Regardless any test results (commented furthermore in the article), school principals are encouraged to adapt to different behavioral categories of the leader and also try to exercise new practices when necessary, in accordance with the characteristics of their followers and institutional objectives. Education directorates can implement on their part developing programs to enhance leadership features of school principals.

6. REFERENCES

Antonakis, House, R.J., “The Full-Range Leadership Theory”.

Bartolo, K., Furlonger, B.,(2000), ”Leadership and Job Satisfaction among aviation firefighters in Australia, *Journal of Managerial Psychology*, vol.72, pp 441-62.

Goleman, D., Byatzis, R., McKee, A, The New Leaders. Transforming the art of Leadership, into the Science of Results, 2008

Grant, R.M. (1991). The resource-based theory of competitive advantage, Strategy: Critical Perspectives on Business and Management, pg. 135.

Hall, R.J., Workman, J.W., Marchioro, C.A., (1998), ”Sex, task and behavioural flexibility effects on leadership perceptions” *Organizational Behaviour and Human Decision Processes*, vol.74,, no.1, pp 1-32.

Herzberg, F., Mausner, B., Snyderman, B.B., (1959), The *Motivation to Work* (New York: John Wiley & Sons, 1959).

House, R.J., (1996), “Path-Goal Theory of Leadership: Lessons, Legacy, and a Reformulated Theory,” *Leadership Quarterly,* 1996, pp 323-52.

Judge, T.A., Piccolo, R.F., Ilies, R., (2004) “The Forgotten Ones? The Validity of Consideration and Initiating Structure in Leadership Research,” *Journal of Applied Psychology*, February 2004, pp 36-51.

Kasimati, M (2011), “Job satisfaction and turnover under the effect of person-organization fit, in Albanian public organizations”, *Journal of East European Management Studies*, Vol.16, issue 4, 2011, pp 313-37.

Koli, Z., Dumani, B. Motivimi dhe efektiviteti i potencialit njerëzor, *Ekonomia dhe tranzicioni* Nr.1, 2000.

Kreitner, R., Kinicki, A. Organizational Behavior, 8th International Edition, 2009.

Kuntonbutr, C., (1999), A Comparative Study between Thai and American Subordinates‟ Perception of Managerial Values in the Banking Industry, unpublished dissertation, University of Sarasota, US.

Lynch, R. (2006), *Corporate Strategy* (4th ed.) (Harlow: Pearson Education Limited)

Mann, R. D., (1959), “A Review of the Relationships between Personality and Performance in Small Groups,” *Psychollogical Bulletin*, July 1959, pp 241-70.

Porter, M. (1985), *Competitive Advantage: Creating and Sustaining Superior Performance*, (Location: The Free Press)

Scandura, T.A., Von Glinow, M.A., Lowe, K.B., (1999), "When East meets West: Leadership "best practices" in the United States and Middle East", in WH Mobley (ed) *Advances in Global Leadership*, vol.1, pp235-248.

Shamir, B., House, R. J., Arthur, M.B., (1993), "The Motivational Effects of Charismatic Leadership: a Self-Concept Based Theory," *Organization Science*, November 1993, pp 577-94.

Sternberg, R., (2007), "A Systems Model of Leadership," *American Psychologist*, January 2007, pp 34-42.

Stogdill, R. M.,(1948),"*Handbook of Leadership,*" New York, Free Press, 1974.

Waldman, D.A., Yammarino, F. J., "*CEO Charismatic Leadership: Levels-of-Management and Levels-of-Analysis Effects*," April 1999, pp. 266-85

Zaccaro, S.J., (2007), "Trait-Based Perspectives of Leadership", *American Psychologist*, January 2007, pp 6-16.

PRACTICAL LEARING OUTCOMES OF ADULT EDUCATION INNOVATION IN U3A

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Abstract: *The paper is based on one decade experience in the management of adult education and training, in particular offered by the university of the third age The paper is an attempt to highlight changing and growing education needs of adults learners and their corresponding changes and trends in education provision. Implementation of the research results of adult learners´ needs and competition analysis is fundamental for the efficiency of the educational process. The most relevant features of the innovated adult learning/teaching methodology incorporating blended learning and exploiting the elements of coaching to achieve expected learning outcomes, are characterized. The desired learning outcomes are the change in individuals, learners and teachers, and the acquisition of practical skills and competences. The author tries to underline the positives and negatives of a new approach to adult education both for the teachers and learners. The Czech population is still getting older and education provided by Universities of the Third Age (U3A) makes their lives active and helps combat ageism.*

Keywords*: Lifelong learning; adult education; motivation; coaching, blended learning, practical outcomes,*

1. INTRODUCTION

Lifelong learning, lifelong teaching, adult education are terms widely used for the education aimed at adults within the European Union education framework, The Czech Republic included. This variety of terms designates the activities leading to widening or deepening the learning process during the life span of a human being. These are carried out in various forms of formal, non formal and in formal education, academic courses, commercial courses, academies, training, preparatory courses, and universities of the third age included. According to Rubenson, European Union, the OECD and the UNESCO proclaimed three fundamental attributes in 1976 that lifelong learning is based on (Rubenson, 2011):

- It is lifelong and therefore concerns everything from cradle to grave
- It is wide-life recognizing that learning occurs in many different settings
- It focuses on learning rather than limit itself to education.

Lifelong learning provided as courses of Universities of the Third Age is an important part of the holistic education, functioning as a corrective to the regular educational system and an innovative mechanism of the educational system.

The objective of this paper is to present ten years experience within the lifelong learning with the provision of the adult education in the University of the Third Age and the application of a new approach to its provision by Business School Ostrava plc. In the first part of the paper the approaches of both the learners and teachers to adult education will be described. In the second part of the paper the results of the research will be presented. The questioning and interviews of 300 respondents took place in 2012 – 2013. The same number of respondents was questioned in Spain and Turkey within the international project of the Grundtvig programme. Though the results show almost identical data in the participating countries, the paper describes findings, and their implications in adult education for the Czech Republic.

The Courses of the University of the Third Age are developed and designed for adult learners, aged 55 and more, which means for experienced mature individuals. Learners of this age had rather limited opportunities for university studies in their young age due to limited access to high education strictly controlled by the government. Minority of adult learners is graduates, but most of the adult learners were quite successful in their careers. Universities of the third age are quite popular within the European Union, and are attractive for and enjoyed by adult learners in the Czech Republic as well. A variety of courses are offered both by public and private high education institutions, while the courses of public high education institution are financially supported by the Ministry of Education, Youth and Sports, the private ones are not eligible for the state subsidy according The Higher Education Act (Ministry of Education, Youth and Sport, 2010). Apart from the educational outcomes the social impact of the education courses is widely promoted and frequently financially supported by municipalities. It is assumed that the person, who is trained, educated on a

permanent long term basis and who maintains active lifestyle has a better chance to live longer, healthier and independent life.
The population of the developed countries within the Europe, the Czech Republic included, is growing older, which is the most charactistic feature of the demographic development. According the Czech statistic institution the inhabitants aged 65 and more will be represented by 22.8 % of the total population in 2030, populace, and by 31.3 % in 2050, which stands for approximately 3 million persons. In 2007 persons aged 65 represented 14.6% of the Czech population. The demographic prognosis expects approximately half a million inhabitants aged 85 and more in 2050 (124.937 in 2007). The National Action Plan for supporting the positive getting older process for 2013 – 2017 was accepted by the Ministry of Labour and Social Affairs., which is in compliance with national priorities and Regional implementation strategy of Madrid international action plan pro the getting older issues (Organisation of United Nations, 2002). Among seven priorities the lifelong learning is included.

The Czech population is getting older. The approximate number of new pensioners is 150 000 each year. These are offered a variety of services: counselling, leisure time activities, palliative care, help lines, health care, special services provided by non-profit organization, in particular. Universities are also very active in this field, offering individual courses, universities of the third age, academies. Though the adult learners may be enrolled in regular studies, they prefer taking the courses without the ambition to be awarded the degree The course content, the affordable price, and the professional, pedagogical and human qualities of teachers are the key criteria for the decision making process of the applicants for the adult learning. High education institutions are appreciated by adult students as the top quality education guaranty.

Generally the contents (curricula), teaching methodology (pedagogy), and the learning outputs of various types of adult education differ. In some learners are guaranteed eligibility for further studies, in others they gain "only" the knowledge and social ties. The knowledge, social networking and especially improvement of the quality of life are considered the crucial issues highly esteemed by adult learners. The courses for adult learners aged 55 and more are typically called the courses for seniors, the courses for the retired, or the University of the Third Age, which is perceived by adult learners and graduates as a very pejorative or even discriminatory labelling and the evidence of ageism.

2. METHODOLOGY

The Courses of the University of the Third Age are particularly developed and designed for adult learners aged 55 and more. Universities of the third age became very popular, they are attractive for and enjoyed by adult learners within the Czech Republic. Restricted opportunities to enter university studies before the Velvet revolution may be one of the significant causes of the unceasing interest in courses offered by universities. The adult education is frequently promoted and financially supported by municipalities within their educational and social initiatives.

Study groups may be organised of large scale, but those of 20 persons at maximum help avoid anonymity and develop positive, warm climate and relaxed atmosphere. All learners are charged fees. Almost 30 per cent of them are graduates, but majority of adult learners gained the experience in managerial positions. Many are still economically active, with full time and part time jobs, most are active in their hobbies, family activities. Although the female learners prevail, the numbers of male learners tend to increase in past two years. The teachers face an extremely highly and permanently motivated group of learners, with fairly high expectations and high demands on the teacher´s expertise and pedagogical skills. The length of studies of adult learners of the University of the Third Age may differ, but four semesters, which means two academic years are customary. Students who complete obligatory courses, usually four core subjects, are invited for the final ceremony similar to graduation ceremony.

This paper presents the results of research that was focused on the approach to adult education aimed at required innovation and development of adult education courses. The paper is based on data gained by the method of questioning, and data collected in interviews. The questionnaire survey was carried out to find out the learners needs and expectations and to gain the feedback by learners for the teachers. The aim was to gather information about learning/teaching process. Questioning was conducted after completing four subjects.

300 respondents, learners of the University of the Third Age executed in different towns took place in questioning; the same numbers participated in the same research done in Spain and Turkey. The research methodology was agreed on by Grundtvig project partners. The core questions, both open and closed, aimed at getting the response to the assumptions that 1. So called traditional approach to education, it means giving the lectures by frontal teaching, is still appropriate for adult learners aged 55 and more, 2. The

adult learners aged 55 and more avoid using new technologies and 3. The adult learners aged 55 and more are neither willing nor are they able to change their approach to learning.

3. ADULT LEARNERS 55+

When designing the courses for adult learners aged 55 and more we strongly believed that so called traditional way of teaching, ex cathedra method, when the focus is on the activity of teachers not on the activity of learners, it means delivering lectures to listeners, would perfectly suit the learners. These could enjoy traditional ex cathedra teaching while listening to the speaker and taking the notes simultaneously. We were convinced that especially graduates appreciated coming back to the environment they were familiar with in their youth. Secondly we assumed that using modern technologies would be not so much popular with adult learners and finally we guessed that adult learners would be not willing to change the attitude towards learning which they got used to.

Surprisingly for us the learners got involved in their studies quite spontaneously and became eager for new and different ways of delivering education they had not experienced during their previous studies. Since the adult learners strongly desired to be actively engaged we understood the must for a dramatic change of our attitude and mindset to adult education.

Three figures are presented.

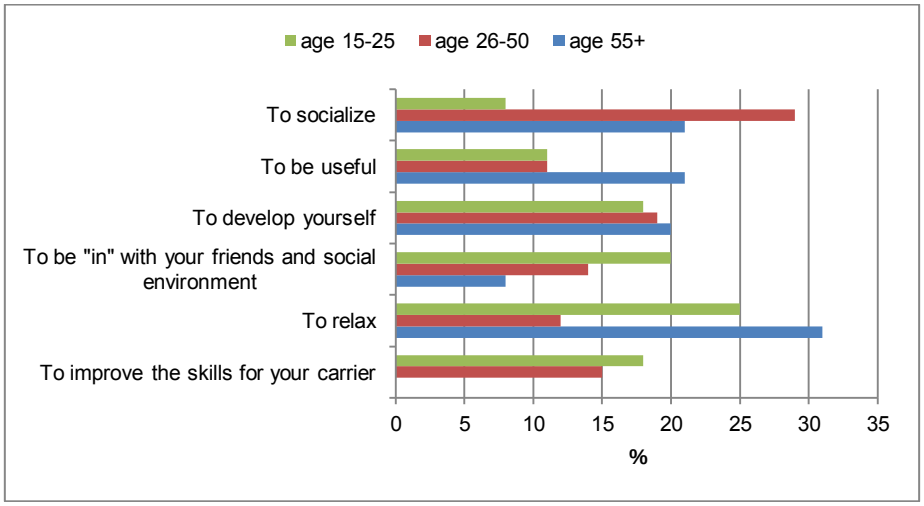

Figure1: The expectations: Why do I attend the courses, 2013, Grundtvig-3G

In Figure 1 the expectations, reasons for attending courses are described. Three age categories were questioned so that expectations, needs could be compared. To relax, socialize, be useful, and develop yourself were the most frequent replies. To develop yourself especially in the field of modern technology was among the priorities. The same questioning took place in Spain and Turkey, with the same number of respondents and almost same results.

Figure 2 describes the experience with previous education university studies or secondary school education. Although theoretical courses were appreciated respondents mentioned that these were so much not enjoyed. The same questioning took place in Spain and Turkey, with the same number of respondents and almost same results.

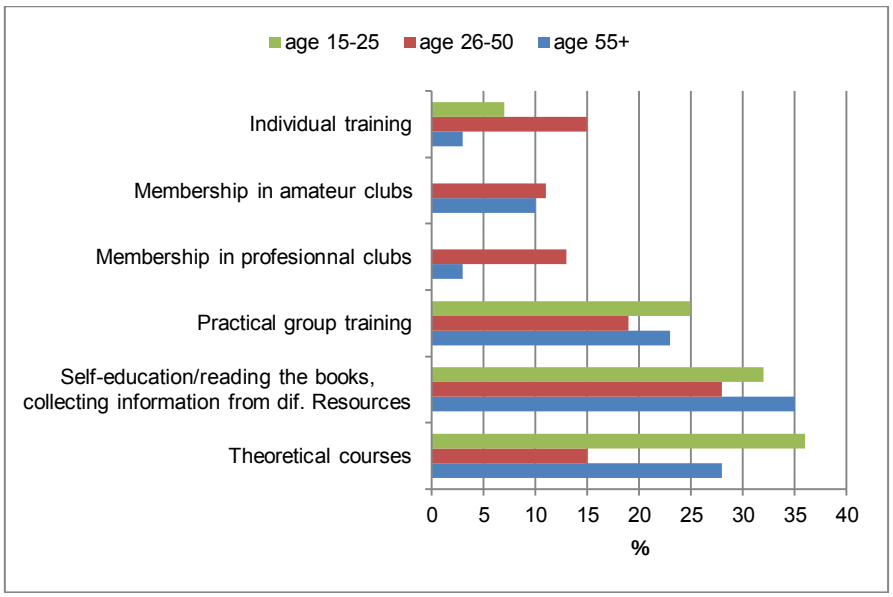

Figure 2: Which type of education I have the experience with, 2013, Grundtvig-3G

Figure 3 expresses the needs and wishes of adult learners. While the theoretical courses took the bottom place, practical group training, self studies, and individual training were preferred by almost the same percentage of replies. The same questioning took place in Spain and Turkey, with the same number of respondents and almost same results.

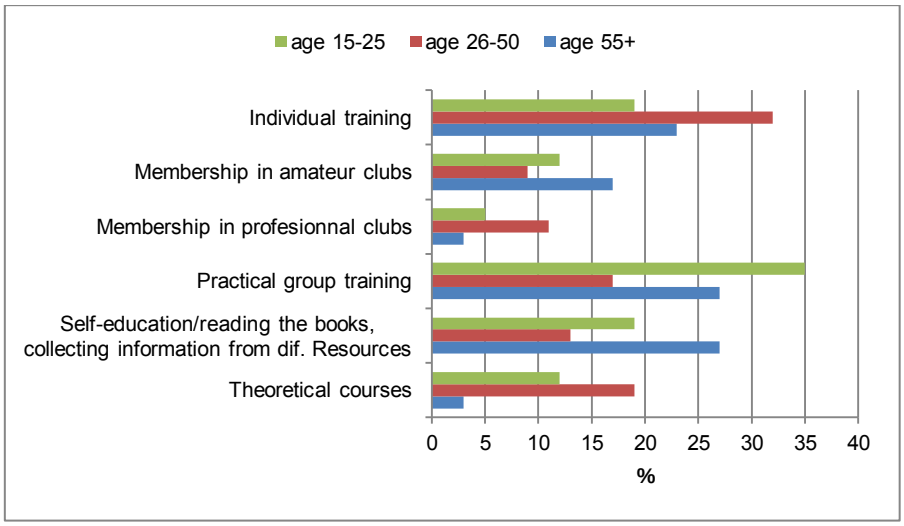

Figure 2: Which type of education do I prefer now, 2013, Grundtvig-3G

Teaching methods

The questionnaire results revealed the following findings: adult students prefer individual form of training in order to deepen and broaden the knowledge in a field that interests them, they prefer individual pace, and although they do appreciate the theoretical courses, their first choice courses are the learning by doing courses, practical group training, the courses with the practical outcomes. Learners do not want to be passive listeners only; being passive consumers of information is not satisfactory for them anymore. They expect being given assignments, being evaluated by the teacher and other learners, being given the feedback. Sharing of ideas and discussions on agreed topics are considered a valuable part of education. Debates, organized discussions were supposed to be strictly controlled by the teacher. Teamwork was described as a new and positive experience, individual projects processed as power point presentations were found enriching challenges.

Meeting on a regular weekly basis brings the adult learners a new quality of life and new challenges. Assignments and project work help connecting generations. Development of verbal skills was considered another benefit.

Subjects
Within the University of the Third Age four compulsory subjects are included. These are aimed at learning and developing computer skills, foreign language skills, and learning the law and legal system issues and fine arts. The subject focused on developing PC skills was appreciated most of all the subjects, especially due to its practical outcomes, while the subject about fine arts was appreciated more than the subjects about a foreign language and law and legal system. Subjects which were offered as voluntary, usually after completing two year course, were appreciated high, because being attended only by those who made the choice (psychology, philosophy, music).

Based on the research results we can say that the offer of the subjects was not the issue to be changed and dealt with dramatically. Three areas to be addressed for the prospective innovation of the course correspond with the assumptions we made at the beginning of developing the adult education courses for the University of the third age and which proved to be our prejudice: traditional ex cathedra teaching complies with the adult learner, adult learners are not excited about using modern technologies, and adult learners are not willing or are not able to change the attitude towards learning which they got used to.

3. NEW MINDSETS

In order to integrate the research results on the demands and wishes by adult learners into innovation of current courses their knowledge and skills, the courses curricula were innovated and new pedagogical approach accepted. Motivation of the learners, their life experience and time at disposal were the positives, while the need to make a change in the attitude to education both by learners and teachers was the only negative. The change of the approach to education, pedagogy, and understanding the need for this change was a little slow and difficult process (but directly associated with the participants´ age). This change occurred during the first course, and was easily adopted in follow up courses. Once understood and accepted, it was appreciated both by the learners and teachers.

New philosophy, new mindset
The initiatives were taken in two areas: the first being to change the attitude, mindset, and the second to change teaching methods. Changes made in one area were immediately reflected in the other.

We did not have to deal with the offered subjects. All the subjects are considered to be needful and attractive.

To improve our teaching methods and the efficiency of education process we decided for a new philosophy of education, which involves changing the focus of education from the process of lecturing to the learning process (Jovanovič et al., 2012). Before implementing different teaching methods the change of the attitude and mindset is necessary. The change in the attitude and mindset is a demanding process. The existing attitudes and mindsets are being developed over a long period of time, and in a way are getting isolated from the society, (Jovanovič et al., 2012). The change of our concept of adult pedagogy was based on incorporating the elements of coaching, a combination of specific attitudes and tools. We looked for a successful model management education in the sense of leadership. We have experienced that success could not be achieved by still increasing effort, more intensive work. I believe that many aspects of coaching were applied intuitively. Initially some approaches seemed to be completely unacceptable, provoking both learners and lecturers. And they do repeatedly provoke new learners every academic year. Our goal was to make a change of thinking, develop action, encourage initiatives and trigger creativity.

The change of the mindset and the attitude towards adult education means the dramatic change of a student's and teacher's roles. The teacher is becoming an advisor, mentor, encouraging learners, but withdrawing from ex cathedra, frontal, teaching. Teachers take much more active role in developing learners speaking skills. Developing reading, writing and listening skills is sufficiently supported by the study material, frequently online resources.

The goal to strengthen student's skills to organize and monitor their performance, control their studies and take responsibility for own learning results was not easily accepted neither by learners nor teachers.

To stimulate the change of traditional roles of learners and teachers our efforts were be directed into five areas:

1. Restriction of the autocratic style of leadership; there is no need for the lecturer to know absolutely everything, to have a solution ready, and to be the first always.
2. Listening. The lecturer learns to listen with no need to make comments; he listens to the opinions and attitudes.
3. To be open, warm: letting the others take the initiative.
4. To help people think more deeply; providing them feeling that the learners are the subjects of the action, developing them in the professional and humanistic ways.
5. To ensure self-reflection, free from stereotypes.

A newly developed and properly accepted attitude to adult learning/teaching process had a very positive impact on the relationship between the learners and teachers. If students perceive the empathy, acceptance and congruence in the teacher´s behaviour, they do not feel threatened, and start be more open to new experiences, which in turn will enhance their confidence and encourage acceptance of responsibility. New and creative solution can be found more easily. (Whitmore,1994)

The teachers training for the adult education included learning the following attitudes and tools:

- Empathy
  The teacher tries to feel the learner´s feelings. He makes no comments. The learner gets the impression: He wants to understand me. This is not: He understood me.
- Acceptance
  Respect is in no relation with the warmth, quality of previous and current experience, feelings, successes, failures. It is the respect with current possibilities, capability and borders of the learner.
- Congruence
  Comprises of sincerity, consistency, authenticity
- Trust
  The teacher brings the learner the confidence, the trust that he is able to develop independently of the starting position and at the individual pace. Each person is fundamentally perfect and has the potential not used previously but being ready to develop. The assumption is that people tend to behave according to the expectations of others.
- Sincere interest
  Interest in the learner´s world, what is his world like, how he perceives it, how he enjoys it.

Our starting point is based on the adult learner's dissatisfaction with the results alongside with his willingness to develop his potential. The tools we used can only support what we had prepared and built by our attitude. The tools not being fully implemented in the pedagogy do not guarantee the success. (Stacke, 2005)

- Creating a relationship
  requires the time investment, ideally in sharing a common experience, as well as the mastery of voice and body language control.
- Asking questions
  asking questions by the teacher is not a sign of uncertainty; questions can stimulate creativity, development of knowledge, skills. Questions generally indicate the respect and interest, primarily because the interviewee is by being asked perceived positively. You can apply a wide range of questions.
- Active listening
  Is related to keeping the eye contact, elimination of disturbing moments, maintaining the interview communication share 50% to 50%, providing sufficient time or the giving the answer, the mastery of keeping and managing the silence.
- Language metamodel
  During our communication, in the dialog, we voice only a part of what we experienced. There are issues of the missing information, reasons why they miss, reasons for applying non-specific verbs, words.
- Expressing and communicating mutual expectations
  Learning to formulate expectations, desires, direction, learning how to define specific goals in individual plans. The conscious and unconscious expectations help develop the educational framework. Communication of mutual expectations is a turning point for learners and teachers. For many participants it is a completely new experience, after which their further development, feelings of satisfaction gradually start evolving.
- Giving and receiving feedback
  Recognition of constructive criticism.
- Reframing
  Finding what is good in a particular situation.

- Dealing with errors and suggested solutions
  Not to avoid mistakes, get rid of perfectionism.
- Using mental techniques
  Applying visualization, relaxation indicates the quality of the relationship between the learner and teacher. Visualization requires to get rid of stereotypes, prejudices, routine. It helps clarify the relationship, develops imagination concerning the future, and removes barriers. (Whitmore, 2007)
-

Mental activities must be maintained, enriched and strengthened though self motivated learning and self education. People can learn about the world by using their common sense and their common sense motivates people to reach the treasuries of knowledge that will enrich their personalities and minds by correcting their own minds and education. (Karavidic et al., 2012)

Teaching methods
Discussions, teamwork, project work, debates accelerate developing verbal skills and help learn the world and its inhabitants and correct the minds and education. High verbal skills are correlated with the decrease in physical aggression by Boone and Montane (Bellon, 2000). Once someone feels capable of responding verbally they fell less inclined to resort to physical force. The learners learn to respect the opposite side. Discussion, debates increase argumentativeness without increasing verbal aggression (Colbert, 1994).

Strengthening the individualization of education and the consequent individualization of learning pace, enhancing practical aspects, practical outcomes, enhancing interaction by involving students in their own learning, based on their learning style, and particularly the sharing of tasks and follow up discussions was partially supported by introducing E- learning.

In the academic circles there is no doubt that E-learning is a significant method of education in the modern world, which backs the modernization and optimization of the educational process in all spheres of modern society. Blended learning, the issue of IT has to be integrated in a very efficient way. Mother tongue, foreign languages and computer languages are ways of communicating and their command creates prerequisites for active participation in a human life, while expertise in the field enriched with the active command of these prerequisites is becoming a must in one´s, not only professional, life nowadays. We strongly believe that e-learning courses will be more theory-led than technology-led in the future; as it is supported by Horton's opinion who claims "E-learning does not change anything about how human beings learn"[1].

The online study material, its structure and learning instructions for use were user friendly. When developing study material close cooperation with IT experts cannot be underestimated at any stage, especially when defining specific needs for the study material, online course structure and the target group of learners.

Learning is a demanding process of acquiring knowledge, abilities and skills. It is the teacher´s approach to learners, which can influence the quality of the educational process, and deal with constrains of online learning process, so the teacher´s role can in no case be neglected. When introducing E-learning the idea was to exploit the online learning as much as possible. Learners were expected to study individually, not only during the lessons in a classroom. The goal was to strengthen student's skills to organize and monitor their performance, control their studies and take responsibility for the results. The opportunity to work at individual pace, and mostly online was considered the benefit by majority of learners while others appreciated more the opportunity to study during the contact lessons. During the lessons in a classroom the learners present their study results, share the experience and discuss.

3. TEACHER´S CONSTRAINS

Even small changes can have a big impact; each activity influences the whole system. If you live in a rather authoritarian environment, both parties are accustomed to issuing and receiving orders. In such an environment, we cannot expect independent personality. For the personal development building a relationship between the learner and teacher and among learners themselves, patience, communicating expectations, consistency, creating a common vision, seeking allies in community, in a family, and friends, networking are needed. When creating the fragile relationship the statements supporting non supportive approach must be excluded from the education process, those of the adult learners exclusively. Statements like I am too busy, Talking is better than asking, They are all the same, I have being doing that for ages have proved to be very contra productive.

[1] Islam, K. (2002) *Is e-learning floundering? Elearning Magazine, 3(5), 22-26*

The need for the change of the attitude towards adult education by teachers was in some cases, dare I say, accepted with more difficulties than by learners. Particularly the teachers with no previous experience with adult education learned a new role more or less that of a tutor, counsellor, or leader with some constrains. If they succeeded they got far beyond their former professional activities and started enjoy new ways of teaching. The emphasis put not only on the education in individual subjects, but also on the personal development of the participants was appreciated by teachers as well. Due to implemented changes, getting the inspiration, motivation, deep insight, taking the corrective measures during the educational process of adult learners became continuous and valuable part of the learning process both for learners and teachers.

The change of a student's and teacher's roles proved to be difficult. The teachers acting as an advisor, mentor motivates and encourages learners. If ex cathedra teaching s abandoned by the teacher takes much more active role in developing learner´s skills. With the aim to strengthen student's skills to organise and monitor their performance, control their studies and take responsibility for learning results the teachers have to adhere to the new role, which cost them a lot of efforts, as they confess. They admit that the need for the change of teaching methods should be brought to the fore with more emphasis.

After the new teaching methods were accepted the teachers noticed a better quality of the relationship between adult learners and teachers, tendencies towards better intergeneration understanding and especially improvement of verbal skills. Though the teachers admit inconvenience, in some cases lower self confidence if letting the more active role to adult learners they notice the increasing level of adult learner motivation and increased level of the assignments quality. The constrains and inconvenience perceived by the teachers during building a different kind of relationship between learners and teacher slowly faded away. The different quality of relationship merged into a more efficient way of education even though the teachers confess that controlling, managing, and leading the teaching process towards changes in individuals based on the new mindset was considered as a very demanding task.

Practical outcomes
Due to the change of the mindset and new philosophy of the adult education the practical outcomes, so needed and expected by the adult learners and expressed in the questionnaires and interviews were achieved. All are considered to be triggered by attending the lifelong courses for adults, the University of the Third Age, by the adult learners. A variety of activities either on a regular basis or unique basis can be regarded the practical, valuable learning outcomes increasing one´s professional or private life. Below you find the listed ones: setting up a nonprofits organization, membership in the international pet club, working with PC: designing web pages for personal use and for business purposes, solving difficult family situation (divorce, marriage), introduction of new family traditions, starting a business (business license), organizing leisure time activities on a regular basis for community members, further studies, solving a difficult situation (illness, finance), charity activities, giving lectures, offering practical training, developing teaching materials, participating in international project, travelling abroad for specific kind of sightseeing, organizing exhibitions.

These effects manifested in the listed areas, include creativity, family planning, care about children, quality of learning, appreciation for arts, culture and learning, health care services, political participation, understanding of social issues, acceptance of social changes, the sense of shared culture and social solidarity. (Karavidic et al., 2012)

5. CONCLUSION

Undoubtedly the primary objective of adult education, the University of the Third Age included, remains the provision of education and increasing knowledge, skills and abilities. Lifelong learning proved to be an integral part of holistic education: a corrective of the regular educational system and an innovative mechanism of the educational system. (Karavidic et al., 2012)
Due to changes in the attitude towards adult education provided for learners over 55 and more, the practical outcomes were reached as being illustrated by a wide variety of activities and events. I do believe the results came into existence due to the efficient interaction of learners and teachers, interconnection of theory and practice. These are the evidence, that education provided to adult learners significantly improves the knowledge levels, intellectual tendencies, influences their self esteem, helps people in finding their own identities and in their individual choice of lifestyles, and to a significant extent increases practical competencies, flexibility and tolerance in their capacities of citizens, workers, family members and consumers, and influences the choice of leisure time activities, their health and their general abilities for coping with problems in life. (Karavidic et al., 2012) Beside the intellectual gains particularly the direction for one´s life are appreciated.

REFERENCES

Bellon, J. (2000). A research – Based justification for debate across the curriculum, Argumentation and Advocacy, Vol. 36 Issue 3, p161-175, Georgia State University, Atlanta, Georgia

Birch, P. (2005). Coaching. Brno: CP Books

Colbert K. (1994) Replicating the effects of debate on argumentativeness and verbal aggression. The Forensic of Pi Kappa Delta, 1-13.

Grundtvig project Connecting three generations, 2012-2014.

Haberleitner, E., Deistler, E., & Ungvari, R. (2009). Controling and coaching in everyday practice. Praha: Grada Publishing, Management.

Jovanovič, S., Dragičevič, N. & Čirovič, M. (2012). Symposium Proceedings XIII International Symposium SymOrg 2012. University of Belgrade. Faculty of Organizational Sciences. Zlatibor, Serbia. ISBN 978-86-7680-255-5.

Karavidic, S., Karavidic, M. C., Jovancevic, D., Cogoljevic, D. & Cogoljevic, M. (2012) Management in Education – Educational Benefits Factor of Socio-Economic Development in Serbia. Journal of US – China Public Administration, Vol. 9, No. 12, p. 1455-1462. David Publishing.

Ministry of Education, Youth and Sports. (2010). Higher Education Act. Retrieved from http://www.msmt.cz/areas-of-work/tertiary-education/higher-education-1.

Ministry of Education, Youth and Sports. (2012). The National Action Plan. Retrieved from http://www.mpsv.cz/files/clanky/14540/NAP_2013-2017_070114.pdf

Rubenson, K. (2011). Adult Learning and Education. Kidlington: Elsevier.

Stacke, E. (2005). Coaching. Praha: Grada Publishing

Whitmore, J. (1994). Coaching. Praha: Management Press

Whitmore, J. (2007). Coaching. Praha: Management Press

ELECTRONIC BUSINESS

SOFTWARE DEFINED NETWORK INFRASTRUCTURE FOR AN E-LEARNING CLOUD

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Abstract: This paper introduces software-defined network infrastructure model for e-learning. The goal of this paper is to analyze the potential of software-defined networks in cloud environment of educational institution. This paper provides an overview of current relevant concepts related to software-defined networks. The second part of the paper gives the proposal of a software-defined networks implementation model within the cloud infrastructure for Laboratory for E-business at the Faculty of Organizational Sciences in Belgrade.

Keywords*: software-defined networks, OpenFlow, cloud computing, network infrastructure, e-learning*

1. INTRODUCTION

Educational institutions have high standards that their IT systems must fulfill. Beside high scalability, availability and security, there are specific requests for implementation of various e-learning services. Development and implementation of new e-learning applications and services demand dynamic environment and new network technologies.

With increasing amounts of data in modern computer networks there is a need for a simple and scalable network architecture, which enables efficient use of different e-learning applications. Traditional computer network, based on a hierarchical model, can respond to the requirements regarding the standard client-server communication. However, modern information systems of educational institutions require dynamic architecture, so it is necessary to make some changes when it comes to network infrastructure. Another important requirement is simple network management. In traditional networks there is a need to know a large number of network technologies and to configure large number of devices in order to implement a service. Another issue is the problem of interoperability since today's network environments are mainly multi-vendor.

Cloud computing is the most common solution for educational network infrastructure (Sultan, 2010) (Radhakrishnan, Chelvan, & Ramkumar, 2012). This concept brings many advantages since it provides high degree of network virtualization and scalability. But, there is still a request for very simple network management and possibility to develop different applications and realize various research projects without knowledge of complex underlying network infrastructure.

The above problems can be successfully solved by introducing the concept of programmability of computer networks, which involves the separation of the process of control and forwarding data. Software-defined networks (SDN) operate on this principle, and provide additional functionalities, so they can respond to requirements and challenges simplifying the process of network infrastructure implementation.

This paper is focused on cloud network infrastructure for educational institutions in IT domain and possibility to implement SDN networks in that environment. Conceptual SDN network model is presented for cloud infrastructure for E-business Laboratory at the Faculty of Organizational Sciences in Belgrade.

2. SDN CONCEPTS

Although the concept of programmability in computer networks is present for more than 20 years (Feamster, Rexford, & Zegura, 2013), many believe that the development of a software-defined networks started with Ethan project (Casado, et al., 2007) which defines a new network architecture where a centralized controller manages the process of traffic forwarding. An important factor in the development of the SDN concept is certainly OpenFlow protocol as the first interface for communication between control and traffic forwarding layers (McKeown, et al., 2008).

Centralization of the control process and complete separation from network elements, using open standard interfaces for communication, are the main characteristics of the SDN networks. These features allow simple implementation of new protocols and applications, simplifying the process of virtualization and network management. This is especially important for educational institutions and their research projects. Another request in educational environment is multi-tenancy. This means that many tenants (teachers, students, administrators etc.) can use the same network infrastructure for their applications but with full isolation of their data and resources. Network-as-a-Service (NaaS) (Wolf, Matteo, Peter, & Pietzuch) is a cloud model that supports multi-tenancy and it is implemented using SDN concepts.

Security, scalability and interoperability are the requests that each educational network infrastructure must fulfill, and that is the case with SDN networks, too. The primary requirement is to ensure secure transmission of information in the network, and therefore the issue of security is given a special attention in the process of development and implementation of SDN network. On the one hand, the centralization of the control process brings a number of advantages, such as simple network management and less complex hardware implementation of network devices, but on the other hand leads to the fact that the controller is a single-point-of-failure in network (Kreutz, Ramos, & Verissimo, 2013). In most network environments controller scalability may became an issue, which is why the latest researches are focused on examining possibilities of distributed controller implementation (Dixit, Hao, Mukherjee, Lakshman, & Kompella, 2013). In many network environments, in order to reduce operating costs, SDN network implementation process involves the use of a hybrid approach. The existence of traditional and SDN network infrastructure, raises the question of interoperability and therefore many organizations (IETF, ETSI and ONF) are focused at developing standards for SDN.

2.1. SDN definition and architecture

Software-defined networking is a new concept in computer networks, which allows network and service management abstracting the lower layers of the network infrastructure. There are several definitions of SDN network, the most important are:

- SDN architecture allows direct control and programmability of computer networks by separating the functions of management (control plane) and data forwarding (forwarding plane) (Open Network Foundation).
- SDN is an approach that enables applications to manage networks by interacting and manipulating the control software of network devices and software resources (Nadeau & Pan, 2011).

Figure 1 presents SDN architecture, which defines three layers: infrastructure, management and application (Software-Defined Networking: The New Norm for Networks, ONF White Paper, 2013). Application layer consists of user applications that use SDN communication services. Communication between this layer and the control layer is made via the northbound interface API. The control layer is responsible for the control and monitoring of traffic forwarding in the network. The communication between this layer and the infrastructure layer is realized over the southbound API interface. The infrastructure layer consists of network elements and devices that perform traffic forwarding.

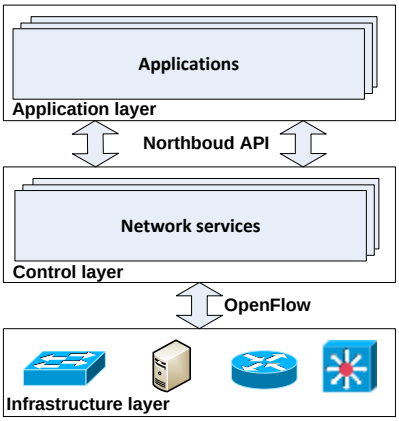

Figure 1: SDN architecture

Basic characteristics of SDN architectures are (SDN in the Campus Environment, ONF Solution Brief, 2013):

- Logical centralization of intelligence - Network management is separated from forwarding traffic, thus the decision making process is simplified and based on the entire network, not just the individual elements, as is the case in traditional computer networks.
- Programmability - Management function in the SDN network is realized by dynamic software programs. The use of open standard API interface allows simple communication between applications and networks.
- Abstraction - In SDN networks are user applications separated from other network elements, and network devices themselves are abstracted from SDN control layer.

In addition to the abstraction of network devices, SDN architecture provides support for different APIs and thus enables the implementation of various network services such as routing, multicast, traffic engineering, QoS and many others.

2.2. OpenFlow protocol

OpenFlow is the first standardized interface between the management and forwarding traffic layers of SDN architecture (McKeown, et al., 2008). This protocol uses the concept of data flow to identify traffic based on predefined rules, which are statically or dynamically defined in the SDN controller software. When it comes to network management, this concept is characterized by high granularity at application, user and session level, which is not feature of the traditional IP networks, in which each data stream must use the same path through the network. OpenFlow can be regarded as a key element of SDN network as it is the only standardized protocol that allows the manipulation of data forwarding plane in network devices. It can be applied to existing physical and virtual networks and due to its flexibility in multi-vendor networks.

OpenFlow logical switch consists of one or more flow table, group table, which performs packet forwarding, and one or more channels to an external OpenFlow controller (Figure 2). Using OpenFlow protocol controller modifies flow entries in flow tables. Packet forwarding is based on set of instructions which are stored in flow entries beside match parameters (OpenFlow Switch Specification, 2013).

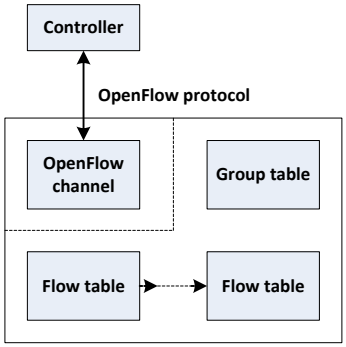

Figure 2: OpenFlow switch

OpenFlow protocol has specific application in scientific research institutions since the possibility of separation of the production and experimental data flows. By defining the route and packet processing rules researchers can control the experimental data flows and thus enable the coexistence of experimental and production data flows in the same network, where production flows are processed in the traditional way. This is particularly important in the case of defining and testing the characteristics of the new routing protocols, address schemes, network models, etc. (McKeown, et al., 2008).

2.3. Application of software defined networking

Thanks to the principles of centralization, abstraction and programmability, SDN architecture can be applied in different network environments, data centers, campuses, and cloud environments, but also in service provider networks.

When it comes to the enterprise environment, the SDN concept can greatly contribute to the businesses since the implementation process of new services is much faster and simplified due to virtualization and configuration automation throughout the network (SDN in the Campus Environment, ONF Solution Brief, 2013). In this way operational costs are reduced too. In addition to the implementation of OpenFlow protocol

this goal can be achieved by a combination of SDN architecture and standard technologies such as VLANs and MPLS protocol (Use Cases and Migration Methods, Open Networking Foundation, 2013).

In data centers SDN concept facilitates the process of virtualization with a high degree of scalability. Migration of virtual machines is implemented automatically, which contributes to better use of server resources and optimum utilization of the available bandwidth in the network (Al-Fares, Loukissas, & Vahdat, 2008).
The complexity of new services, but also complicated process of implementing them, as well as high maintenance costs, impact on service providers to consider the possibility of applying the SDN concept in their networks. Service provider network infrastructure is designed to meet the requirements in terms of scalability, reliability, service quality, and service management (Sezer, et al., 2013).

The traditional approach involves the integration of control and data plane, so the biggest challenge in service provider environments is the separating of these two functions. An important parameter in these environments is also a failure recovery, but without affecting the end-user services. One method is the existence of an additional predefined path in order to protect the data plane. Another way is to incorporate into the OpenFlow support for protocol that already has a mechanism for the failure recovery such as MPLS-TE (Traffic Engineering Multi Protocol) (Das, Sharafat, Parulkar, & McKeown, 2011).

The challenges that face today's networks, such as the efficient management of resources, scalability, flexibility, rapid implementation, and cost reduction can be successfully overcomed by combining cloud computing technology and SDN architecture (Dürr, 2012). SDN concept simplifies the delegation of management functions and makes abstraction of the network, so users beside logical network view, have the ability to configure a small part of the network, which of course raises the question of the safety (Azodolmolky, Wieder, & Yahyapour, 2013).

3. SDN IN OPENSTACK ENVIRONMENT

3.1. OpenStack

OpenStack is a management tool for Infrastructure-as-a-Service (IaaS) cloud computing infrastructure (Bist, Wariya, & Agarwal, 2013). It is an open source project, managed by the OpenStack Foundation, and was released under the Apache license. OpenStack technology makes more related projects, which control a large set of resources (pool) for the calculation, storage and networking resources, which can be controlled via the control panel (dashboard), a command line or a RESTful API (Fifield, et al., 2014). Simple implementation, scalability, and a range of additional features contribute to the popularity of OpenStack project that is used in a number of educational networks.

OpenStack Networking is one of OpenStack projects that have the task to provide the Network-as-a-Service (Neutron's Developer Documentation). The original name of this project is Quantum and in 2013 was changed into a Neutron. The aim of this project is to eliminate the network as a limiting factor in the implementation of cloud solutions and to enable users to easily configure network parameters. In this way, teachers and students can be focused on application development and testing without knowledge about complete underlying network infrastructure. Neutron is an integral part of the OpenStack platform, which should enable network connectivity between device interfaces that are managed by other OpenStack services. The idea is to get users the ability to implement a variety of network technologies in a simple way through the API and all that based on the plug-in principle.

OpenStack Networking provides the ability to manage IP addressing. It supports static addressing and DHCP (Dynamic Host Configuration Protocol) as well. In addition, advanced network services such as IDS (Intrusion Detection System), firewall, VPN (Virtual Private Network), etc. are supported (OpenStack Networking).

3.2. Open vSwitch

Open vSwitch is a multilayer software switch for hypervisors created in order to support standard management interfaces and with the option of programmable control of packet (Open vSwitch, 2013). It represents an open source project and is available under the Apache 2 license. Open vSwitch supports a variety of virtualization technologies such as Xen, KVM and VirtualBox. Main task of the Open vSwitch is to provide communication between virtual machines and physical interfaces. It supports Ethernet technology

and the implementation of VLANs, but also provides the possibility of integration in virtual environments and management by passing data through different interfaces (Pfaff, et al., 2009).

Open vSwitch data forwarding model is similar to OpenFlow. This method allows definition of the traffic forwarding that originates from a virtual interface, one or more virtual machines. Implementation of interfaces for global configuration management and traffic forwarding separates the logical network topology from the physical.

Thanks to the principles of virtualization, it can be said that in modern information systems there is expansion of the network to the host level, where the Open vSwitch is. If it is a completely virtualized environment each network node is in fact a virtual switch. In this way it is possible to make a complete separation of core and edge part of the network infrastructure with the existence of communication between these parts. Virtual switches can implement a large number of network functionality, enabling the very simple design of the core infrastructure which has the main task to provide connectivity between the hosts (Pfaff, et al., 2009).

4. SDN NETWORK INFRASTRUCTURE MODEL FOR E-LEARNING

The network infrastructure of the educational institution has a task to ensure the implementation of a system for e-education and scientific research of high availability, scalability and reliability. In addition to services for teachers and students, the system must support cooperation with external partners in distributed research teams. Flexibility, scalability and high degree of data security are basic requirements that must be met. Cloud computing is a technology that can successfully respond to many requests, such as scalability, availability and security. In order to provide more flexibility and granular network management, it is necessary to implement certain SDN concepts.

4.1. Cloud computing infrastructure of the Laboratory for E-business

Laboratory for E-business at the Faculty of Organizational Sciences organizes courses using the blended learning concept (Despotović-Zrakić, Marković, Bogdanović, Barać, & Krčo, 2012). System for e-learning is based on the Moodle Learning Managemet System, and in addition to this the Laboratory infrastructure provides students with a wide variety of services (Despotović-Zrakić, Simić, Labus, Milić, & Jovanić, 2013), such as web hosting for student projects, CRM services, mobile applications, edutainment services etc.

The network architecture of a laboratory is based on a hierarchical network model where complex network infrastructure is divided into layers, with the definition of certain functions in each layer (Radenković, Despotović-Zrakić, Bogdanović, Vujin, & Barać, 2013). Access layer is the interface to end-users and connects users' devices with the rest of the network. Distribution layer aggregates traffic from access layer and represents interface between the core and access layers. Core layer is the backbone of the network and provides connectivity between distribution layer devices. This layer implements connection to the Internet and the issue of security is of great importance. Firewall/NAT is a software or hardware component of the network infrastructure, which controls incoming and outgoing network traffic.

One part of the network infrastructure is implemented in a traditional manner, while the other part is implemented as a private cloud. Cloud infrastructure includes parts of the distribution and access layers of computer network. This approach allows the further development of educational and research services in the cloud with the flexibility, scalability and high security of data transmission (Vouk, et al., 2008) (Dong, Zheng, Qiao, Shu, & Yang, 2009).

4.2. SDN network infrastructure model of the Laboratory for E-business

Teachers and students of the Laboratory for E-business are constantly working on the development and implementation of new services and applications necessary for the implementation of the educational process in order to improve the quality of teaching. In addition to network services for communication, collaboration and creation of teaching materials, special attention is devoted to applications and services designed for students, such as edutainment services, various quizzes, mobile applications for learning a foreign language, etc. Given the complexity of requests that network infrastructure must fulfill, the concept of software-defined networks are emerging as a natural choice. The following parameters must be taken into account when defining the SDN network model:

- Existing cloud network infrastructure must be used.
- SDN infrastructure must support all existing services.

- Network management should be implemented in a simple way.
- The development and implementation of new services and applications must be enabled without a high degree of knowledge of networking technologies at the infrastructure level.

The conceptual model of the SDN infrastructure is shown in Figure 3. This model is based on a hierarchical model. Interaction between teachers and students and network infrastructure is realized at the application level, which communicates with the SDN controller through the API interface. Business logic is separated from the infrastructure layer and is at the jurisdiction of the SDN controller, which manages OpenFlow infrastructure using OpenFlow protocol. Since there is the request to use the existing network infrastructure, it is not possible to create fully virtualized network as some network devices do not support the OpenFlow protocol. Therefore a hybrid approach is applied, and at the infrastructure layer, there are two sub-layers: the OpenFlow infrastructure and the traditional network infrastructure (non-OpenFlow infrastructure). OpenFlow infrastructure sub-layer can be realized using Open vSwitch and OpenFlow enabled network devices.

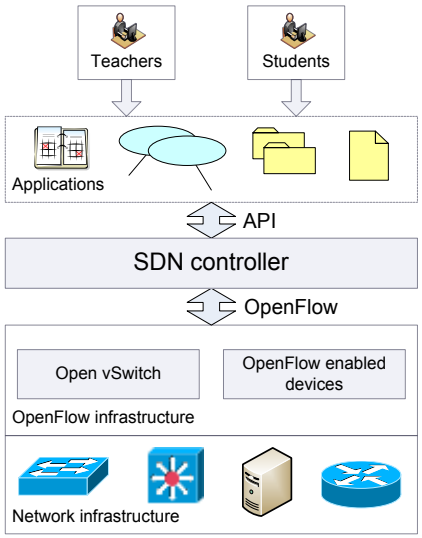

Figure 3: Conceptual model of the SDN network infrastructure

Figure 4 shows the conceptual logic diagram of the OpenFlow infrastructure sub-layer with Open vSwitch. One physical host can have more defined virtual machines that communicate over virtual interface with physical interfaces. This communication takes place via Open vSwitch. Traffic management is performed by SDN controller which defines records in the flow table. Traffic forwarding rules can be defined based on the parameters of the first 4 layers of the OSI network model, such as MAC address, IP address, TCP / UDP port, VLAN ID, etc. Traffic isolation can be performed at the 2 layer using VLANs. Also, implementation of the policies for traffic limiting can affect the quality of service. There are two types of communication: within the private network and via the Internet.

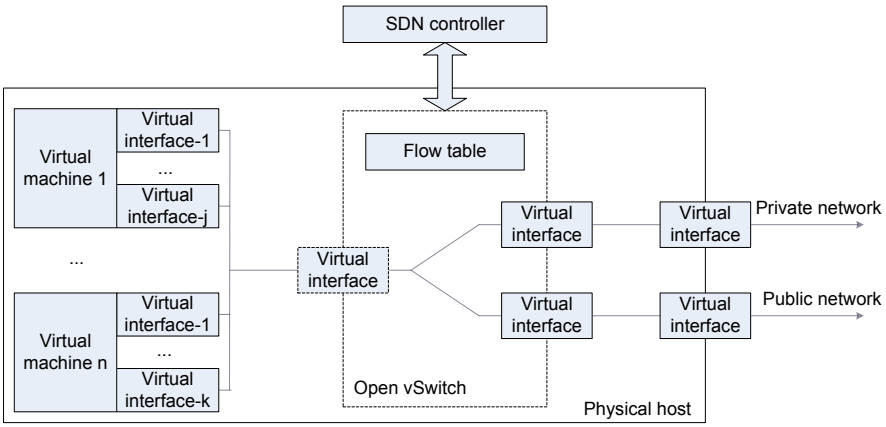

Figure 4: Conceptual logic diagram of the OpenFlow infrastructure sub-layer with Open vSwitch

Neutron OpenStack and Open vSwitch make base for an OpenFlow infrastructure sub-layer. Neutron enables deployment of multiple services on a single or on many physical hosts. The network architecture recognizes the following types of hosts:

- Controller node - manages other hosts

- Network gateway node - provides traffic Layer 3 forwarding and communication with external networks using NAT
- Compute node - performs traffic forwarding

Controller and Network gateway functionalities can be implemented on a single physical host, and it is important to emphasize that the Network node must implement neutron-l3-agent, and if necessary, neutron-dhcp-agent. In the Laboratory network there will be one Network node that has the role of the Controller, as well as more Compute hosts.

Cloud network infrastructure support multi-tenancy concept where the same infrastructure is used by many different users. All tenants can create complete end-to-end network topology based on their specific requirements with complete isolation between their applications. Figure 5 presents multi-tenancy concept in Laboratory network where network topologies for student's projects are created.

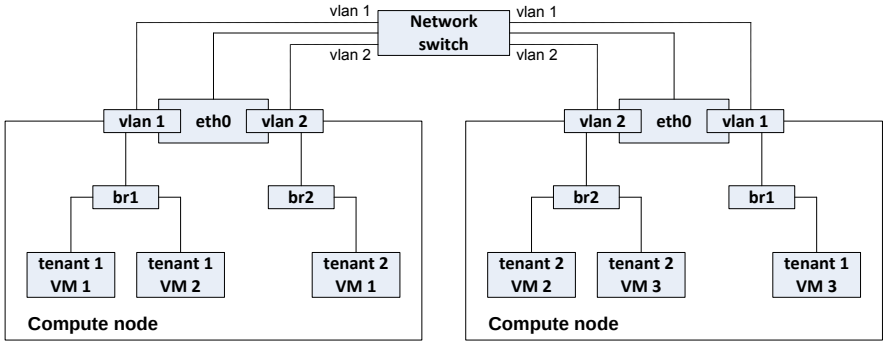

Figure 5: Multi-tenancy concept

Depending on specific needs, tenants can make custom rules for traffic forwarding via SDN controller. Controller manages the OpenFlow infrastructure making changes in Open vSwitch configuration or directly on OpenFlow enabled devices.

There are two types of scenarios based on user groups. Teachers are users who must have full network control and they have possibility to implement their applications and complex projects which demand communication with other networks over the Internet. This means that their environment beside OpenStack Neutron uses external routers for routing and connection to the Internet. Other user group is students and for them is planned different kind of network environment. They also can develop and implement their applications using the same cloud infrastructure and have end-to-end network topology but they do not have possibility to communicate via Internet. Students can create various network topologies and if necessary implement L3 routing between them but only within their projects. That function is realized as NaaS using OpenStack Neutron.

5. CONCLUSION

The new network services and applications place high demands in terms of scalability, availability and flexibility, that traditional computer networks can difficult to meet. A new trend in the design of the network infrastructure is faced to programmability and implementation of software defined networks.

The first part of this paper gives the systematization of knowledge about the basic concepts of SDN networks, with a highlight of OpenFlow protocol as a key component. It then describes a tool for managing cloud computing infrastructure, OpenStack and the Open vSwitch as an example of the virtual switch. The second part of the paper defines and describes the model of cloud network infrastructure of the E-business Laboratory at the Faculty of Organizational Sciences, and then proposes a model of the SDN network infrastructure.

The main contribution of this paper is a definition and a formal description of the network infrastructure model of the research laboratory based on the principles of hierarchy, cloud technology and the concept of a software-defined networks. The presented model can greatly improve the performance of the education processes and contribute to the efficient realization of educational activities. Future research will focus on the implementation of this model, examining the possibilities of Big Data application, and then the quality of service application in order to optimize the processes.

REFERENCES

Al-Fares, M., Loukissas, A., & Vahdat, A. (2008). A Scalable, Commodity Data Center Network Architecture. *SIGCOMM'08.* Seattle, Washington, USA: SIGCOMM'08.

Azodolmolky, S., Wieder, P., & Yahyapour, R. (2013). SDN-based cloud computing networking. *15th Internationa lConference on Transparent Optical Networks (ICTON).* Cartagena.

Bist, M., Wariya, M., & Agarwal, A. (2013). Comparing delta, open stack and Xen Cloud Platforms: A survey on open source IaaS. *3rd IEEE International Advance Computing Conference (IACC).*

Casado, M., Freedman, M. J., Pettit, J., Luo, J., McKeown, N., & Shenker, S. (2007). Ethane: Taking Control of the Enterprise. *SIGCOMM'07.* Kyoto, Japan.

Das, S., Sharafat, A., Parulkar, G., & McKeown, N. (2011). MPLS with a simple OPEN control plane. *Optical Fiber Communication Conference and Exposition (OFC/NFOEC), 2011 and the National Fiber Optic Engineers Conference.* Los Angeles, CA.

Despotović-Zrakić, M., Marković, A., Bogdanović, Z., Barać, D., & Krčo, S. (2012). Providing Adaptivity in Moodle LMS Courses. *Educational Technology & Society, 15*(1), 326-338.

Despotović-Zrakić, M., Simić, K., Labus, A., Milić, A., & Jovanić, B. (2013). Scaffolding Environment for Adaptive E-learning through Cloud Computing. *Educational Technology & Society, 16*(3), 301-314.

Dixit, A., Hao, F., Mukherjee, S., Lakshman, T., & Kompella, R. (2013). Towards an Elastic Distributed SDN Controller. *SIGCOMM HotSDN'13.* Hong Kong, China.

Dong, B., Zheng, Q., Qiao, M., Shu, J., & Yang, J. (2009). BlueSky Cloud Framework: An ELearning Framework Embracing Cloud Computing. *International Conference on Cloud Computing (CloudCom 2009).* Beijing, China.

Dürr, F. (2012). *Towards Cloud-assisted Software-defined Networking, Technical Report 2012/04.* Institute of Parallel and Distributed Systems, Universität Stuttgart.

Feamster, N., Rexford, J., & Zegura, E. (2013). The Road to SDN. *ACM Queue - Large-Scale Implementations, 11*(12).

Fifield, T., Fleming, D., Gentle, A., Hochstein, L., Proulx, J., Toews, E., & Topjian, J. (2014). *OpenStack Operations Guide.* O'Reilly Media.

Kreutz, D., Ramos, F. M., & Verissimo, P. (2013). Towards Secure and Dependable Software-Defined Networks. *SIGCOMM HotSDN'13.* Hong Kong, China.

McKeown, N., Anderson, T., Balakrishnan, H., Parulkar, G., Peterson, L., Rexford, J., . . . Turner, J. (2008). OpenFlow: Enabling Innovation in Campus Networks. *ACM SIGCOMM Computer Communication Review, 38*(2), 69-74.

Nadeau, T., & Pan, P. (2011). Software Driven Networks Problem Statement. *IETF Internet-Draft*.

Neutron's Developer Documentation. (n.d.). Retrieved 03 27, 2014, from http://docs.openstack.org/developer/neutron/

Open Network Foundation. (n.d.). Retrieved 03 27, 2014, from https://www.opennetworking.org/sdn-resources/sdn-definition

Open vSwitch. (2013). Retrieved 03 27, 2014, from http://openvswitch.org/

OpenFlow Switch Specification. (2013). Retrieved 03 27, 2014, from https://www.opennetworking.org/images/stories/downloads/sdn-resources/onf-specifications/openflow/openflow-spec-v1.3.3.pdf

OpenStack Networking. (n.d.). Retrieved 03 27, 2014, from http://www.openstack.org/software/openstack-networking/

Pfaff, B., Pettit, J., Koponen, T., Amidon, K., Casado, M., & Shenker, S. (2009). Extending networking into the virtualization layer. *HotNets.*

Radenković, B., Despotović-Zrakić, M., Bogdanović, Z., Vujin, V., & Barać, D. (2013). Designing network infrastructure for an e-learning cloud. *The Fourth International Conference on e-Learning (eLearning-2013).*

Radhakrishnan, N., Chelvan, N. P., & Ramkumar, D. (2012). Utilization of Cloud Computing in E-learning Systems. *International Conference on Cloud Computing Technologies, Applications and Management (ICCCTAM)*, (pp. 208-213).

SDN in the Campus Environment, ONF Solution Brief. (2013). Retrieved 03 27, 2014, from https://www.opennetworking.org/images/stories/downloads/sdn-resources/solution-briefs/sb-enterprise-campus.pdf

Sezer, S., Scott-Hayward, S., Chouhan, P., Fraser, B., Lake, B., Finnegan, J., . . . Rao, N. (2013). Are we ready for SDN? Implementation challenges for software-defined networks. *IEE Communications Magazine, 51*(7), 36-43.

Software-Defined Networking: The New Norm for Networks, ONF White Paper. (2013). Retrieved 03 27, 2014, from https://www.opennetworking.org/images/stories/downloads/sdn-resources/white-papers/wp-sdn-newnorm.pdf

Sultan, N. (2010). Cloud computing for education: A new dawn? *Int. J. Inf. Manage, 30*(2), 109-116.

Use Cases and Migration Methods, Open Networking Foundation. (2013). Retrieved 03 27, 2014, from https://www.opennetworking.org/images/stories/downloads/sdn-resources/use-cases/Migration-WG-Use-Cases.pdf

Vouk, M., Averritt, S., Bugaev, M., Kurth, A., Peeler, A., Schaffer, H., . . . Thompson, T. (2008). Using Virtual Computing Laboratory (VCL) Technology to Power Cloud Computing. *2nd International Conference on the Virtual Computing Initiative (ICVCI'08).*

Wolf, P., Matteo, C., Peter, M., & Pietzuch, A. L. (n.d.). *NaaS: Network-as-a-Service in the Cloud.* Retrieved 03 27, 2014, from http://research.microsoft.com/en-us/um/people/pcosta/papers/costa12naas.pdf.

HADOOP INFRASTRUCTURE FOR EDUCATION

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Abstract: *The subject of this paper is Hadoop infrastructure implementation for deploying Big Data technologies. The goal of this paper is to introduce Big Data infrastructure deployed as Hadoop platform in order to improve education process. The platform is convenient for integration with Learning Management System (LMS) Moodle platform. With infrastructure described in this paper, managing large amount of structured and unstructured data from variety of sources is enabled. The platform is deployed within the e-learning infrastructure of Laboratory for E-business at the Faculty of Organizational Sciences - University of Belgrade.*

Keywords*: Hadoop, Big Data, infrastructure, cluster, education, platform*

1. INTRODUCTION

In order to offer high-quality education to their students, education institutions need to have access to relevant information. “Recent advances in educational technology have hinted at a means to measure learning efficiency, in terms of personalization of learner competency and capacity in terms of adaptability of observed practices, using raw data observed from study experiences of learners as individuals and as contributors in social networks (Govindaraja, Somasundaram, Kumar & Kinshuk, 2013).” Information arrive to organizations from variety of sources nowadays, such as databases, sensors, social networks, emails, etc. The flow of this information is rapidly increasing, and it is becoming more complex to manage that information. Another issue to this matter is that nowadays information is represented in variety of types. “The amount of available data increases every day. This huge amount of data is a resource that, if properly exploited, provides useful knowledge. However, to be able to extract useful knowledge from it, efficient and powerful systems are needed. (Garza, Margara, Nepote, Grimaudo & Piccolo, 2014).” A large number of institutions across the world dedicate much of their resources to this matter. “Data driven research has become an important part of scientific discovery in an increasing number of disciplines (Xu, Luo & Woodward, 2012).” A possible approach for exceeding these problems is to introduce Big Data paradigm, “Big data is a term for massive data sets having large, more varied and complex structure with the difficulties of storing, analyzing and visualizing for further processes or results (Sagiroglu and Sinanc, 2013).”

One of the solutions for managing Big Data is Hadoop software framework. It is an open source project developed by Apache Foundation. Reliable, scalable and distributed computing is provided with Hadoop. Laboratory for E-business at the Faculty of Organizational Sciences - University of Belgrade deployed Hadoop infrastructure for dealing with variety of data problems and needs, primarily for Laboratory staff and prominent students to test and deploy Big Data solutions. Two main purposes of this research are devoted to testing different infrastructure approaches and data management functionalities.

2. MODEL DESIGNED IN LABORATORY OF E-BUSINESS FOR IMPLEMENTING HADOOP ECOSYSTEM IN EDUCATIONAL INSTITUTIONS

Hadoop ecosystem can contain various number of tools. These tools are improving performance of Hadoop and help programmers and data analysts to make their work more efficient. Most of the tools come from Apache Foundation and usually work only with Hadoop. The most widely used are Pig, Hive, HCatalog, HBase, Sqoop, Mahout etc. Every tool has its specific functionality, and combining them with Hadoop makes ecosystem very powerful.

These tools can be grouped in few categories. The most common is grouping into tools for importing data in Hadoop file system, data processing, data warehousing and special tools for real time data processing. Another significant Apache projects is Ambari, tool for managing Hadoop cluster which includes all described tools. Some of the companies are offering free or nonfree data platforms that contain already defined ecosystem.

A model for managing Big Data in educational institutions is shown on Figure 1. Laboratory for E-business at the Faculty of Organizational Sciences - University of Belgrade, implemented a modified HDP 2.0 (Hortonworks Data Platform). HDP is a platform that provides a specific Hadoop ecosystem. It is developed by Hortonworks company and it is open source, which allows modification of ecosystem structure.

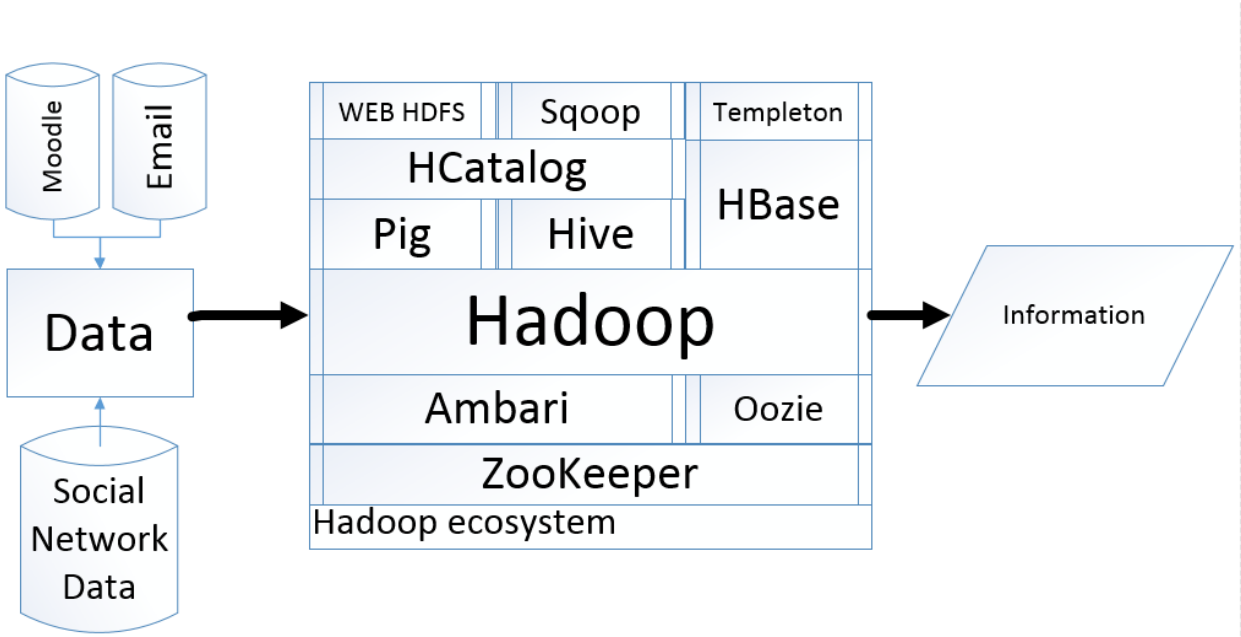

Figure 1: Model for managing Big Data in educational institutions

The Laboratory specifically designed this model for the purposes of educational research and improving quality of education. Principal techniques that are integrated permit working with data from different data sets. The approach that is applied is to collect data generated through the education process, primarily from e-learning processes. Input of the model is represented by structured or unstructured data created from student's activities on their assignments and interaction during process of education. Emails, Moodle logs, student activities on social networks, etc. are collecting in a real time process. Laboratory is focused on finding and resolving student's problems connected to exams and practical assignments, so emails and Moodle logs are chosen as primary input source. Further, the data is transferred to processing.

Whole process of exploiting data into information is happening in Hadoop ecosystem. Core of this ecosystem is Hadoop platform which contains tools needed to process data. Components of Laboratory implementation are elected specifically, based on data generated through main education processes and can be easily reorganized to specific purposes. As a core component of Hadoop ecosystem, Hadoop platform must be applied in every implementation with no exception. Other tools are optional.

Zookeeper, Ambari and Ozzie tools are implemented in this research for cluster management. With this approach it is enabled to easily monitor processes that are performed on a cluster - both processing and management processes.

Pig, Hive, HBase and HCatalog are utilized for data manipulation and WEB HDFS, Sqoop and Templeton which are used for importing data and exporting information. These processes can also be tracked through management tools previously described. Information generated as output of manipulation process contributes to improving the quality of education process at the Laboratory.

The model described in this paper is implemented with a primarily goal for other services of e-learning infrastructure of Laboratory for E-business at the Faculty of Organizational Sciences - University of Belgrade to perform independently of this model.

With this concept, e-learning infrastructure is resistant to failures of Hadoop platform. This provides an environment that is convenient for testing different implementations of the model.
Another characteristic is that the model is flexible and scalable. With these characteristics, the model can be integrated with other e-learning platforms.

3. IMPLEMENTED HADOOP E-LEARNING INFRASTRUCTURE

Hadoop cluster that is designed for the purposes of Laboratory of E-Business at the Faculty of Organizational Sciences is integrated with other e-learning services of the Laboratory.

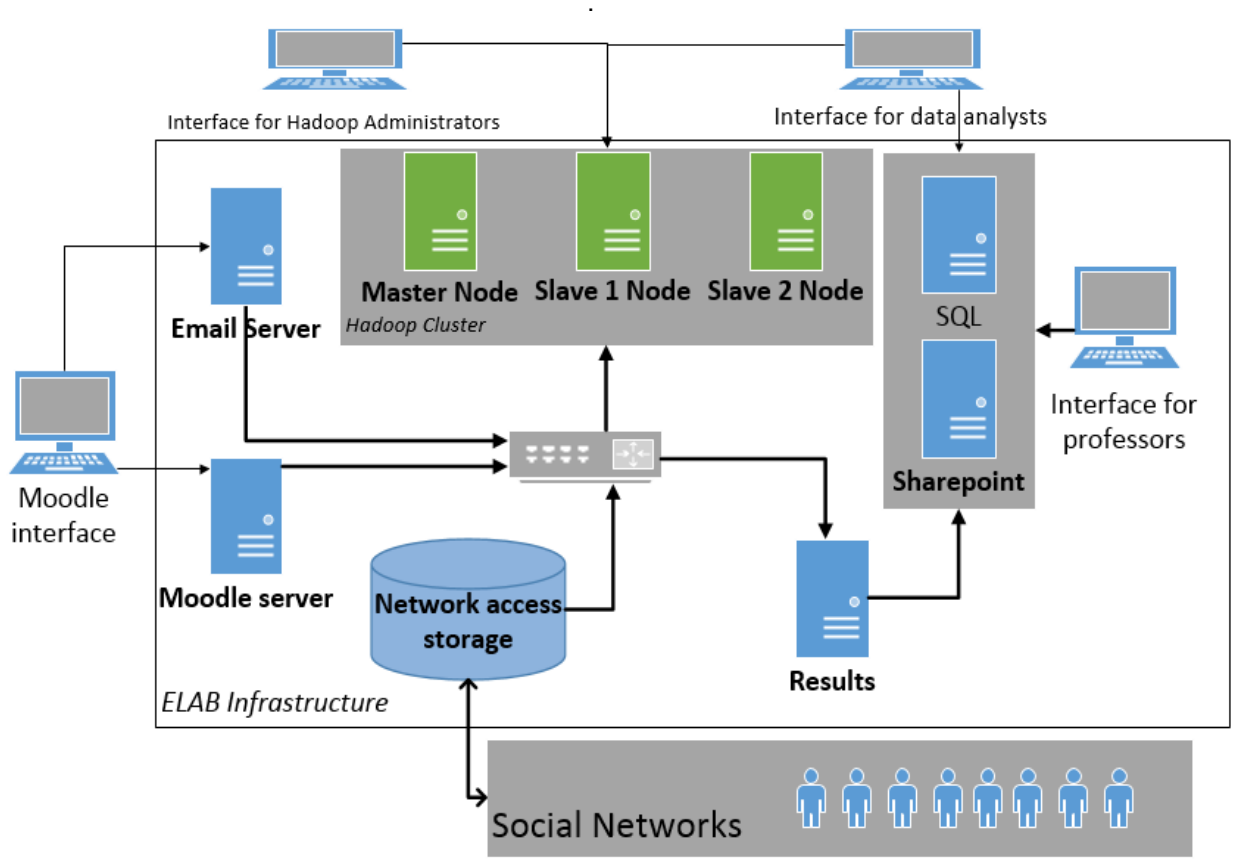

Figure 2: Implemented Hadoop e-learning infrastructure

The implemented solution is based on the model described in chapter 2 of this paper. Cluster communicates with other components using TCP/IP protocol and all data is transferring through Ethernet infrastructure. Hadoop cluster contains three nodes: Master node, Slave 1 node and Slave 2 node. The cluster can be accessed only by Hadoop administrator and Data analysts. Some features are available to students for educational purposes. Important thing to mention is that the cluster can be accessed only through Laboratory for E-business's network. Only Laboratory staff can access the cluster. Hadoop cluster is connected with Email server, Moodle server, Network data storage and Sharepoint cluster through Results server.

Email server collects all mails sent from students to Laboratory staff in text format. Important issue when working with personal information and mails is privacy. In order to overcome this issues, Hadoop cluster is collecting data every day but it uses only mail's body text, omitting student's personal data. It is important for students to be aware that their personal information are not abused.

The primary role of Moodle server is to collect all the data gathered from Moodle LMS, generated in e-learning process. "Learning management systems (LMS) are powerful integrated systems that support a number of activities performed by teachers and students during the e-learning process (Despotović-Zrakić, Marković, Bogdanović, Barać & Krčo, 2012)." In interaction with Hadoop, logs and errors from exams taken by students on Moodle LMS are used as input for manipulation. The primary role here is represented by Sqoop tool, that automatically collects data from Moodle server once a month.

The importance of presence of educational institutions on social networks is inevitable nowadays. The Laboratory of E-business at the Faculty of Organizational Science actively communicates with students via social networks, primarily via Facebook and Twitter. Data that is generated with interaction with students on social networks is accumulated on Network storage. This data is processing in real time since the accumulated data is erased from the storage every week. In that order, the results are stored and can be used as input for further processing. The data from sources other than social networks are imported to Hadoop cluster and stored in Hadoop Distributed File System (HDFS, abbr.) for one year. "For some organizations, the HDFS infrastructure becomes a catch-all for data that has an indeterminate purpose

(Cohen & Acharya, 2013).” Some of data analysis jobs are performed automatically, as a service. Besides this, it is enabled for a data analysts to test new algorithms and perform variety of jobs.

Results of performed jobs are at first stored in Result server. Primary purpose of this server is to store data permanently. With this approach, it is enabled to use variety of tools for visualizing results and applying different Business Intelligence tasks. One possible solution to this matter that is implemented at the Laboratory for E-business is based on Sharepoint cluster. Power BI tools and reporting tools represent the core of this cluster. The data from Result server is transferred to Sharepoint cluster for further manipulation. The Laboratory staff can access the data and perform variety of tasks on it.

The goal in the implementation described in this paper was to make parts of the system independent in work, which enables those parts to be managed in an efficient way. Important issue to notice is that with growth of data, the existing implementation can be too narrow to support it efficiently. Advantage of Hadoop cluster to this issue is it’s linear scalability. New node can be easily implemented to support emerging amount of data. As a principal matter of security, Network storage, Email server and Moodle server are also unreachable outside of the Laboratory facilities.

Three major principles of Big Data are satisfied in the implemented model. Data that accumulates within the network of Laboratory come from variety of sources (Moodle logs, emails, social networks, etc.) - the principle of variety. The speed of data arriving for processing is high, especially in the exam terms - the principle of velocity. The principle of volume is something that comes with time.

Since the implemented platform is still in the testing phase, infrastructure can be easily improved. New devices, tools and even clusters can be easily attached to existing, flexible system. Components of the implemented Hadoop cluster are open source, which allows a whole system to be tailored to specific needs.

Hadoop cluster is implemented on a Laboratory’s hardware infrastructure. In its performance, Hadoop cluster is the biggest consumer of processor power and RAM memory. Principles of optimization are crucial in order to maintain the system upstanding. Hard Disk Drive memory is monitored with cluster management tools previously described. The data that is already explored to its maximum can be erased from the drive. Also, if some raw data is unused for six months, it should be erased from the memory. These principles are implemented to increase the speed of analyzing and to optimize the infrastructure. When it comes to the results of data manipulation, it is up to the Laboratory staff to deal with this matter. Important thing to know is that Hadoop Distributed File System and Result server allocate a significant amount of memory.

Whole Hadoop cluster is deployed on physical servers, but it is tested in parallel on Cloud based infrastructure. Moodle server, email server and Sharepoint cluster are deployed on Cloud. For Cloud software at the Laboratory OpenStack is implemented. With objective of deploying Hadoop cluster on cloud infrastructure variety of testings is performed. “Using a Hadoop cluster in a remote shared infrastructure enables users to avoid the costs of maintaining a physical infrastructure (Xu, Luo & Woodward, 2012).” One direction of research is conducted to implementing Hadoop directly on OpenStack, and the other one is performed via plugins which are still in early phases of development.With this approach infrastructure is gaining flexibility and easier maintenance.

4. CLUSTER ORGANIZATION AND MANAGAMENT OF HADOOP ECOSYSTEM

Hadoop cluster organization currently implemented for the purposes of Laboratory of E-Business is shown in figure 3.

Hadoop components and Apache tools are distributed within three nodes. Central role that is responsible for Hadoop’s performance is represented by Master node. This node contains all clients - Pig, Hive, etc. The main distinction of this node from the others is in Name Node and HBase Master. Main purpose of Name Node is to save meta data for all data stored in Hadoop cluster. HBase Master manages all NoSQL jobs performed on a cluster. These two components are installed only on this node. Component with a purpose of data storing is Data Node. Implementations with more than three nodes usually do not have implemented Data Node on Master Node. Data is stored only on nodes other than Master Node. In order to optimize Hard Disk Drive Memory, in the implementation described here Data Node is installed on the Master Node. With this approach it is enabled to use the Master Node’s unused memory to store data. Ambari Server is a component deployed on a Master Node that is responsible for managing and monitoring the cluster. It provides a web interface convenient for attaching a new node and cluster size management (Figure 4).

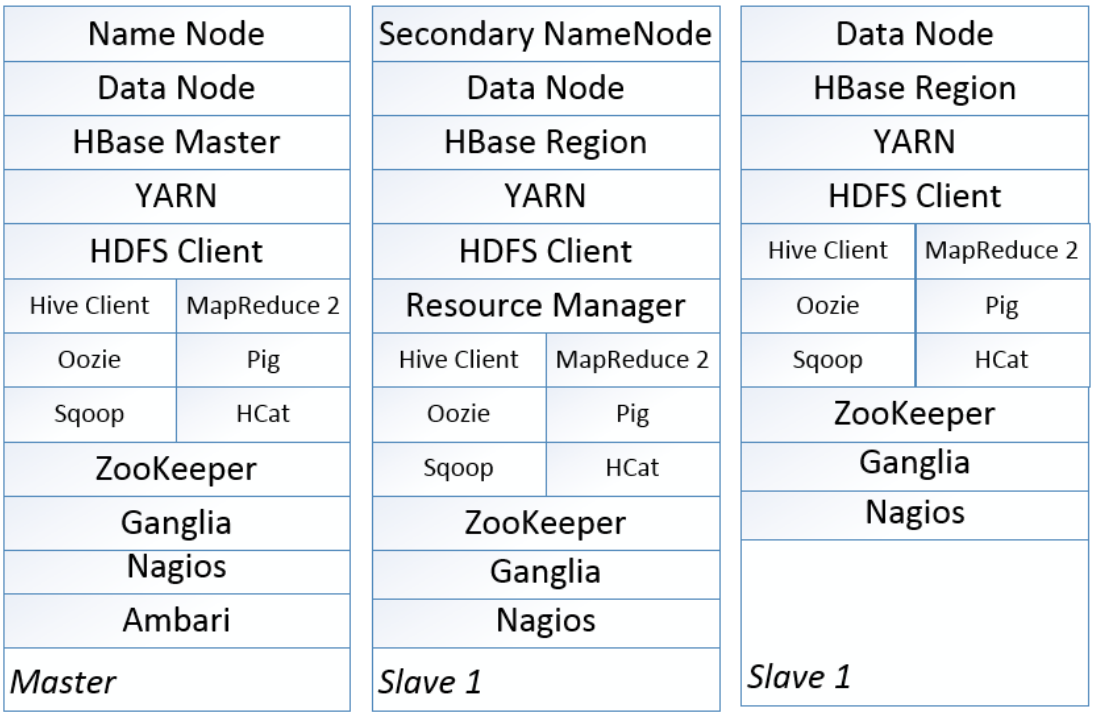

Figure 3: Hadoop cluster organization in Laboratory of E-Business

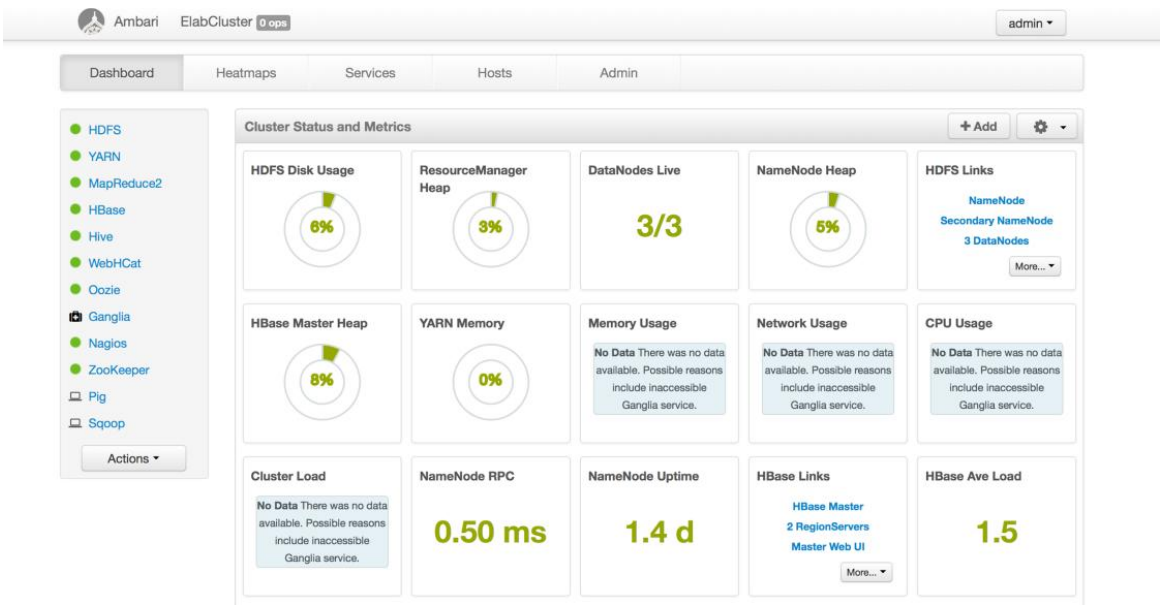

Figure 4: Ambari Web interface

Client components and Data Node are deployed on other two nodes (Node 1 and Node 2). As a mechanism to overcome the issues proceeded from Name Node failure, a Secondary Name Node is deployed on a Node 1 with a purpose to serve as a backup for a Name Node. Node 1 contains Resource Manager component for managing all the resources on the cluster. Node 2 does not contain any extra features besides the storage and processing. With this organizational aspect Node 2 can be used as template for adding new nodes to cluster. This aspect is optional.

Communication that is happening inside the cluster is carried by Ethernet cable supported with TCP/IP protocol. Important issue in distributed systems is performance of the link between components. Problems with the link between nodes may lead to losing of data. Imposed mechanism for overcoming this problem is to constantly monitor network infrastructure. This approach provides possibility to act instantly in these occasions. Data in Hadoop is stored in blocks. Each block is replicated three times, so if one block is lost other two can serve as backup. This means that for storing 1TB (terabyte) of data, 3TB of memory blocks are

required. This replication is distributed on different nodes. Importing and exporting data is automated with Sqoop component. Specific situation requires specific approach to Sqoop processes.

Every Node installation is flexible. New components can be easily added and removed. Client components are elected based on the data to be processed. For structured data such as Moodle logs Hive component is implemented for manipulation. For unstructured data such as emails Pig component is implemented. For real time processing of data from social networks HBase is implemented.

5. CONCLUSION

The paper presented a scalable platform that brings Big Data based on Hadoop to e-learning environment. The infrastructure is integrated with LMS Moodle platform, student's emails and social networks data. Model for managing Big Data in educational institutions enables manipulation of data generated through student's online activities. Output of manipulation process is used to improve the quality of e-learning. Architecture and main mechanisms were described. Described model is implemented in Laboratory for E-Business at Faculty of Organizational Science in Belgrade through unique infrastructure. The model is flexible and allows implementation in other educational institutions as well.

The future research and development are directed to optimizing the model for integration with e-learning services and other existing services at the Laboratory. Primary goal in future research is deploying Hadoop SaaS (Software-as-a-Service) concept based on Cloud infrastructure and migrating entre Hadoop cluster to Cloud environment.

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REFERENCES

Cohen, J., Acharya, S. (2013). Network and System Security, Towards a More Secure Apache Hadoop HDFS Infrastructure. Springer Berlin Heidelberg. pp. 735-741. doi: 10.1007/978-3-642-38631-2_64

Despotović-Zrakić, M., Marković, A., Bogdanović, Z., Barać, D. & Krčo, S. (2012). Providing Adaptivity in Moodle LMS Courses. Educational Technology & Society Journal, 15(1), 326-338, ISSN 1436-4522

Garza, P., Margara, P., Nepote, N., Grimaudo, L., Picollo, E. (2014). New Trends in Databases and Information Systems, Hadoop on a Low-Budget General Purpose HPC Cluster in Academia. Springer International Publishing, NY, USA. pp.187-192. doi: 10.1007/978-3-319-01863-8_21.

Govindaraja, K., Somasundaram, T.S., Kumar, V.S., & Kinshuk. (2013). Continuous Clustering in Big Data Learning Analytics. *IEEE Fifth International Conference on Technology for Education (T4E)*. pp.61-64. doi: 10.1109/T4E.2013.23

Sagiroglu, S., & Sinanc, D., Big data: A review. *International Conference on Collaboration Technologies and Systems (CTS)*. pp.42-47. doi: 10.1109/CTS.2013.6567202

Xu, W., Luo, W., & Woodward, N. (2012). Analysis and Optimization of Data Import with Hadoop. *Parallel and Distributed Processing Symposium Workshops & PhD Forum (IPDPSW) IEEE 26th International.* pp.1058-1066. doi: 10.1109/IPDPSW.2012.129

IMPROVING E-LEARNING SERVICES WITH BIG DATA ANALYSIS

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Abstract: *This paper presents various aspects of using Big Data analysis in an educational institution. Hadoop platform for Big Data analysis is used for determining and analyzing scattered data about student's problems. The main goal of this paper is to show that Hadoop can be utilized in e-learningpurposes.In this paper is presented a solution model which works on data analysis. Data used to analyze is mostly from Moodle learning service and other sources of data with various format. Visualization of gathered data can help teachers and course creators to improve existing online courses.*

Keywords: *Big Data,Hadoop, e-learning, visualization, online courses*

1.INTRODUCTION

Using the electronic media and information and communication technologies in the teaching process is broadly inclusive nowadays. A large number of universities all around the world use systems for e-learning. E-learning can take place synchronously or asynchronously. In synchronous systems, participants meet in "real time", and teachers conduct live classes in virtual classrooms. In asynchronous learning, which is sometimes called "self-paced" learning, students' are expected to complete lessons and assignments independently through the e-learning system. Asynchronous courses have deadlines just as synchronous courses do, but each student's is learning at his own pace.

Universities around the world use different LMS systems for e-learning. One of the most used is Moodle LMS (Despotovic-Zrakić, M., Markovic, A., Bogdanovic, Z., Barac, D. & Krco, S. 2012). In this paper is given a preview of Big Data analysis and the LMS Moodle. For Big Data analytics Hadoop platform is used. Student's Moodle logs has been analyzed with a goal to determine student's problems related to overcoming materials of courses which they enrolled. The research was conducted in scope of Laboratory for E-business at the Faculty of Organizational Sciences, University of Belgrade.Collected results are important for teachers because they can help them to improve e-learning services, and for students' to enhance their learning outcomes.

2. TECHNOLOGIES FOR BIG DATA ANALYSIS

The most used technology for Big Data analysis is Hadoop (Wasi-Ur-Rahman, M.; Islam, N.S.; Xiaoyi Lu; Jose, J.; Subramoni, H.; Hao Wang; Panda 2013). For this research apache Hadoop framework is tested as well as their tools: MapReduce, Apache Pig, Apache Hive, HBaseand Apache HCatalog. For data visualization Share Point is used.

MapReduce is framework for programming applications that process large amounts of both structured and unstructured data in parallel across hundreds or thousands of industry-standard servers in a Hadoop cluster, in a reliable and fault-tolerant manner. MapReduce, Hadoop Distributed File System, YARN and Hadoop are usuallycalled in a form the core of Hadoop.
The MapReduce really referes to two distinct tasks that Hadoop program performs.First job is the map, it takes sets of data and converts it in others sets of data where individual elements are broken down into value pairs.The reduce job takes the output from map job as input and combinations of value pairs into a smaller set of value pairs. As the name MapReduce implies, the reduce job is performed after the map job.

MapReduce's benefits:

- Developers can write applications Built-in recovery: MapReduce takes care of failures. Programmers can write map and reduce job codes in their preferred language, such as Java, C++,Python
- MapReduce is scalable, it can process petabytes of data on one cluster.
- Speed: Parallel processing means that Hadoop can take problems that used to take days to solve and solve them in hours or minutes.
- If data is unavailable on one server, and another server has a copy of the same value pair, it can be used to solve the same sub-task. Service called JobTracker keeps track of all jobs and it solves previously mentioned problem.
- MapReduce moves compute processes to the data on HDFS. Processing tasks can occur on the physical node where the data resides. This compellingly reduces the network I/O patterns and keeps the I/O on the local disk or within the rack.
- MapReduce takes care of the prosaicdetails around deployment, resource management, monitoring and scheduling, the users can focus on answering questions about their business (Shengsheng Huang; Jie Huang; Jinquan Dai; Tao Xie; Bo Huang, 2010).

Apache Pig present a platform for MapReduce programming. Apache Pig also referred to as Pig Latin was initially created by Yahoo! to make it easier for researchers and engineers to mine the hugedatasets. It is used in collaboration with Hadoop. This script language is similar to SQL queries for RDBMS systems. Pig Latin can easily be extended using the UDF or (User Defined Functions) which can be written in Java, Python, JavaScript, Ruby or Groovy and then call directly from the language (Yongzhi Wang; Jinpeng Wei; Srivatsa, M.; Yucong Duan; Wencai Du 2013).

Apache Hive is a data warehouse infrastructure. It is a query language used mostly for analyzing structured data. The development of Apache Hive language was done by Facebook to handle the amount of logs and data dimension, but further development of Apache Hive was taken over by Netflix.It supports analysis of large datasets stored in Hadoop's HDFS and compatible file systems such as Amazon S3 filesystem, and provides an SQL-like language called HiveQL while maintaining full support for map/reduce. To accelerate queries, it provides indexes, including bitmap indexes (Im, J.-F.; Villegas, F.G.; McGuffln, M.J., "VisReduce 2013).

HBase is a distributed column-oriented, open source, non-relational, distributed database. HBase is used when real-time read/write random access to a huge datasets is required. It was modeled after Google's BigTable and written in Java, and it is the only tool in Hadoop ecosystem that can process real time data analysis. It is developed as part of Apache Software Foundation's Apache Hadoop project and runs on top of Hadoop Distributed Filesystem, providing BigTable-like capabilities for Hadoop. That is, it provides a fault-tolerant way of storing large quantities of sparse data. HBase features compression, in-memory operation, and Bloom filters on a per-column basis as outlined in the original BigTable paper. Tables in HBase can serve as the input and output for MapReduce jobs run in Hadoop, and may be accessed through the Java API but also through REST, Avro or Thrift gateway APIs. HBase is not a direct replacement for a classic SQL database, although recently its performance has improved, and it is now serving several data-driven websites (Dan Han; Stroulia, E. 2012).

Apache HCatalog can be described asmetadata management tool. Apache HCatalog stores consistent schema information that are important to program languages that implement MapReduce and other third party systems that need to collaborate with Hadoop. It is a table and storage management layer for Hadoop. HCatalog enables users with different data processing tools – Apache Pig, Apache MapReduce, and Apache Hive – to more easily read and write data on the grid. HCatalog's table abstraction presents users with a relational view of data in the Hadoop Distributed File System and ensures that users need not worry about where or in what format their data is stored. HCatalog displays data from RCFile format, text files, or sequence files in a tabular view. It also provides REST APIs so that external systems can access these tables' metadata.

Benefits of using Hadoop to analyze large datasets are: scalability (more nodes can be added if there is a need for more resources), its distributed file system facilitates rapiddata transfer rates among nodes and allows the system to continue operating uninterrupted in case of a node failure.
Hadoopis used for analysis and prediction of behavior throughoutlarge variety of students' demographics, personal backgrounds, learning styles, thinking processes, academic objectives, environmental factors, skills and potentials.

These three points are crucial for enhancing the LMS(Despotovic-Zrakić, M., Markovic, A., Bogdanovic, Z., Barac, D. & Krco, S. 2012):
Volume**:** Benefit from using Big Data is ability to process large amounts of information is the main attraction of big data analytics. Big Data can gather and analyze information from thousands of students taking the

same course. It can also clarify multiple data points, about a single learner. Because of its scalability, Big Data might bring together learning data from hundreds of courses to provide a global perspective on world education.

Velocity**:** The increasing rate at which data flows throughout organization has followed a resembling pattern to that of volume.Big Data enables course creators and students to have instant access to data even in real time. In example if student enters a wrong answer in an online exam.By virtue of velocity he would instantly be provided with remedial and enrichment options based on his historical learning patterns and successful strategies made by thousands of other learners who also failed that question. It would also allow instructors to make adjustments to content delivery, based on rapid analysis of user experience, on a continual basis.

Variety**:** Data is rarely present in a perfectly ordered form and ready for processing. A source data in big data systems is diverse, and it doesn't fall into neat relational structure. It could be text from social networks or emails, image data, a raw feed directly from a sensor. Big Data connects the dots (different case scenarios), connecting together a variety of information from students' with different skills and abilities. It allows us to see the correlations between environment and performance. Without BigData analyses,traveling expenses and limited representation are common and almost always present with people ready to learn something new.

3. MODEL FOR ANALYZING BIG DATA FROM LMS

Model for analyzing Big Data from LMS is developed in scope of Laboratory for E-business at Faculty of Organizational Sciences, University of Belgrade. The model integrates Hadoop platform with Moodle LMS services, Mail services and social networks of the laboratory. This is done in scope of cloud infrastructure. This model is shown in figure 1.

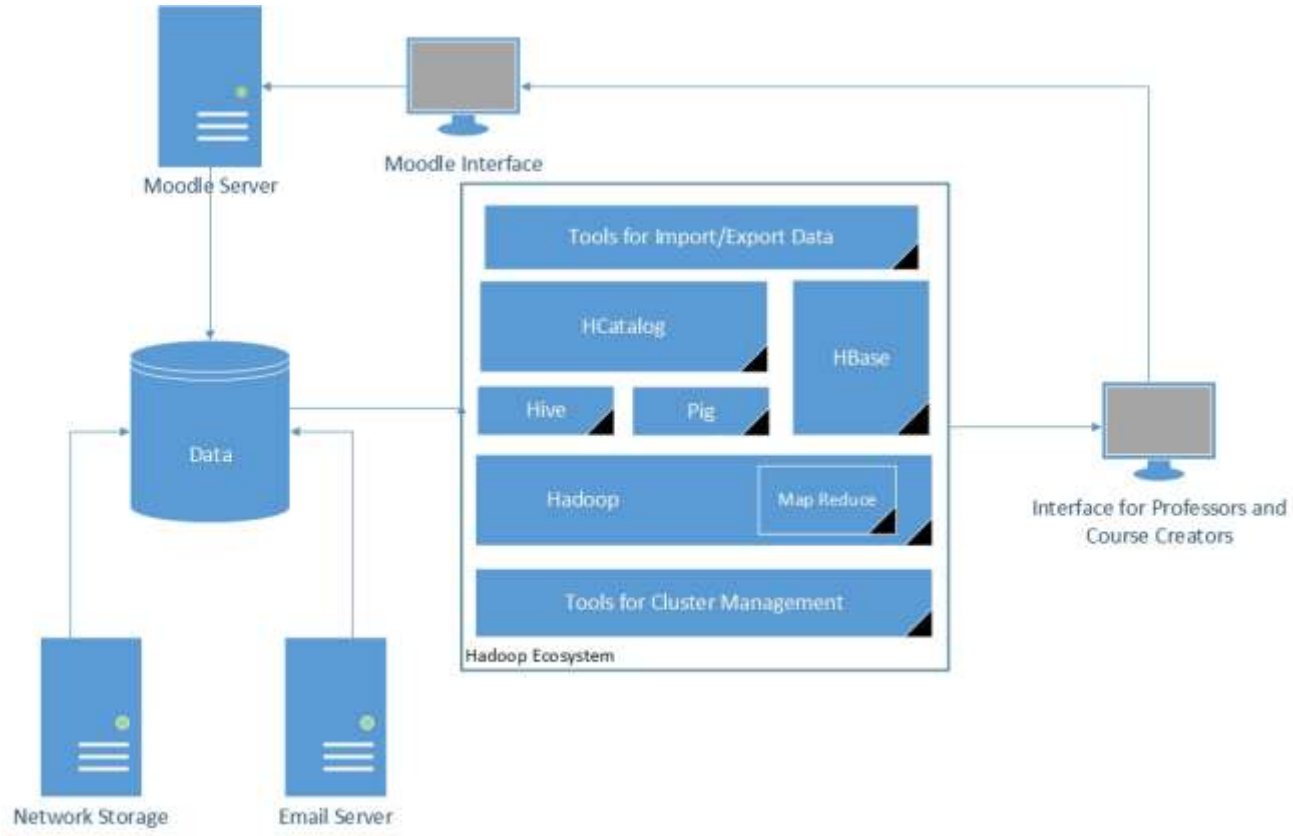

Figure 1: Model for analyzing big data from LMS

Laboratory for E-business at the Faculty of Organizational Sciences in Belgrade organizes a large number of online courses for all level of studies by using Moodle LMS. The most chosen courses by students' are: E-business, Internet Technologies, M-business, Concurrent Programming, Internet Marketing and other courses. Since 2001 the Laboratory has been using e-learning and blended learning concepts (Franzoni, A. & Assar, S. 2009), (Despotovic-Zrakić, M., Markovic, A., Bogdanovic, Z., Barac, D. & Krco, S. 2012). Moodle LMS e-learning system is suitable for mining various data related to e-learning. For student relationship

management (SRM) and collecting relevant data for different kind of analysis Laboratory for E-business uses Facebook and Twitter(Bogdanovic, Z., Barac, D., Labus, A., Simic, K., & Vulic, M. ,2012), (M. Vulić, M. Despotović-Zrakić, D. Barać, A. Labus, Z. Bogdanović, 2011). The main aim of the laboratory appearance on social networks is informing students' about the laboratory activities, providing them with the information related to exams, events and projects in which they can be enrolled in scope of the laboratory. By providing posts from the classes, events, exams, etc. teachers can collect information in which posts students' are interested the most and encouraging students' to interact with each other about the courses and trending topics.
Hadoop ecosystem developed in above mentioned model is convenient for analyzing data provided from Laboratories services to visualize and even predict students' results that can be useful to improve existing and help creating new courses on Moodle LMS. It is possible to visualize results for only one student or groups of students' activities throughout the semester.

4. PERSONALIZATION OF E-LEARNING BY USING HADOOP

The personalization process is focused on providing the students' with the profile on Moodle LMS, and based on their activities and courses they enrolled they get different materials and assignments using Hadoop to analyze Big Data. Big Data is currently used for various purposes, primarily for more productive business results. In the e-learning domain, there are many interesting experiments being carried out around the world, in order to understand the enormous potential of Big Data.

For example, with the help of Big Data, you can watch your students' virtually and track:

- Areas of the program they find hard and spend more time on
- Pages they revisit often
- Areas in which they get stuck
- Sections they recommend to their peers
- Learning styles they prefer
- Time of the day they learn better

Hadoop with Big Data analysis can help teachers understand the real behavior patterns of students' more effectively than traditional beliefs and theories on students' behavior. These patterns could lead us to highly valuable information on what and how they learn; thereby helping us make well-informed decisions about the learning programs and even identify design flaws.However, the real strength of Big Data lies in its power to help forecast or predict scenarios and take preventive action. For example, with the help of Big Data, you could predict:

- How strong your learners are in every concept of the course that they haven't even taken yet!
- Where your learners are likely to struggle or fail

Big Data analysis could help teachersassessaboutstudents' performances and outcomes on their courses before they start a training program. This could even be at the early stages of analyzing the training requirements. It could allow us to forecast trends and draw conclusions about our learning and development initiatives.

By visualizing results from Big Data analysis here at the Laboratory for E-business it can be seen the activities of student's on Moodle LMS via userid. This model does not bind students' personal information and their user id, the model monitors students' userids and the activity of that user on the Moodle LMS.

Figure 2showsvisualized data about activities of all students' on Moodle LMS, this gives the course teacher insight about the time that students' has been most active, so the teacher can try to give the needed materialsand assignments based on this information.

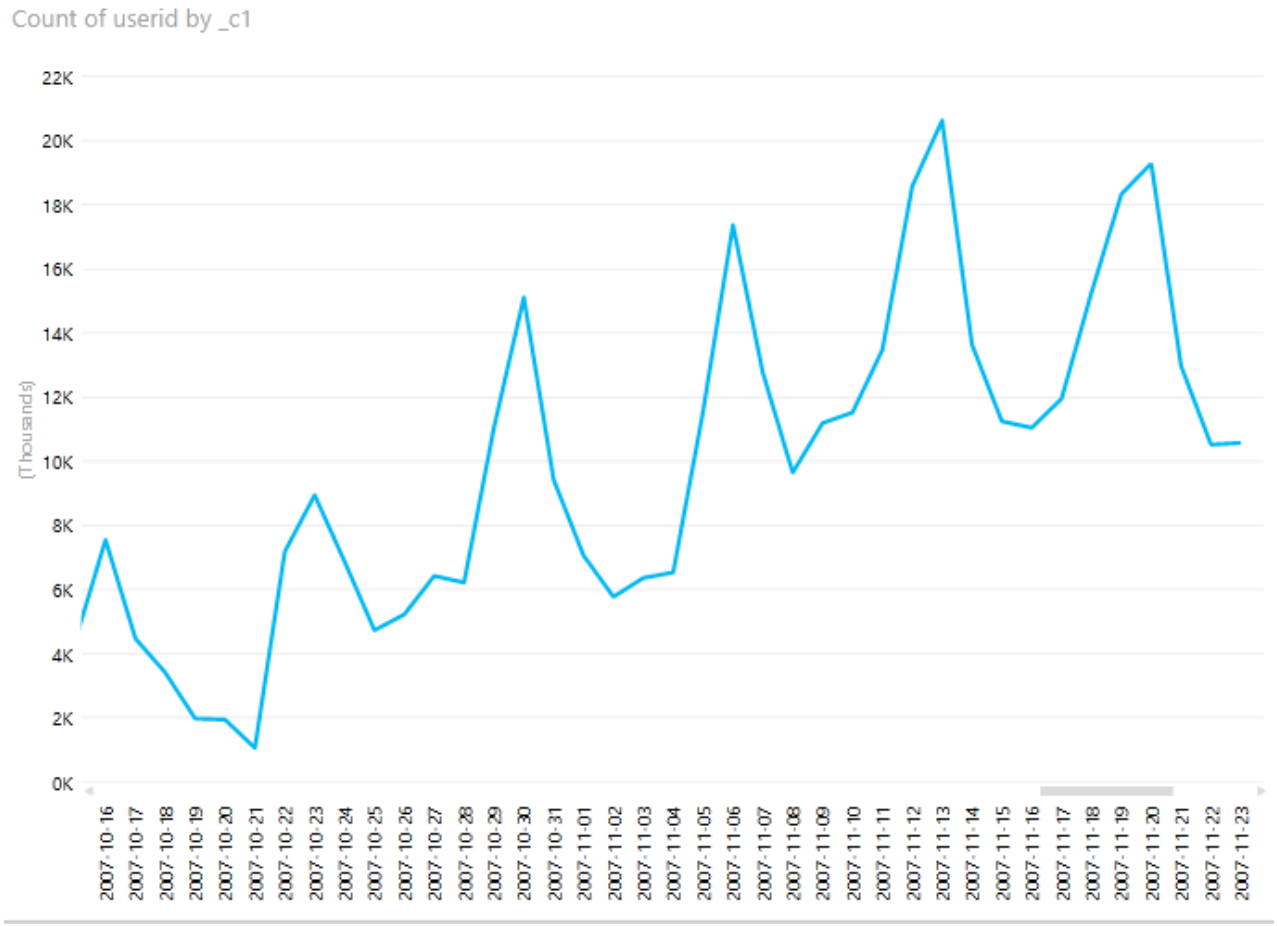

Figure2. Activities of all students' on Moodle LMS

5. FUTURE IMPROVEMENTS OF MODEL

Future improvement of model is to add more information to our analysis for better and more reliable real time information about our students' results. Information that could be added to our analysis would be from different sources like sensors for room temperature where students do their exams or data from VoIP consultations with their mentors. Improvement of our model could provide real time analysis and instant feedback to student behavior on course providing him instantly with needed material.Future researches are directed toward improving adaptation mechanisms and automation of adaptation process for implementation in other online education services, as well as complete integration of all processes in adaptive e-learning system.

6.CONCLUSION

This paper presented how students' learning and efficiency can be improved by analyzing data from Moodle, e-mails with questions and social network to meliorate courses to fit students' characteristics and learning habits and present them with solution for frequent problems. The capability to gather vast amounts of digital data and the computational methodologies to analyze them are changing many aspects of science. The research questions that can be answered using data driven approaches evolve and are multiplied based on the progress of pattern analysis and data mining technology. The adaptation services enable tailoring Moodle courses and features based on data analysis from student's model. Adaptation was performed considering these criteria: common questions from students' via e-mail, students' results on tests, students' social activities, students' learning styles and students' interests. Analytic methods and technologies used for analysis were described.

Evaluation of the system should provide additional information about users experience in using the system, as well as data about system performances and impact on learning process outcome. Integration of social networks and developing services for social interaction should improve students' loyalty and motivation for learning.

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REFERENCES

Dan Han, & Stroulia, E. (Sept. 2012). A three-dimensional data model in HBase for large time-series dataset analysis, *Maintenance and Evolution of Service-Oriented and Cloud-Based Systems (MESOCA), 2012 IEEE 6th International Workshop on the*, pp.47, 56, 24-24
doi: 10.1109/MESOCA.2012.6392598

Despotovic-Zrakić, M., Markovic, A., Bogdanovic, Z., Barac, D. & Krco, S. (2012). Providing Adaptivity in Moodle LMS Courses. Educational Technology & Society Journal, 15(1), 326-338, ISSN 1436-4522

Franzoni, A. & Assar, S. (2009). Student Learning Styles Adaptation Method Based on Teaching Strategies and Electronic Media. Journal of Educational Technology & Society, 12(4), 15-29
doi: 10.1177/1473095211400151

Im, J.-F., Villegas, F.G., & McGuffln, M.J. (Oct. 2013). VisReduce: Fast and responsive incremental information visualization of large datasets, *Big Data, 2013 IEEE International Conference on* , pp.25,32, 6-9
doi: 10.1109/BigData.2013.6691710

M. Vulić, M. Despotović-Zrakić, D. Barać, A. Labus, Z. Bogdanović, *Customer relationship management in e-education*, Social responsibility in 21st century, Slovenia 2011, pp. 460-472, Zbornik radova, Viera Žuborova, Diana Camelia Iancu, Uroš Pinterič (editors), Založba Vega, Ljubljana, ISBN 978-961-93138-1-7

Shengsheng Huang, Jie Huang, Jinquan Dai, Tao Xie, & Bo Huang (2010 March). The HiBench benchmark suite: Characterization of the MapReduce-based data analysis, *Data Engineering Workshops (ICDEW), 2010 IEEE 26th International Conference on*, pp.41, 51, 1-6

Wasi-Ur-Rahman, M., Islam, N.S., Xiaoyi Lu, Jose, J., Subramoni, H., Hao Wang, & Panda, D.K.D. (2013 May). High-Performance RDMA-based Design of Hadoop MapReduce over InfiniBand, *Parallel and Distributed Processing Symposium Workshops & PhD Forum (IPDPSW), 2013 IEEE 27th International*, pp.1908, 1917, 20-24

Yongzhi Wang, Jinpeng Wei, Srivatsa, M., Yucong Duan, & Wencai Du (Oct. 2013) "IntegrityMR: Integrity assurance framework for big data analytics and management applications," *Big Data, 2013 IEEE International Conference on*, pp.33,40, 6-9
doi: 10.1109/BigData.2013.6691780

A MODEL FOR SMART E-LEARNING ENVIRONMENT

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Abstract: *This paper deals with using Internet of Things and crowdsourcing in education. The main subject of this paper is researching the usage of Internet of Things in e-education. The primary goal of this paper is improving a teaching process at higher education institutions by introducing concepts of Internet of Things and crowdsourcing. Concepts of Internet of Things, e-learning, crowdsourcing and smart environments are described. A model for smart e-learning environment in a higher education institution is proposed.*

Keywords*: Internet of Things, e-learning, crowdsourcing, smart environment, smart classrooms, Cloud Computing*

1. INTRODUCTION

Internet of Things represents a modern research problem nowadays. Internet of Things includes a number of different devices or "things", namely sensors, actuators, tags or mobile devices which can mutually communicate and be used for different purposes. For example, the mentioned devices can be used for building different complex smart environments, such as smart homes, smart classrooms, smart offices, smart factories, smart cities, smart power grids or smart e-government. Smart environments can be customized according to users' needs and preferences which are suitable for automating these environments.

There are few examples in literature of using Internet of Things in education. In this paper, concepts of e-learning, Internet of Things, smart environments and crowdsourcing are defined. Crowdsourcing is a relatively new concept of sharing ideas between "crowds" – large groups of people. Also, we propose a model of smart e-learning environment based on Internet of Things and crowdsourcing.

2. THEORETICAL BACKGROUND

Using information and communication technologies in every part of the modern society has required introducing these technologies in education as well. A lot of universities and other education institutions has been using e-learning systems in addition with traditional learning methods. E-learning represents a complex system which consists of distance learning and teaching as processes separated in space and time and teaching materials available in different forms (Radenković, Despotović, & Bogdanović, 2006). Learning management systems are core components of e-learning systems. They consist of standard learning and teaching tools and components which are usually integrated into information systems of education institutions via portals. Nowadays, e-learning is omnipresent and possible by using a large number of different devices, e.g. mobile phones and tablet computers. This process is known as ubiquitous learning (Casey, 2005; Chen, Chang, & Wang, 2008).

For creating a stable e-learning environment, it is necessary to have a solid and quality, distributed infrastructure which can respond to increasing number of requests. The infrastructure should be highly scalable to accept increasing number of students, reliable and fault-tolerant. Cost-effective solution which can respond to previously mentioned requirements is Cloud Computing (Despotović-Zrakić, Simić, Labus, Milić, & Jovanić, 2013). Many universities around the world have been using their own private clouds for building e-learning environments (Liang & Yang, 2011).

Cloud Computing represents highly scalable and abstracted infrastructure with virtualized resources, hosting various applications for end-users (Sultan, 2010). Depending on the method of delivering the cloud technology to end-users, there are three service models of Cloud Computing: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS) (De Assunção, Di Costanzo, & Buyya, 2009). According to the ownership of Cloud Computing infrastructure, there are several cloud deployment models: Public Cloud, Hybrid Cloud, Public Cloud and Community Cloud (Mell & Grance, 2011).

Internet of Things can be used for improving the overall learning process. Internet of Things implies connecting different kinds of devices to the Internet (Atzori, Iera, & Morabito, 2010). By using sensors and actuators, it is possible to create smart environments which respond to various automation scenarios. Smart

environments are based on wireless sensor networks, which are distributed networks consisted of sensor areas interconnected by wireless networks. Sensor networks consist of multiple sensor nodes which are spatially placed. The positions of sensor nodes in smart environment are usually random. The main design factors regarding sensor networks are: fault tolerance, scalability, production costs, hardware constrains, sensor network topology, environment, transmission media and power consumption (Akyildiz, Su, Sankarasubramaniam, & Cayirci, 2002a, 2002b).

Wireless sensors networks are highly constrained. Comparing to traditional wireless networks, wireless sensor networks have short range, low bandwidth, limited storage and processing units in each node and limited amount of energy (Yick, Mukherjee, & Ghosal, 2008). The most important components of Wireless Sensor Networks are: sensors which measures physical values of the environment (temperature, pressure, sound, light intensity etc.); actuators which can turn devices on or off and wireless Infrastructure (routers, access points etc.) which makes communication between sensors, actuators and the Internet possible.

Internet of Things is used for creating different types of smart environments, such as smart buildings, smart homes, smart government and smart classrooms. Buildings with some automated elements are known as smart buildings. These buildings are capable of warning their residents and/or employees of fire, flood and other natural disasters. Also, these buildings can “sense” the presence of people and to react adequately (i.e. to turn on the light or to turn the air condition on).

Smart Homes uses home automation systems which integrate several different systems for managing home appliances, such as: Heating System, Air-Conditioning System, Anti Burglar System, Fire Alarming System, Home Lightning Systems, Audio Systems, Video Systems, etc. (Chan, Esteve, Escriba, & Campo, 2008; Ding, Cooper, Pasquina, & Fici-Pasquina, 2011). Smart Government means using information and communication technologies, applications and different contents for improving the process of providing services to citizens/enterprises and for improving the overall processes of public administration (Downs, 2005; Neirotti, De Marco, Cagliano, Mangano, & Scorrano, 2014). The main objective of introducing Smart Government is focusing on structural and fiscal reforms in the public administration for improving the quality of life.

Smart Classrooms represent synthesis of technology, user interface and traditional lecturing methods. New generations of Smart Classrooms are equipped with high technology and they become necessary for performing teaching processes at universities. Smart Classrooms have audio-visual equipment which enables transferring the knowledge by using a wide spectrum of different media (Gligoric, Uzelac, & Krco, 2012; Huang, Hu, Yang, & Xiao, 2012). Some authors propose using of near field communication (NFC) technologies for creating a smart classroom which is able to provide real-time feedback of students, locate them and automate recording of their attendance at classes (Shen, Wu, & Lee, 2014).

With Internet of Things in education, students are able to have teaching process and teaching materials created in accordance to their needs (Yan-lin, 2010). Ubiquitous computing and ambient technologies can be used in synergy with Internet of Things to create a prototype of an environment of smart campus which consists of Touching Note, Touching Cabinet, Touching Campus and NFC Interactive Panel. These elements are used for providing the students with different kinds of useful information related to timetables, teachers’ tutoring classes etc. (Gonzalez, Organero, & Kloos, 2008).

Internet of Things in classrooms can be valuable for collecting different data about students before classes. Teacher can use these data for improving the teaching process (Tissenbaum, Lui, & Slotta, 2012). One example of applying concepts of Internet of Things in education is Open Smart Classroom. This project represents a smart classroom which is able to translate teaching materials (Power Point Presentations) from English to Chinese and Japanese using web services. Also, presentations can be controlled by using smart phones (Suo, Miyata, Morikawa, Ishida, & Shi, 2009).

To personalize teaching and learning experience and to customize these processes according students’ and teachers’ needs, a concept of crowdsourcing can be used. Crowdsourcing involves contribution from a large group of people to a project (Satzger, Psaier, Schall, & Dustdar, 2013). In education, crowdsourcing means active participation of students and different teachers in the learning process. Students are partly involved in creating teaching materials and education environment, according to their needs and affinity (Satzger et al., 2013). Wikis and open source communities are some examples of using crowdsourcing in education (Albors, Ramos, & Hervasa, 2008). Smartphones can be used for crowdsourcing as well (Chatzimilioudis, Konstantinidis, Laoudias, & Zeinalipour-Yazti, 2012).

Poway Unified School District in California used crowdsourcing as a part of the project for improving the safety levels in schools, where all teachers and other employees in education institutions of the District were

involved in proposing their ideas for securing schools. Discussions between staff members were conducted by using different communication channels, such as smart phones, tablets and desktop web browsers. Participants of this crowdsourcing platform generated over than 10000 page views, 500 comments and about a thousand votes on nearly 100 ideas proposed (Davis, 2013).

3. A MODEL FOR E-LEARNING ENVIRONMENT BASED ON INTERNET OF THINGS

Smart building of higher education institution should be constructed according to standards of energy efficiency. New buildings should have energy passports. Energy passports are documents which describe energy efficiency, thermal protection and greenhouse gas emissions (Fehlauer, Winkler, & Braetz, 2009). Concepts of Internet of Things can be deployed in this building. Subjective and objective parameters about students' satisfaction with lecture classes can be measured.

Subjective parameters for quality evaluation of the lecture are measured as students' feedbacks in the real time. During the lesson, students should evaluate the quality of presentation and its contents by filling an electronic survey via their laptops, smart phones or tablet computers. A feedback server collects and processes all data from surveys. Teacher can view statistical results of the survey in the real time.

Objective parameters can be measured by using different sensors. For example, it is possible to measure noise which is relevant to students' satisfaction.

In addition to smart classrooms, a smart building of higher education institution can have a smart corridor with a smart infoboard. Smart infoboard is equipped with Bluetooth and NFC transmiters and it is connected to the main information system of the institution. Students can tap the infoboard with their smart devices to acquire the latest information about the institution. For example, the students can get their latest class timetables or the information about school events.

A model of previously described smart and energy-compliant building of education institution is shown in the Figure 1.

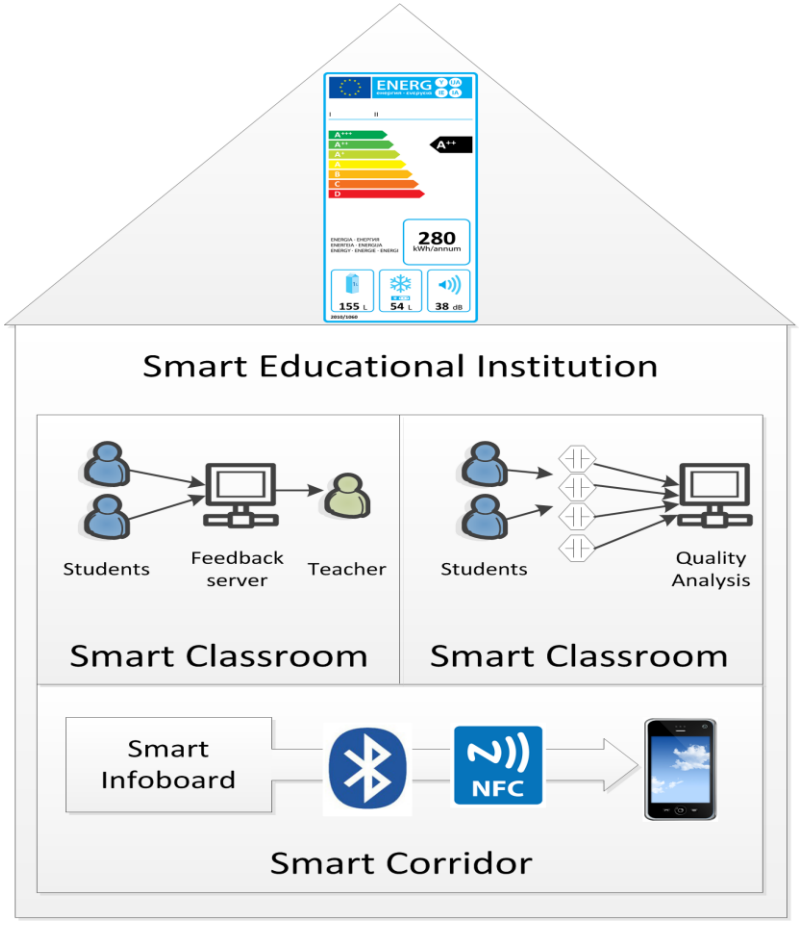

Figure 1: A model of the smart building of higher education institution

A model for e-learning based on Internet of Things and crowdsourcing consists of following main components: Sensors, which gather various data about students, teachers and learning environment; Router, which collects data from sensors wirelessly and stores them into the big data warehouse; Big data warehouse, which is capable to store several terabytes of raw data and Data Analysis Server, which analysis data from the big data warehouse.

The model is shown in the Figure 2.

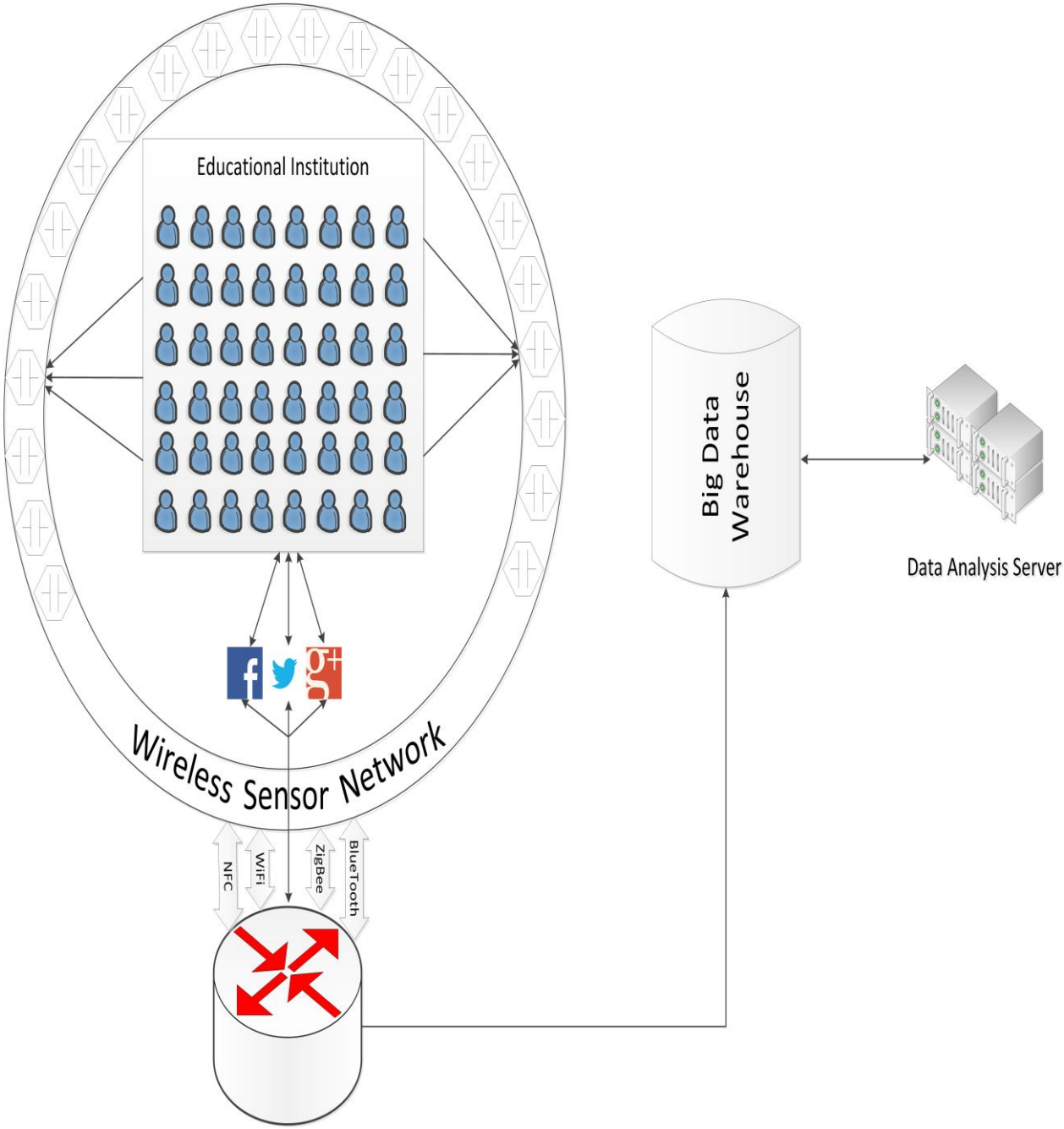

Figure 2: A model for e-learning based on crowdsourcing and Internet of Things

The main purpose of the model is to improve the learning environment according the needs of students.

Students can take surveys and choose their favorite learning styles. These information can be used for creating different teaching materials for each learning style. Data about students can be acquired by using sensors. For example, each chair can be equipped with presence sensor which is useful for creating historical report related to the number of students present on the lecture. Big Data Warehouse and Analytics Server are capable of graphical data visualization. Sensors can also provide participants of the teaching process with the data of teaching environment. It is possible to get values related to temperature, humidity, sound noises, brightness etc. These values can be in correlation with students' motivation and their attention. Different students can prefer entirely different environmental factors, i.e. some students better learn when the

temperature is about 17°C, and others prefer environments with 25°C. Students can vote about their favorite environmental factors. A mean value of the voting results can be used for adjusting environmental factors, such as air conditioning or heating.

Crowdsourcing concept can be used for getting feedback from students about their satisfaction of lecture classes in real time and encouraging students to participate in creating of teaching materials, according their own interests about particular subjects. The proposed model can be integrated with social media. The big data and analysis subsystems can collect data posted on social networks and analyze them. For example, if a student posted a tweet “I am cold” on the day when temperature was 20°C, this information can be used for further analysis of student’s preferences.

4. CONCLUSION

Internet of Things and crowdsourcing in education are not widely used nowadays. The proposed model uses crowdsourcing and Internet of Things concepts for building smart learning environment. Students can provide preferred values of environmental variables or these data can be acquired via social media. In future, the model can be expanded by adding more sensors to the environment according to feedbacks of the students who attended experimental classes in smart environments.

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REFERENCES

Akyildiz, I. F., Su, W. L., Sankarasubramaniam, Y., & Cayirci, E. (2002a). A survey on sensor networks. IEEE COMMUNICATIONS MAGAZINE, 40(8), 102–114. doi:10.1109/MCOM.2002.1024422

Akyildiz, I. F., Su, W., Sankarasubramaniam, Y., & Cayirci, E. (2002b). Wireless sensor networks: a survey. COMPUTER NETWORKS, 38(4), 393–422. doi:10.1016/S1389-1286(01)00302-4

Albors, J., Ramos, J. C., & Hervasa, J. L. (2008). New learning network paradigms: Communities of objectives, crowdsourcing, wikis and open source. INTERNATIONAL JOURNAL OF INFORMATION MANAGEMENT, 28(3), 194–202. doi:10.1016/j.ijinfomgt.2007.09.006

Atzori, L., Iera, A., & Morabito, G. (2010). The Internet of Things: A survey. COMPUTER NETWORKS, 54(15), 2787–2805. doi:10.1016/j.comnet.2010.05.010

Casey, D. (2005). u-Learning = e-Learning + m-Learning. In G. Richards (Ed.), Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2005 (pp. 2864–2871). E-Learn 2005--World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education: AACE. Retrieved from http://www.editlib.org/p/21634

Chan, M., Esteve, D., Escriba, C., & Campo, E. (2008). A review of smart homes - Present state and future challenges. COMPUTER METHODS AND PROGRAMS IN BIOMEDICINE, 91(1), 55–81. doi:10.1016/j.cmpb.2008.02.001

Chatzimilioudis, G., Konstantinidis, A., Laoudias, C., & Zeinalipour-Yazti, D. (2012). Crowdsourcing with Smartphones. IEEE INTERNET COMPUTING, 16(5), 36–44.

Chen, G.-D., Chang, C.-K., & Wang, C.-Y. (2008). Ubiquitous learning website: Scaffold learners by mobile devices with information-aware techniques. Computers & Education, 50(1), 77–90.

Davis, M. R. (2013). K-12 Districts, Groups Turn to Mobile “Crowdsourcing” to Solve Problems. Education Week, 2013(06).

De Assunção, M. D., Di Costanzo, A., & Buyya, R. (2009). Evaluating the cost-benefit of using cloud computing to extend the capacity of clusters. In Proceedings of the 18th ACM international symposium on High performance distributed computing (pp. 141–150).

Despotović-Zrakić, M., Simić, K., Labus, A., Milić, A., & Jovanić, B. (2013). Scaffolding Environment for e - Learning through Cloud Computing. Educational Technology & Society, 16(3), 301–314.

Ding, D., Cooper, R. A., Pasquina, P. F., & Fici-Pasquina, L. (2011). Sensor technology for smart homes. Maturitas, 69(2), 131–136.

Downs, A. (2005). Smart growth - why we discuss it more than we do it. JOURNAL OF THE AMERICAN PLANNING ASSOCIATION, 71(4), 367–378. doi:10.1080/01944360508976707

Fehlauer, K., Winkler, H., & Braetz, M. (2009). Quality tests for Energy Passport software. BAUPHYSIK, 31(3), 174–185. doi:10.1002/bapi.200910023

Gligoric, N., Uzelac, A., & Krco, S. (2012). Smart Classroom: Real-time feedback on lecture quality. In Pervasive Computing and Communications Workshops (PERCOM Workshops), 2012 IEEE International Conference on (pp. 391–394). IEEE.

Gonzalez, G. R., Organero, M. M., & Kloos, C. D. (2008). Early Infrastructure of an Internet of Things in Spaces for Learning. Advanced Learning Technologies, IEEE International Conference on, 0, 381–383. doi:http://doi.ieeecomputersociety.org/10.1109/ICALT.2008.210

Huang, R., Hu, Y., Yang, J., & Xiao, G. (2012). The Functions of Smart Classroom in Smart Learning Age. Open Education Research, 2012(2), 22–27.

Liang, P.-H., & Yang, J.-M. (2011). Virtual Personalized Learning Environment (VPLE) on the Cloud. Lecture Notes in Computer Science, 6988, 403–411.

Mell, P., & Grance, T. (2011). The NIST definition of cloud computing. Retrieved from http://csrc.nist.gov/publications/nistpubs/800

Neirotti, P., De Marco, A., Cagliano, A. C., Mangano, G., & Scorrano, F. (2014). Current trends in Smart City initiatives: Some stylised facts. CITIES, 38, 25–36. doi:10.1016/j.cities.2013.12.010

Radenković, B., Despotović, M., & Bogdanović, Z. (2006). Obrazovni i tehnički aspekti projekta sistema za E-Obrazovanje. In E-trgovina 2006. Palić.

Satzger, B., Psaier, H., Schall, D., & Dustdar, S. (2013). Auction-based crowdsourcing supporting skill management. Information Systems, 38(4), 547–560.

Shen, C., Wu, Y.-C. J., & Lee, T. (2014). Developing a NFC-equipped smart classroom: Effects on attitudes toward computer science. COMPUTERS IN HUMAN BEHAVIOR, 30, 731–738. doi:10.1016/j.chb.2013.09.002

Sultan, N. (2010). Cloud computing for education: A new dawn? International Journal of Information Management, 30(2), 109–116. doi:10.1016/j.ijinfomgt.2009.09.004

Suo, Y., Miyata, N., Morikawa, H., Ishida, T., & Shi, Y. (2009). Open Smart Classroom: Extensible and Scalable Learning System in Smart Space Using Web Service Technology. IEEE TRANSACTIONS ON KNOWLEDGE AND DATA ENGINEERING, 21(6), 814–828. doi:10.1109/TKDE.2008.117

Tissenbaum, M., Lui, M., & Slotta, J. D. (2012). Co-Designing Collaborative Smart Classroom Curriculum for Secondary School Science. JOURNAL OF UNIVERSAL COMPUTER SCIENCE, 18(3), 327–352.

Yan-lin, L. I. L. Z. (2010). The Application of the Internet of Things in Education [J]. Modern Educational Technology, 2, 5.

Yick, J., Mukherjee, B., & Ghosal, D. (2008). Wireless sensor network survey. Computer Networks, 52(12), 2292–2330. doi:10.1016/j.comnet.2008.04.002

LEVERAGING PLATFORM AS A SERVICE FOR SIMULATION LEARNING INFRASTRUCTURE

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Abstract: *Development, availability and accessibility of information and communication technologies lead to new paradigms in teaching and learning processes. This paper describes a new approach for learning simulation processes. Main goal of the research is to improve process of learning simulation by leveraging platform as a service cloud computing paradigm. The main components of the proposed model are: private cloud of an educational institution, platform as a service delivery model, and platform as a service engine API. The proposed solution is designed to improve scalability, availability, security and modularity of simulation learning processes.*

Keywords*: learning simulation, cloud computing, platform as a service, simulation infrastructure*

1. INTRODUCTION

Modern technologies are used every day for very different purposes: to communicate, collaborate or retrieve information from services, to improve learning process, etc. Many universities in the world organize courses and trainings via distance learning systems. The concept of e-learning can be successfully applied to learning simulations. Simulation tools provide environment for the analysis of various features of system: feasibility, behaviour, stability, performance, etc. (Granlund, Berglund & Eriksson 2000; Banks, Carson, Nelson & Nicol, 2010). However, a majority of simulation tools have limitations such as platform dependence, high costs, maintenance difficulties and limited reusability (Byrne, Heavey & Byrne, (2010); Kuljis & Paul, (2003)). A rapid development and ubiquity of Internet and Internet technologies have had an impact upon the field of simulation, as they provide numerous ideas on how simulation can be improved. One of the methods to overcome these limitations is to develop a cloud computing based model for learning simulation.

The main objective of this paper is to provide a preview of development and realization of model for learning simulation which is based on cloud computing infrastructure in a higher education institution. Proposed model is developed as platform as a service in aim to provide scalability and reliability of educational applications and services. The model can be successfully applied to the study and modelling of processes, applications and real-world objects.

2. KEY CONCEPTS

2.1. Cloud computing

Cloud computing is an area of computing that refers to provide users with highly scalable IT capacities as a service via the Internet. Services and data coexist in a shared and dynamically scaled set of resources (Srinivasa, Nageswara, & Kumar, 2009). Cloud computing is an infrastructure that can bring a new value to an e-learning system, as educational services can be delivered in a reliable and efficient way. It also provides a suitable environment for ubiquitous learning activities (Despotović, Simić, Labus, Milić & Jovanić, 2013).

Talking about application of cloud computing infrastructure in higher education, three basic approaches can be noticed. First approach is complete outsourcing of e-education infrastructure (Sultan, 2010) second approach is cloud within the private infrastructure (Caron, Desprez, Loureiro, & Muresan, 2009) and the third approach represents combination of previous two approaches (Costanzo, Assuncao, & Buyya, 2009). There are three types of model for service delivery: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS) (Peter & Grance, 2011).

The aim of the implementation of the private cloud is to provide users run virtualized infrastructure, environment and service. The system for managing virtual infrastructure will automate, coordinate and integrate the existing solutions for: networking, storage, virtualization, monitoring and management of users. In this way, students and teachers are provided with tools for quick and easy access to the necessary educational and scientific services and resources. (Vujin, Simić, & Kovačević, 2014)

There are several open source packages that take a holistic approach and integrate all of the necessary functionality into a single package (virtualization, management, interfaces, and security). When added to a network of servers and storage, these packages produce flexible cloud computing and storage infrastructures (IaaS). However, in order to fulfill specific requirements, such as providing PaaS on demand, it is necessary to develop a new solution developed to enable integration software for learning simulation and cloud computing infrastructure of educational institution.

Cloud computing can be applied in educational institutions using different deployment and technology models. The problem of modeling infrastructure is specific in terms of resource provisioning and how to deploy virtualized services (Sotomayor, Santiago, Llorente, & Foster, 2009). In (Ercan, 2010) author gives a review on how higher education institutions can benefit from CC infrastructure. Main areas of application include: students and administrative personnel have the opportunity to quickly and economically access various application platforms and resources through the web pages on-demand, cost of organizational expenses are reduced and more powerful functional capabilities can be offered.

Much research has been done in the field of cloud computing in the previous years. However, only a small number of authors deal with the problem of developing and deploying a “platform as a service” model in order to support e-learning. Main research directions relevant to the problems outlined in this paper include supporting simulation learning within cloud computing environments, modelling the cloud computing platform, and resource management in systems for learning simulation.

2.2. The development of simulation approaches

The area of computer simulation has been successfully applied to the study and modelling of processes, applications, and real-world objects. Simulation enables computer-engineering students to analyze various types of systems, investigate relations and interactions between a system‟s components, design a model and an implementation of a system, verify different solutions and environments, and test projected capabilities and technical characteristics.

The main purpose of an educational simulation system is to enable a cheap and easy learning and practising environment, particularly suited for students of engineering (Zikic & Radenkovic, 1992). A Web-based simulation allows simulation to be carried out over the Internet using a standard web browser. A Web-based simulation is defined as the use of resources and technologies offered by the Internet for ensuring an interaction with the client and server modelling and simulation tools (Byrne, Heavey & Byrne, 2010). Downloading simulation software via the Internet and executing simulation on the user‟s computer, independent of browser doesn‟t fall into the category of web simulation: the browser plays an active role in the modelling and simulation process (Byrne, Heavey & Byrne, 2010). The key advantages of the web-based simulation approach are the following: wide availability, controlled access, efficient maintenance, increased integration, availability, interactivity, collaboration, cross platform compatibility and interoperability.

Resource demanding simulation software used to be available to researchers in big scientific centres and big companies which could afford expensive hardware for this purposes. Each researcher needed access to computer with software that is used for modelling and simulation execution and data analysis. Limited resources implied also limited possibilities for performing experiments. Besides that, there were limitations in software infrastructure, especially in simulation experiments which included two or more linked simulations. As we have seen, Cloud computing offers virtually unlimited hardware infrastructure, so companies and researchers who are users of simulation platforms do not need to possess their own servers and other infrastructure. Leasing of simulation software as service (SaaS) offers notable advantages: scalability,

configurability, significantly less time for simulation models and software development (Marinković, Čavoški & Marković,2014).

The reason we propose platform as a service model for learning simulation is that it is beneficial for simulation software to exploit the tremendous resources and huge amount of storage, that cloud computing is able to provide. Another reason to use platform as a service model is the use of composed simulation services. Composed simulation services are constructed by governing multiple individual simulation services and/or composed simulation services within a common temporal factor. Platform as a service model enables user to use and change predefined simulation model or part of the model. This approach enables active planning and monitoring capacities in real time, so that infrastructure can dynamically be scaled to support high loads of users„ requests.

3. PLATFORM AS A SERVICE BASED MODEL FOR LEARNING SIMULATION

Using the concept of cloud computing, educational services and resources can coexist in a shared and dynamically scaled environment. In a higher education institution, IT infrastructure refers to a set of hardware, software, network and other resources meant to provide modern services to support teaching, learning, research, promotion and other processes within the institution. The infrastructure has to be flexible, scalable, reliable and safe, and these requirements can be fulfilled through a private cloud. The architecture of the private cloud is based on flexible federations of servers, storages and networking (Cerbelaud & Huylebroeck, 2009).

Main goal of developing a model of infrastructure for learning simulation is to create a framework, standards and techniques that will lead to higher quality of the overall education process. Key principles in designing the model include:

- Scalability
- Availability
- Security
- Modularity

The model of infrastructure for learning simulation developed as a platform as a service is shown in Figure 1. The model contains: infrastructure (hardware) support, big data database, high-performance, distributed memory object caching system, tasking - asynchronous task queue, servers, controllers, web server solution for proxying TCP and HTTP-based applications, platform as a service engine api and fault tolerance layer. All components are in details described in the text that follows.

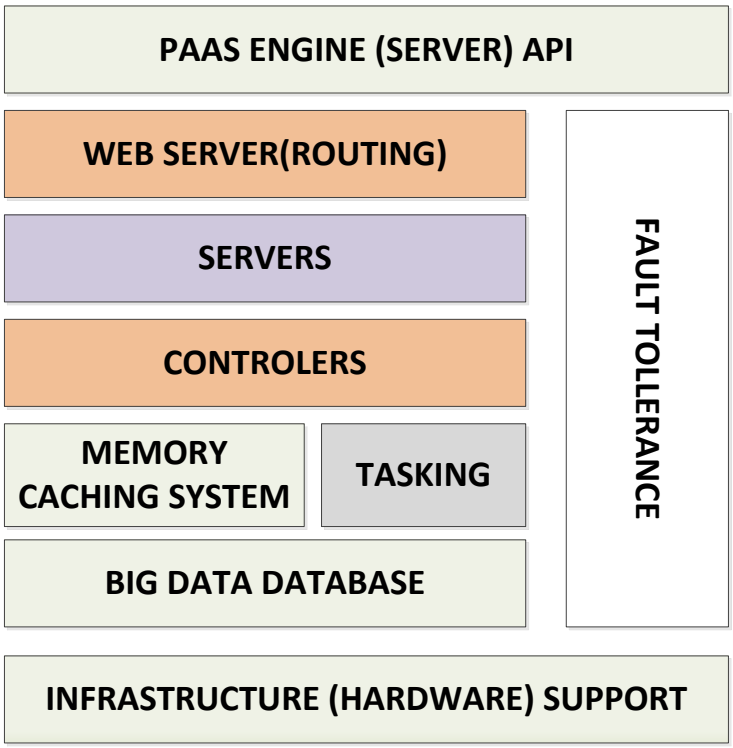

Figure 1. Model of infrastructure for learning simulation developed as a platform as a service

Figure 1. shows the design and implementation of model of infrastructure for learning simulation, an distributed software system that implements a cloud platform as a service (PaaS).

The PAAS engine API includes a module for teachers and a module for students. The module for teachers enables them to create, update, test and manage cases and problems. Teachers can also perform basic system administration tasks such as managing user accounts, resources, etc. Web server should be particularly suited for web sites crawling under very high loads while delivering web assets with unparalleled speed, maximizing performance and efficiency. This solution should support tens of thousands of connections. Its mode of operation makes its integration into existing architectures very easy and riskless, while still offering the possibility not to expose fragile web servers to the Net. Servers are controlled through PAAS Engine SDK. In first phase SDK should provide support for python scripting language. Production of these scripts would be done on some open source 3D graphics and animation software. Memory caching system enables high-performance, distributed memory object caching system and it should be an in-memory key-value store for small chunks of arbitrary data. Tasking system should be focused on real-time operation, and enables support for scheduling as well. The called tasks should be executed concurrently on a single or more worker servers using multiprocessing. Tasks should be preformed asynchronously (in the background) or synchronously (wait until ready). Big data database layer should provide linear scalability and fault-tolerance on cloud computing infrastructure. Leveraging in-memory computing, big data database layer should provide high performance for both reads and writes. Fault tolerance layer should provide resistance to faults within a cluster. It should enable replication support for applications and their data. Processes should be monitored and restored for cases where they have terminated or when they are misusing resources. Using proposed model, system is able to provide fault tolerance and elasticity automatically and in a straightforward manner, since any virtual machine can take on any role on-demand.

A more detailed overview of the proposed model is given in figure 2. The core infrastructure components include:

- A repository of predefined customizable models
- A model transformation service that transforms external models into an internally supported simulation format
- Task management services that manage the entire process and implement fault tolerance
- Task and result queues that accept and store jobs until they are executed by processing nodes
- Interprocess registry that stores all variables shared between the tasks
- Trend analysis and reporting service
- Web interface for creating, editing, and executing jobs.

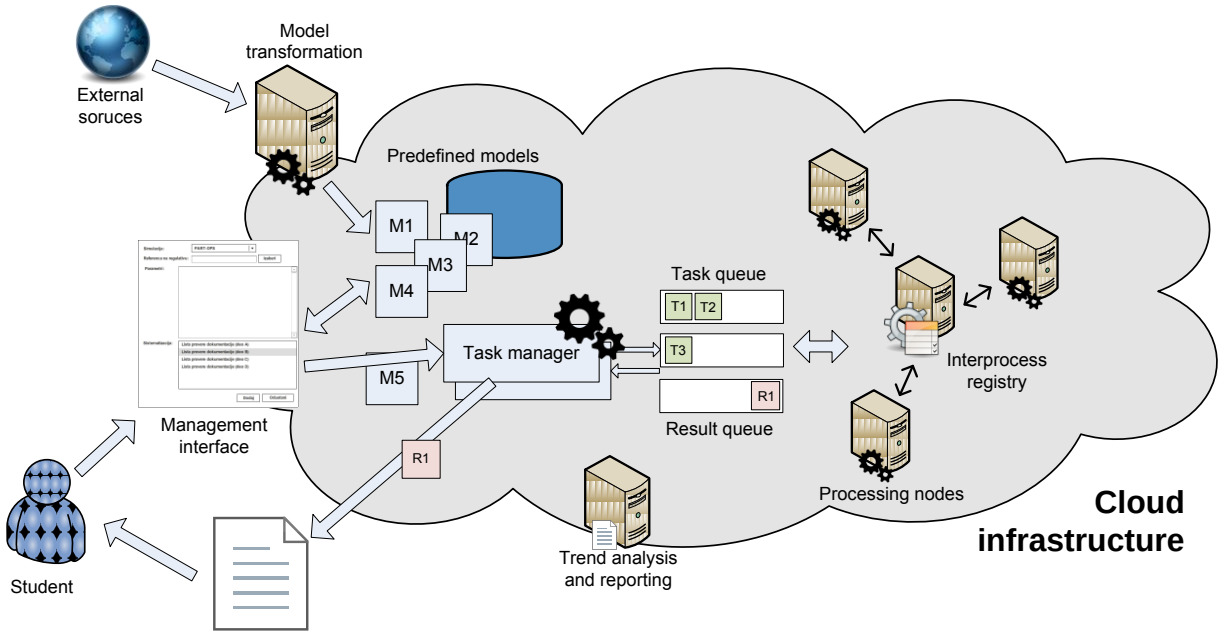

Figure 2 Detailed overview of model for learning simulation developed as a platform as a service

The standard usage scenario for the presented model is based on simulation models defined and stored in an internal model repository. These models describe standard simulation scenarios, and possess modifiable parameters and components. The students can access any of the existing models and modify them to suit

their need, as well as define new models using existing components or external sources. The management and execution of these models is performed through a simple web interface. The backend of the management interface communicates with the task manager, by sending him specific parameters of the simulation model relevant for its execution.

The task manager represents a core component of the system that performs orchestration of all tasks, retrieval of results, and is replicated in order to provide fault tolerance. Using the parameters received from the user, the task manager calculates an estimate of required time and resources for optimal task execution. The calculation is presented to the user. If the student"s privileges are inadequate for execution of submitted simulation (where limitations to maximal CPU/memory allowed are applied), the interface will require the student to modify parameters. When all system conditions are met by the model, the user can submit the model to execution in the system. Upon submitting a simulation model, the task manager decomposes received models into individual tasks/processes. Models are decomposed based on the degree of their mutual independence and processes with the least interdependencies are apportioned directly to the task queue. The processes that are highly interconnected pass another round of analysis in order to ascertain their requirements. This round is performed in order to weigh the potential losses incurred when tightly coupled processes are distributed into separate tasks. If the loss outweighs the gains from parallelization, the processes are bundled into a single task; otherwise, they are distributed into separate tasks.

When execution nodes complete their previous tasks, they poll the queues of corresponding types and grab the tasks. Processing nodes differ in the amount of processing power and memory resources allotted, and are linked to specific queue types, i.e. some queues contain tasks for less powerful nodes, others contain more complex tasks. During the execution, the tasks occasionally need to communicate changes of variables to other tasks. This is done by reporting all such changes to the interprocess registry. The interprocess registry is a quick, memory-based caching system that stores variables shared between processes. Upon completion, the simulation results are forwarded to the result queue. The task manager polls the result queue in order to ascertain whether all of the composing bits of the model are complete. When all processing is completed, the task manager synthesizes all bits into the result, which is then sent to the user. User behavior and executed simulation models are continuously tracked, and all activity is recorded in the logs. These logs can be analyzed later using the trend analysis and reporting service. The results are generated as HTML pages enriched with interactive JavaScript visualizations.

In a platform as a service approach, developers code to standardized APIs. This represents a paradigm shift from infrastructure as a service, where users decide what software needs to be installed, what version of each piece of software are needed to work together, how to configure the software, maintain it, and finally write the software they set out to create. With platform as a service approach students only need to worry about writing their application. Our solution handles how to deploy application to best serve users and provides user with ability to control platform as a service deployment.

4. CONCLUSION

The Internet enables a distributed environment for utilizing simulation tools. The cloud computing concept and its characteristics can help higher education institutions improve productivity and enhance hardware and software resources management that are necessary to provide e-education features, scientific and research activities and students projects (Dong, Zheng, Yang, Li, & Qiao, 2009). By using modern Internet technologies, the transition to platform as a service based model for simulation is simplified. Today, researchers are focused upon finding new approaches and environments that can make learning simulation easier. The potential benefits of designing, developing, and using platform as a service based simulations are huge, and they include improved efficiency and effectiveness in the learning experience.

The objective of this study is to introduce a new platform as a service based environment for learning simulation. The material in this study has provided comprehensive concepts and techniques for embedding specific software tools used in engineering education. The future research is directed toward improving and implementing the model as a proof a concept. Also, the model should be improved with additional features to enable collaborative modelling of systems.

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REFERENCES

Banks, J., Carson, J. S., & Nelson, B. L. (2010). DM Nicol (Ed.), Discrete-Event System Simulation. 5th edition Prentice Hall.

Byrne, J., Heavey, C., & Byrne, P. J. (2010). A review of Web-based simulation and supporting tools. Simulation modelling practice and theory, Vol. 18(3), pp. 253-276.

Caron, E., Desprez, F., Loureiro, D., & Muresan A. (2009). Cloud Computing Resource Management through a Grid Middleware: A Case Study with DIET and Eucalyptus. In J. E. Guerrero (Ed.), *2009 IEEE International Conference on Cloud Computing*. (pp. 151-154). Los Alamitos: IEEE Computer Society.

Cerbelaud, D., Garg, S., & Huylebroeck, J. (2009). Opening the clouds: qualitative overview of the state-of-the-art open source Vmbased cloud management platforms. In *The 10th ACM/IFIP/USENIX International Conference on Middleware*, *Article No.: 22*, (pp. 1-8). New York: Springer-Verlag.

Costanzo, A., Assuncao, M., & Buyya, R. (2009). Harnessing Cloud Technologies for a Virtualized Distributed Computing Infrastructure. IEEE Internet Computing, Vol. 13(5), pp.24-33.

Despotović-Zrakić, M., Simić, K., Labus, A., Milić, A., & Jovanić, B. (2013). Scaffolding Environment for e-Learning through Cloud Computing. Journal of Educational Technology & Society, 16(3).

Dong, B., Zheng, Q., Yang, J., Li, H., & Qiao, M. (2009). An E-learning Ecosystem Based on Cloud Computing Infrastructure. In A. Ignasio, C. Nian-Shing, Kinshuk, & S. Demetrios (Ed.), *The Ninth IEEE International Conference on Advanced Learning Technologies* 2009, (pp. 125-127). Los Alamitos*: IEEE Computer Society*.

Ercan, T. (2010). Effective use of cloud computing in educational institutions. Procedia - Social and Behavioral Sciences, Vol. 2(2), 938-942

Granlund, R., Berglund, E., & Eriksson, H. (2000). Designing web-based simulation for learning. Future Generation Computer Systems, Vol. 17(2), pp. 171-185.

Kuljis, J., & Paul, R. J. (2003). Web-based discrete event simulation models: Current states and possible futures. Simulation & Gaming,Vol. 34(1), pp. 39-53.

Marinković, M., Čavoški, S., & Marković, A. (2014). Application of Cloud-Based Simulation in Scientific Research. *Handbook of Research on High Performance and Cloud Computing in Scientific Research and Education*, 281.

Peter, M., & Grance, T. (2011). The NIST definition of cloud computing (NIST special publication 800-145: 7). Washington, DC: NIST.

Sotomayor, B., Santiago, R., Llorente, I., & Foster, I. (2009). Resource Leasing and the Art of Suspending Virtual Machines. In: *Proceedings of. 11th IEEE International Conference on High Performance Computing and Communications.* (pp. 59-68), Seoul, Korea. IEEE Computer Society, Los Alamitos.

Srinivasa, R. V., Nageswara, R. N. K., & Kumar, E. K. (2009). Cloud Computing: An overview. Journal of Theoretical and applied Information Technology, Vol. 9(1).

Sultan, N. (2010). Cloud computing for education: A new dawn? International Journal of Information Management, Vol. 30(2), pp. 109-116. Elsevier. doi:10.1016/j.ijinfomgt.2009.09.004

Vujin, V., Simić, K., & Kovačević, B. (2014). Digital Identity Management in Cloud. *Handbook of Research on High Performance and Cloud Computing in Scientific Research and Education*, 56.

Zikic, A. M. and Radenkovic, B. LJ. (1992). Applications of GPSS/FON in teaching simulation, International Journal Of Engineering Education., Vol. 8(5), pp. 355-366.

A PLATFORM FOR LEARNING INTERNET OF THINGS

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Abstract: *This paper presents a web platform for learning Internet of things in a higher educational institution. The platform enables students to learn about Internet of things and helps them to build applications that can be run on smart devices. The main goal of this paper is to introduce new services and platform to students that will foster e-learning in the Internet of things environment. Paper also presents a model for learning Internet of things that integrates a cloud web application with web services and Moodle Learning Management System. The application uses web services and different smart devices to allow students to build various applications and learn about Internet of things and devices connected with this platform. Model is developed and implemented within Laboratory for e-business at Faculty of Organizational Sciences, University of Belgrade.*

Keywords*: Internet of Things, Raspberry Pi, Arduino, Web Service, Cloud Computing, Moodle.*

1. INTRODUCTION

The Internet of Things (IoT) is the network of physical objects that can be controlled and accessed through Internet and can be used to perform some simple or more complicated tasks. The main devices in IoT paradigm are actuators and sensors. Sensors are objects that receive signals and measure it on some way and actuators are the objects which do some action after receiving some signal.

For example we have temperature sensor which measures temperature. Other example is fire sensor which only shows if there is a flame near the sensor so it returns only true or false (Boolean). Objects which receive some signal and then make some action we call actuators. In other words the devices which are able to perform some actions that will have an impact on the physical realm we call actuators (Miorandi, et al., 2012).

Actuators are objects that react when some signal or smart devices tells them so. For example when temperature is higher than 300 degrees some microcomputer sends a signal to actuator to open the window.

The next era of computing will be outside the traditional desktop approach and devices and their controllers will communicate over the Internet. In the Internet of Things (IoT) paradigm, many of the objects that surround us will be on the network available to communicate on the demand and we will be able to access them even when we are not close to them. Radio Frequency Identification (RFID) and sensor network technologies will be used more in the future to help people and perform some tasks instead of them. It is predictable that, in the future years, the Internet will spread more and more and we will be wrapped all around us with smart devices which will be used for various goals such as education, fun, spraying garden and so on. Content, services and smart devices will be all around us, always available and ready to help us when we need so and enabling new ways of working, interacting, and new ways of living and demanding from programmers new services and applications which will manage with smart devices and tell them when to do some actions. In the future we will be able to rely on sensor which will spray the garden when the earth is dry or order food when our refrigerator is empty.

This paper presents a model based on cloud web applications that could help informatics students to achieve basic knowledge in IoT through process of computer-mediated activities that include presentation of IoT devices, their structure, how they could be connected with other devices and what it could be done with them using the present platform. Platform is integrated with Moodle Learning Management System and developed and implemented at Laboratory for e-business at Faculty of Organizational Scientists. At start, on our platform intelligent devices that will be used are Raspberry Pi microcomputer and Arduino microcontroller. Reason for choosing these two devices is because they are very cheap, easy to use and very easy to connect with web services and actuators which we will also use to perform actions after giving signal over smart devices and Internet web service. A platform for learning IoT is developed in scope of

Laboratory for e-business and deploys Raspberry Pi microcomputer and Arduino microcontroller as intelligent devices.

2. LITERATURE REVIEW

In the last few years, in the area of wireless communications, a new paradigm named the Internet of Things (IoT) which was first familiarized by Kevin Ashton in the year 1998, has gained increasingly more attention in the science and industry and today it is all around us in its various forms ready to help us complete some tasks and jobs. (Santucci, 2009).

Introducing IOT in an environment can be achieved by introducing and linking intelligent devices in various places and giving them various tasks to perform. There is a number of different applications of IoT which can be used in business, education, transportation, logistics, healthcare, public administration, etc, which make life easier and better (Atzori, Lera, & Morabito, 2012).

It is an advanced intelligent devices paradigm that requires technology, knowledge and infrastructure, at the level of which is available, for now only in rich, developed countries. In developing countries IoT solutions can provide more profitable economic development and greater opportunities for outsourcing and really help people to by making their life easier. Cheap micro devices such as Raspberry Pi and Arduino can enable the development of various systems with less investment in infrastructure but with enough power to handle basic applications and requests which are needed to perform tasks (Raihan, 2013)(Kaloxylos, et.al., 2014).

Raspberry Pi and others similar devices provide Application Programming Interfaces(APIs) that abstract his low-level operations , enabling effective use and operation of multiple perspectives .

Depending on the educational context, one can adopt several approaches to learning IOT 's. At the lowest level are individual IoT devices, whose understanding requires knowledge of low level - knowledge of electronics and programming microcontrollers. The middle level is oriented towards computer science and includes communication protocols, systems integration, web services, user interfaces, and so on which will control these devices. Teaching IOT brings a set of problems for students and teachers, particularly at the higher levels of IoT 's. Some of these problems are (Raihan, 2013):

- The need for the use of complex hardware and software tools which are not always available,
- lack of time to create complex IoT projects and always learning about basic applications,
- Lack of implementation of all functionality IoT project .

One approach to teaching IOT is to use simulation tools to simulate the device or the environment in which they will be placed. An example of this approach can be seen in (Callaghan, 2012), where the authors used an electronic board that they have developed themselves. This platform is capable of processing digital and analogue inputs and simulation of home devices. Using this approach teaching can be performed even without the hardware components and the complete course can be more concentrate on the software aspect of the IoT 's even without expensive equipment such are some expensive actuators and complicated sensors. However, the simulation cannot replace the all benefits of working with the real hardware devices and potentially limits the imagination of students, forcing them to work in the framework of simulated scenarios which could not always represent real problems and components so the experience could not be always as the one that can be earned with working with real devices.

Nowadays, new type of service based computing is becoming more and more interesting for programmers. Its name is cloud computing and its main ides is to provide service over Internet on demand. Cloud computing represents extension of virtualization and grid computing. "*Cloud computing makes the computing resource become a kind of professional service, and provides them to users in an informational way*" (Yilmaz, 2011) Cloud Computing represents a highly scalable, and very reliable computer infrastructure that hosts applications for the end-users. Also, Cloud Computing allows efficient usage of resources because having several virtual machines which can operate together so there are a smaller chances of the whole system failrue than there are when an application is running on a single machine (Huang, Li, Yin & Zhao, 2013):

3. MODEL FOR LEARNING INTERNET OF THINGS

The presented model was developed within of Laboratory for e-business at Faculty of Organizational Sciences, University of Belgrade. Present model was designed for students that take a part in subjcects such as "Internet of intelligent devices" on Faculty of Organizational Scientists at all study levels. Within the mentioned subjects students are available to see what are intelligent devices, to learn about them and to

develop smart areas such are smart houses, smart parking, smart classrooms and so on. A generic model for learning IOT should have three layers: Application layer, service layer and the device layer. On the device layer students can use devices such as Raspberry Pi and Arduino because they are very cheap and they have enough power to handle basic instructions and pass them to actuators which will do the specific job. Stronger and more expensive devices can be added if there is need for them. They can be used for some more complicated projects. For the academic purposes, universities don't need to buy expensive actuators. Instead of them some university can use just few led diodes coloured in different colours which could represent different actuators. For example, Red diode could represent fire, yellow presence of magnetic field and white presence of water. On the service layer we have Internet web service that should be able to handle requests from the application layer and also communicate with device layer by sending commands to devices and receiving signals and voltage from devices which will be send to application layer where it will be analysed and, after that, certain action will be performed. Web service should be also available to communicate with the external devices and phone devices which could send some request to application layer that will be processed and send, also over the service layer, to devices to be performed. Application layer and device layer should be inside a cloud ,which will provide us better provide us better and more redundant services so we don't have to worry about system fail true. Platform, through application layer, should be connected with platform for e-learning. Reason for doing this is to integrate theoretical and practical learning which will be described later. In addition, after integration of IoT platform with Moodle Learning and Management System process of grading will be faster and more efficient and some grading could be performed automatically. For example, some applications on application layer can receive signal that certain actuator has been used and, after that, information about well done job can be send to Moodle and students who made actuator move can be graded automatically. Model for learning Internet of things is shown in figure 1.

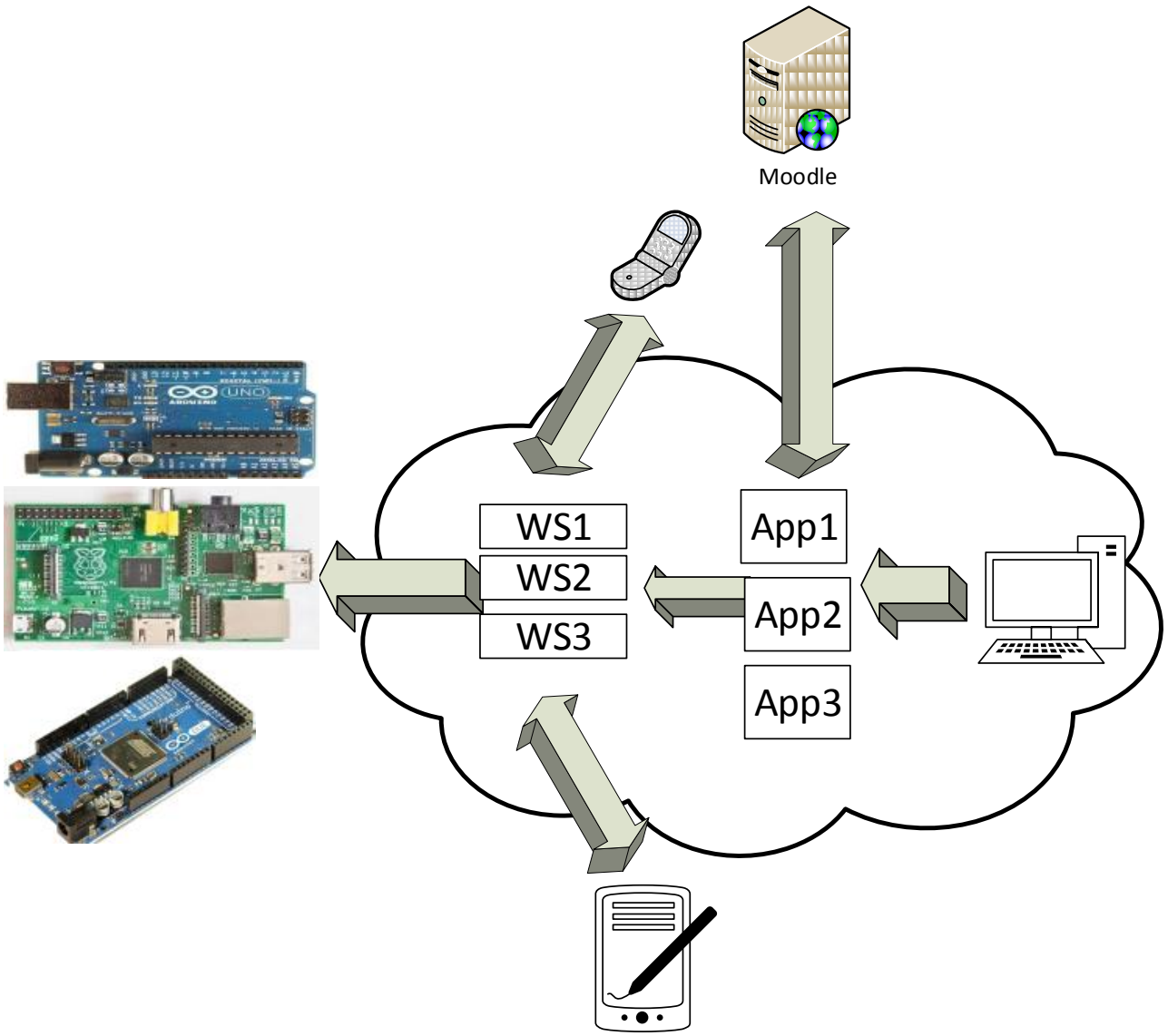

Figure1: Model for learning Internet of thing

When someone adds devices on the device layer, it also should be registered on the application layer so the basic user will be able to use devices through simplified commands. For example, if an university has a Raspberry Pi microcomputer, students can create some generic functions which could be integrated in applications so basic user can drag and drop wanted functionality which he needs it and use it on some pin. Other example can be building application for checking is there a fire in some area, so students can make generic application which sends an e-mail or text message to some address about presence or not present flame in some area. Also, microcontrollers should be registered on web service layer because service layer needs to have a functionality of receiving signals from devices and sending it to application layer or mobile phone or PDA.

Also, some generic functionality on device layer can be integrated in advance. For example students can build functionality of receiving signal from some pin and returning true or false if signal is present. After that, user only needs to set pins for receiving signal. For example, if some university is using Raspberry Pi, they can build generic Python function that returns true if signal is present on some pin and false if signal is not present.

External devices such as mobile phone; PDA devices and so on should have functionality of receiving and sending signals through web service with mobile applications which also should be developed in this course. Also these devices should have a functionality of communicating with application layer and using simplified applications to use smart devices through them. Application layer will contain mobile applications for communicating with devices directly so the user only needs to download the application, install it on the phone and set an ip address after what he can communicate with devices directly. Mobile application should be upgraded every time when some device on device layer is registered and ready to use.

Role of Moodle in this platform is important. Using Moodle and with principle of Blended learning, students will be able to get all literature they need to get theoretical knowledge about IOT and smart devices that we are using on the device layer (Despotovic-Zrakić, et al., 2012) Also, with a help of Moodle teachers are able to track progress of each student. Every student has his own account on Moodle where his activities and grades are stored and which are visible every time when student wants so. Moodle also should contain some tests, quizzes and puzzles which could be solved and by solving those students can earn points and higher grades. Also, on Moodle teachers can create tasks that need to be solved. When teacher creates a task he also needs to create a small application on application layer and new listener on web service layer.
For example one of tasks could be developing Python application for Raspberry Pi which call's fire department if sensor on Raspberry Pi notices smoke in a house. Sensor could be replaced with a led diode. When a certain student makes function which turns on a led diode of noticing a smoke, a web service gets information that a diode is turned on and sends information's on applications layer which sends that information to Moodle. When Moodle gets information about turning on a led diode by a certain student, service writes points for certain task to student who made a function that turns on a led diode.

Application layer should also contain information about devices on the device layer. Information about certain device should have its picture, described performance, ports and some examples connecting devices with sensor and actuators. Description should be implemented in an interactive application which could allow students to click on some of parts of devices after what students will see the description of certain device part and picture of that part. That will help students to get theoretical knowledge about every element of smart device and it will help students understand purpose of every part. Moodle also should have tests based on devices description and parts and students, after seeing the device description and parts can try a Moodle test and see how well they have mastered material about some device. After completing the test, student will get points which will be a part of grade from a subject based on IOT.

On application layer students and teachers also can describe different sensors and actuators. This description will contain performance of sensor or actuator, its price, usability and a small example code which shows how easily students can use certain actuator or sensor in combination with some smart device and how to connect it on smart devices. Also, descriptions should contain an example how students can simulate certain actuator with one or more led diodes and also a small code example how to simulate actuator with led diod. If student chooses to try actuator simulation, code for simulating actuator is being put to one of devices and then started. After this presentation application layer removes code from the device if it's not needed anymore. For sensors, application layer will have example codes how to simulate some signal from sensor with Python or C++ functions and explanation how often signal should be send which will be send to service layer and after that, on application layer processed and utilized. Later, students can run these codes on Raspberry Pi, Arduino and similar smart devices to simulate sensor behaviour and complete tasks even without having a real sensor or actuator.

Application layer would also have a description of devices that university don't have on the device layer and description of their performance and all benefits and faults which can come with a certain device. For some simple microcontrollers, application layer should have a small simulator which allows students to try how it is to use a certain smart device which will allows students to feel the difference between devices. This part will be particularly hard to develop because programmer of this application needs to simulate whole smart device, it's performance, behaviour and weaknesses, it's connection with sensors and actuators and their communication, but, from the other side, virtual smart device will only exist on the application layer and it won't be necessary to register that device on the service layer and on the device layer. Also programmer doesn't need to develop whole virtual smart device and its all possibilities. Instead of that programmer can just make a virtual smart device which will perform basic functions such are connecting with few sensors and actuators and some basic commands in programming language which certain devices uses.

Application layer will also have a videos section which will allow students to see the look of various microcomputers, microcontrollers, sensors, actuators, different smart devices and equipment that is useful for IoT, how to connect microcomputers with microcontrollers, how to attach sensors and actuators to certain smart device and how complex systems of devices, sensors and actuators work. Videos section should also contain videos that show how sensors look and how they can be used, videos section also should contain a section that shows what could be made with smart devices. For example, students or teachers could make a video how smart classroom should look and what smart devices, sensors and actuators we need to have to build a smart classroom. Besides these videos, section will have documentation that describes, step by step, what it takes to build a smart areas such are smart classrooms, smart parkings, smart homes and so on.

Also, platform should have implemented inside itself open-source application called Fritzing which allows students to virtually connect various devices and see what they would get with connecting them because, sometimes, working on real device could damage it if student didn't have earlier experience with smart devices and electricity. Also platform should have some test based on connecting devices like it's done in Fritzing where students can verify that they have a mastered connecting devices smart devices with other smart devices, resistors, actuators and sensors.

Next functionality of this platform is also connected with Moodle. On Moodle, students can choose witch project they want to make and sign up for it. When they sign up, application layer creates project folder for the specified project after what students can start building their application or service. Also project folder will contain documentation about equipment that can be used for specific project such are smart devices and their ip addresses, which sensors, actuators or led diodes students are allowed to use and on which pins specified diodes, sensors and actuators could be found. Student will also get a folder on the device layer where his code should be written. Reason for implementing functionality like this it to allow students to actually work with smart devices from their homes without having their own smart device. Also, if students want so, they can use their own smart devices and connect them with platform's web service or build also and their own service layer and connect their system directly with application layer. After implementing their application on the application layer, students need to make, or, depending of type of specific task, use already build web service that connects smart devices on the device layer and new application on application layer. After completing the project, students will get a grade on Moodle.

Besides this, students will be able to take part of bigger projects for which they can sign up on Moodle. For example, students can sign up for building one of web services or application functionality that is a part of larger application which is being currently developed. After completing some part of application, students will get certain amount of points on Moodle.

Students can also make their own documentation and descriptions of sensors, actuators, microcontrollers and microcomputers or any other part of devices and equipment that they have been using or just suggest what smart device they wish to use and why. After making documentation about specific subject, students can upload it on local server through application layer and, after it passes the checking, documentation will be available for everyone enrolled in this course to see it.

Besides this, students also can make their own presentation of devices which have not been described or mentioned on this platform yet. For example, if students have been using some new microcomputer or microcontroller, student can make a jQuery presentation of device which shows for every device part description and role which certain device part has which will be showed when we place a mouse over it and which shows bigger description and presentation of device when we click on it.

The implementation of the presented model can potentially be very complex, with a large number of interconnected services. Although not necessary, an optimal solution in such conditions is to utilize a cloud platform, providing high scalability and redundancy, with better utilization of available processing resources

(Beaty 2013; Sultan 2010). The suitability of utilizing cloud infrastructure in higher education is presented in a number of research papers (Despotović-Zrakić et al. 2013; Ercan 2010).

4. CONSLUSION

This paper presents a model based on cloud infrastructure that helps students achieve basic and intermediate knowledge in the area of IoT. Advantages of presented model are its way of acting because it uses a specific type of learning which could be very interesting for students and which helps students to start learning about IoT on the way where they can choose which things they like to learn and skip things they already know.

The presented model is simple, cheap and scalable and it wouldn't take long to be implemented. Model like this would allow students to learn about Internet of things on easy and interesting way through tests, quizzes and projects which could be useful in real life and which can be taken from Moodle Learning Management System. Biggest advantage of this platform model is because it allows students to start learning about IoT exactly from their current level. For example, if student already is working with smart devices and really knows what are sensors and actuators, he can take a part of bigger and more complicated projects and extend his knowledge. From the other side, student who doesn't know anything about smart devices can use application layer for developing applications which will allow him to work with smart devices without any earlier knowledge about them. We can conclude that this type of learning would be easy and interesting because very similar approach is already been implemented at Laboratory for e-business at Faculty of Organizational Sciences, University of Belgrade, and it has outstanding results because students are learning very fast and classes are very interesting and with great quality

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REFERENCES

A. Kaloxylos, A. Groumas, V. Sarris, L. Katsikas, P. Magdalinos, E. Antoniou, Z. Politopoulou, S. Wolfert, C. Brewster, R. Eigenmann, and C. Maestre Terol,(2014, Januarry) A cloud-based Farm Management System: Architecture and implementation, Paper presented in Comput. Electron. Agric., vol. 100, pp. 168–179, Jan. 2014.

Biqing Huang, Chenghai Li, Chao Yin and Xinpei Zhao (2013) Cloud manufacturing service platform for small- and medium-sized enterprises , Int J Adv Manuf Technol 65:1261–1272

Daniele Miorandi, Sabrina Sicari , Francesco De Pellegrini , Imrich Chlamtac (2012), Internet of things: Vision,applications and research challenges, CREATE-NET, via Alla Cascata 56/D, IT-38123 Povo, Trento, Italy

Despotovic-Zrakić, M., Markovic, A., Bogdanovic, Z., Barac, D. & Krco, S. (2012). Providing Adaptivity in Moodle LMS Courses. Educational Technology & Society Journal, 15(1), 326-338, ISSN 1436-4522

Despotović-Zrakić, M., Simić, K., Labus, A., Milić, A., & Jovanić, B. (2013). „*Scaffolding Environment for Adaptive E-learning through Cloud Computing. Educational Technology & Society*", 16 (3), 301–314.

E. N. Yilmaz, (December. 2011.), Education set design for smart home applications , Comput. Appl. Eng. Educ., vol. 19, no. 4, pp. 631–638

K. Raihan, (2013), Raspberry Pi Image Processing based Economical Automated Toll System, Glob. J. Res. Eng. Electr. Electron. Eng., vol. 13, no. 13

L. Atzori, A. Iera, and G. Morabito, (October. 2010), The Internet of Things: A survey, Comput. Networks, vol. 54, no. 15, pp. 2787– 2805.

Santucci, G. (2009). From internet to data to internet of things. In Proceedings of the international conference on future trends of the internet, Journal Wireless Personal Communications: An International Journal archive Volume 58 Issue 1, May 2011 Pages 49-69

V. Callaghan, (April, 2012), Buzz-Boarding, Practical Support for Teaching Computing Based on the Internet-of-Things, in 1st Annual Conference on the Aiming for Excellence in STEM Learning and Teaching, pp. 1–5.

MOBILE ADAPTIVE LANGUAGE LEARNING

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Abstract: *This paper presents a model for mobile adaptive learning specifically oriented towards the field of language learning. Adaptivity is especially significant in the mobile environment where the learning is performed on the move, in short time intervals, and where the learners' cognitive capacity is often limited. The main goal of this paper is to improve the mobile language learning process using adaptive techniques. Several types of adaptivity applicable to the mobile environment are considered, and an ontological framework supporting aggregation of atomic content units into learning objects and adaptation based on learners' knowledge, interest, behaviour, device, and context is presented. A cloud and web-service based system for adaptation is envisioned on top of the ontological framework and presented, with some implementation suggestions and possibilities discussed.*

Keywords: adaptive learning, mobile learning, ontologies, learning objects, cloud computing

1. INTRODUCTION

E-learning systems support complex learning processes, services, elements and users' roles. Learners are often diverse even if some learning contexts imply the existence of some similarities in their interests and demographic parameters. Various types of e-learning resources are also abundant, each possessing a different structure, and educational and presentational requirements. Accordingly, e-learning systems need to be able to mix and match learning resources in order to accommodate different types of learners.

Mobile learning systems are faced with the same problems, as well as those stemming from the characteristics of the mobile environment. Learning activities and resources must adapt to both the users' and devices' characteristics. Mobile learning is performed on the move, with time constraints and limited cognitive ability of learners, and all aspects of the learning process must adapt in order to keep the interactions with the user simple, effective, and motivating. Language learning also introduces a number of specifics stemming from the high granularity of the learning content, and concepts like learning objects and ontologies can help in describing the learning domain in a way conductive to adaptation algorithms.

The main goal of this paper is to improve the mobile language learning process by designing a model for adaptive learning. The second part of the paper outlines the theoretical background concerning the approaches to adaptivity and mobile language learning. The model for platform-independent adaptive learning, including an ontological framework, adaptation components, and a cloud-based infrastructure is given in third chapter. The final chapter discusses the presented model and possible future improvements.

2. THEORETICAL BACKGROUND

Mobile technologies are a viable solution for learning performed on the move and with heavy time constraints, allowing the learners to control the preferred pace and the location of learning (Wang, Shen, Novak, & Pan, 2009). Such a push towards student-centered learning produces a new problem - increasing the learners' freedom increases the importance of their self-motivation and interest for the area of study. This puts additional importance on understanding the users' needs and interests, and mobile applications should use any means possible to additionally motivate the learners.

Learning resources are easy to access using web-enabled devices, but these resources are usually not very well suited for use in the mobile environment. The designers must adjust the learning environment and the presentation of educational content in order to find an optimum model of interaction with the users. Innovative methods of presenting information, imaginative interaction patterns and edutainment concept make the learning material more accessible to less motivated learners (Arnone, Small, Chauncey, &

McKenna, 2011). The success of such methods inherently depends on two factors - the learner and the device used for learning, and learning activities, lesson structure, extent, and presentation need to adapt to each specific user and device. Additionally, the mobile learning applications can utilize the learning context as a basis for further improvements of the learning process.

The domain of language learning also introduces a number of specifics that need to be considered. Learning vocabulary is the main activity of language learning and requires a high level of repetition from the learners. Language learning can benefit from multimodal learning, while the concept of "learning paths" is of less importance because the highly granulated nature of the core educational content (words) makes it difficult to structure into meaningful units.

Learning systems can be adaptable, allowing the learners to personally change various system parameters and behaviour, and adaptive, possessing some form of logic for automatic adaptation according to learners' behaviour. An e-learning system is considered to be adaptive if it can monitor users' activities, interpret them using domain-specific models, infer user requirements and preferences out of the interpreted activities, represent them appropriately in associated models, and act upon available knowledge about the users and the subject matter in order to dynamically facilitate the learning process (Paramythis & Loidl-reisinger, 2004).

Adaptive e-learning systems come with a number of constraints (Despotović-Zrakić, Marković, Bogdanović, Barać, & Krčo, 2012). Adaptive e-learning systems are complex and expensive to develop and integrate into the educational process. Learning content is often impossible to recreate and use anew, and different learning systems are not interoperable. Course administration, content authoring and other operations are more difficult to carry out in adaptive systems, and teachers/administrators are expected to have some preknowledge about the system. Time is an important factor, and adaptive systems need to know about the students' needs as soon as possible in order to maximize the time a student spend in a personalized environment.

In order to allow matching of appropriate educational content with user/environment characteristics for the purpose of adaptation, the content needs to be annotated at some, preferably smaller level. Learning objects are a concept of e-learning that can serve to this purpose. Learning objects (LOs) denote small, compact educational units focused on achieving a specific educational goal, and most authors put the emphasis on their characteristics – smaller scope, reusability, relative independence, and the possibility of aggregation (McGreal, 2004). These characteristics of learning objects, beneficial for the process of adaptation, are mostly enabled by their heavy reliance on metadata. Metadata can describe both the educational characteristics of learning objects, usable for finding the right content for a specific learner, and the technical characteristics, usable for device adaptation. Different metadata models and standards for learning objects have been developed, IEEE LOM (IEEE Learning Technology Standards Committee, 2002) being among the most prominent. IEEE LOM standard is expandable and can be used to establish advanced semantic relations between educational resources.

Learning objects are usable in a mobile environment, especially when adjusted to a certain extent, especially in the domain of their presentation. A set of recommendations about the design of mobile learning objects is given in (Churchill, 2011), mainly concerning different ways of displaying and repeating the content on a limited surface while avoiding the complexity of the user interface. An example of use of learning objects in a mobile environment for language learning can be found in (Milutinović, Labus, Stojiljković, Bogdanović, & Despotović-Zrakić, 2013).

The educational content model and metamodel need to be rich and flexible enough to support some higher level adaptation logic that could adjust its volume and complexity according to user and device capabilities. Ontologies, defined as formal, explicit specifications of a shared conceptualization (Gruber, 1993) can be used for this purpose. Ontologies represent a linguistic infrastructure that can describe conceptual relations between course materials, and a number of applications exist in the educational domain. Ontologies can assist the automated construction and adaptation of a personalized learning path according to the difficulty level of course materials, learner prior knowledge and abilities, in order to avoid learner cognitive overload or disorientation (Chen, 2009). By describing learning object attributes in an ontology, an appropriate amount of knowledge can be served to learners for consummation on the fly, using their mobile devices. An ontology can then serve as a backbone for the learning domain and support technology at the semantic level by facilitating context acquisition (Basaeed, Berri, Zemerly, & Benlamri, 2007). Multiple ontologies (e.g. user model ontology, domain ontology, learning design ontology, device ontology) can be combined to produce an ontological framework capable of representing context-specific metadata. An example of such framework is given by (Jovanović, Gašević, Knight, & Richards, 2007), where it is utilized to accumulate data about the context of LO usage, by attaching the learners' models to each LO they used. This accumulated data can

then be used for for advanced learning services, such as personalization or adaptation of content in accordance with the students' objectives, preferences, learning styles, and knowledge levels.

Learning objects can be considered as pieces of a puzzle, where ontologies define each piece's connection points to other objects. When combining learning objects, the quality of the result will depend on the size and flexibility of individual units – the smaller they are, the easier it will be to mix them as needed. Although it would require a substantial effort, ideally the learning objects should be the smallest possible, while still retaining a number of semantic links to other objects. Language learning is somewhat specific in this regard, as the smallest learning units are individual words given by a vocabulary. Several machine readable, ontology-like vocabularies, "wordnets," exist, defining concepts, words and their relations in different languages. The original wordnet was developed by Princeton for English language and is described by its authors as a lexical database (Miller, 1995). Other authors often refer to it as an ontology and it has been linked to formal ontologies like SUMO upper ontology (Fellbaum, 2010). Similar projects in different languages have been modeled after the WordNet, one of them being the EuroWordNet that encompasses eight languages. This wordnet is especially interesting for language learning since words in different languages are interconnected with interlingual links stored in a Interlingual Index (ILI) (Vossen, 2002).

A model for ontology based language learning utilizing available wordnets as a starting point for construction of a language learning domain ontology is given in our previous work (Milutinović, Stojiljković, & Lazarević, 2014). However, an implementation of such a system would likely be very complex, and a more general approach can be taken by parsing existing educational materials. The words can be roughly grouped by areas of interest (e.g. sports, cars, economics, politics), by word types (verbs, nouns, adjectives) or by difficulty as defined by existing lists and official learning materials. An example of a system performing adaptation using such parameters to match resources according to learners interests, knowledge and learning style is given in (Li et al., 2010)

Adaptation is usually performed based on a user model. In mobile learning, different devices posses a variety of technical characteristics, and the device model also need to be considered. By using a device based reasoning approach, combined with a standard user model, a technically and educationally appropriate selection of learning objects can be served to learners (Chorfi, Sevkli, & Bousbahi, 2012). In order to facilitate device-based reasoning, device features need to be known for every device using the learning system. Projects like WURFL, OpenDDR, and Apache DeviceMap attempt to maintain databases of all device features for purposes of capability detection (Power, 2012).

Mobile learning is often performed on the move, and mobile devices offer unique opportunities for delivering learning content in authentic learning situations. Modern devices and platforms have built-in GPS, cameras, sensors, accelerometers, and compasses that are valuable sources of context information (Godwin-Jones, 2011). Context information can be used in advanced adaptation scenarios, where content is organized according to some learner context parameter like location (Jong, Specht, & Koper, 2009).

Mobile devices offer unique opportunities to deliver learning content in authentic learning situations. Apart from being able to play various kinds of rich multimedia content, they offer new ways of tailoring information to the learner's situation or context. This paper presents the results of a study of mobile media delivery for language learning, comparing two context filters and four selection methods for language content. Thirty-five

3. MODEL FOR MOBILE ADAPTIVE LANGUAGE LEARNING

In order to design an adaptive language learning system that would fully support mobile learning on different devices, all components must be selected appropriately. In this section we outline a model for adaptive mobile learning (Figure 1) based on the following components:

- An ontological framework, roughly composed out of an educational ontology and a user/device ontology;
- Learning objects for delivery of educational content to learners and institutions;
- Web services as a platform-neutral, developer-friendly interface for accessing system functions;
- Internal services for managing the adaptation process and for processing and correlating user data;
- Cloud computing infrastructure for scalability support.

We base our suggestions on previous experiences in related areas, and especially on our previous work on designing a non-adaptive, ontology-based multimodal language learning system (Milutinović et al., 2014). Unlike some other comparable models available in literature (Basaeed et al., 2007; Jovanović et al., 2007), the model presented in this paper is partially specialized for language learning. Another core concept is the separation of concerns, where the learning objects are used only for the delivery of content and instructions,

while the actual client applications decide how to present content (according to the received instructions). This is in contrast to the popular, standardized Sharable Content Object Reference Model (SCORM) learning objects that mostly contain browser-openable/HTML files, with content being mixed with markup and style data. The separation of concerns generally comes with a trade-off – components tasked with content presentation need to be developed specifically for each platform, but can utilize the device's capabilities much better than generic HTML files. On the other hand, the content is free from variation, can be stored in centralized repositories, and accessed by any number and type of clients.

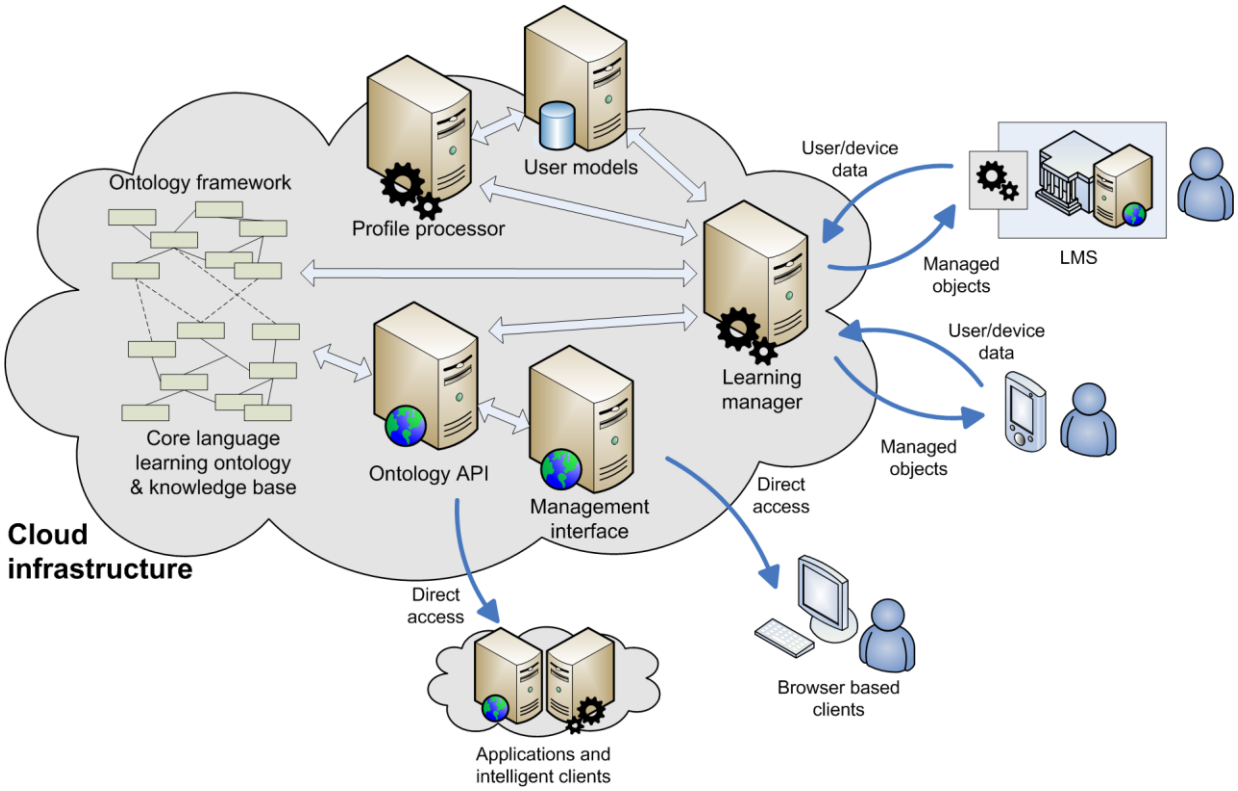

Figure 1: Model for mobile adaptive language learning

Separation of concerns on the account of data storage and presentation also implies a more complex, two-part adaptation process. The core adaptation logic is stored on a centralized location and executed by a learning manager. This manager receives and processes requests for content from various clients. Depending on the input it periodically receives from each client, the learning manager can assemble appropriate learning objects and generic instructions for their adaptation, and return them to clients. The clients then interpret the instructions as well as they can, while gathering further information about the user for the next cycle of communication with the learning manager. In order to allow such a scenario, all communication must be done through standard interfaces and based on a common ontology serving as a common language between the manager and the clients.

Ontology framework

The core component of the presented model is the ontology framework, composed out of following, interconnected and interdependent ontologies: educational content ontology, educational activity/learning design ontology, user knowledge ontology, user interest ontology, user behaviour ontology, device capabilities ontology, and context ontology. Developing all of the aforementioned ontologies in detail is outside of the scope of this chapter, but we give some general remarks and a rough model for future development. When developing a new ontology, existing developments should first be explored and reused, if possible (Noy & McGuinness, 2001).

The language learning ontology must contain concepts like words, grammar rules, typical sentences and other atomic content units. Words can be described using wordnets, with the original, English wordnet, defining several relations, including synonymy, antonymy, hyponymy, meronymy, troponomy, and entailment (Miller, 1995). These relations connect both the concepts (e.g. jet plane is a type of plane, toe is a part of foot), and the words (e.g. interrogate, interrogator, interrogation), providing rich semantics that can be utilized for generation of tailored learning resources. However, the level of detail and complexity of interconnections in a wordnet are likely larger than necessary for language learning, and wordnets do not

describe other relevant concepts (grammar, sentences). Extensive modifications might be required for integration of wordnets with other ontologies, so we suggest developing a simplified ontology by extracting only some of the information from a wordnet or a simple vocabulary – word type, word difficulty (relatable to user knowledge), and a rough domain of use (relatable to user interest). Some guidelines for developing a a content ontology can be found in (Boyce & Pahl, 2007).

The educational activity/learning design ontology should describe different types of activities the learner can take and methods of structuring activities in order to produce a learning session. This ontology should also be connected to the language learning ontology and specify which types and units of content can take part in which activities. The user knowledge ontology should describe concepts needed for construction of the user knowledge model, and for inferring additional information about the user based on his results. The user interest ontology should roughly describe possible areas of interest of the user, and define relations to domains of use from the language learning ontology.

The user behaviour ontology describes possible learners' behaviours. Learners' behaviour implicitly provides information about their knowledge and their interest. For instance, a learner that spends more time learning words in a single, specific domain of use, likely has some interest in that domain. Likewise, if a learner takes more time to answer questions from a specific domain during a quiz, it can be inferred that his knowledge in that area is lacking, even if his actual results do not deviate as much. This ontology needs to be connected to most of the other ontologies. Behaviour will be related to doing specific tasks with specific units of content; it will imply interest and knowledge; and, finally, depending on the device capabilities, some behaviours won't be possible to perform using some clients. Learner behaviour, therefore, needs to be expressed using a generic language that can cover a large number of use scenarios.

The device capabilities ontology can rely on OpenDDR or a similar device capabilities database. However, like in the case of using wordnets for language content, such databases are likely more complicated than necessary for the needs of the language learning domain, and we suggest parsing the capability database and extracting only the minimum necessary information. Domain-specific capabilities should also be defined and associated with the requirements of specific learning activities.

Finally, a context ontology should describe methods of gathering context information (e.g. GPS), related to the device capabilities, and enumerate possible detected contexts for each source of context information (e.g. learner is at the zoo or at the beach). On the other hand, the contexts should be connected to specific activities and domains of use so that the right activity/content can be presented at the right time.

System components and infrastructure

The use of ontologies provides many possibilities, with some added complexity. The designed adaptive system should be completely transparent for the users and they should be shielded from any added complexity. For a Web-centric learning system this can be achieved by providing access to core concepts through Web services (Kreger, 2003) operating with standard interchange formats like XML and JSON.

Components of the presented model that operate upon the ontological framework are: ontology API, ontology management web interface, user model storage, profile processor and learning manager. The ontology API should be implemented as a web service, offering direct access to the ontology framework. This type of access should be used for ontology/content management, and providing direct access to external applications that do not require adaptivity or implement their own mechanisms. A basic management web interface should be developed on top of the ontology API, for use by system administrators and teachers/domain experts.

The user model storage stores all reported information about the users of the system – their knowledge, interests and past behaviour. When a learner starts using the system, he is given an initial test to assess his pre-knowledge, as well as an array of optional questions for assessing his interests. Initial data is stored in the user model, and updated every time the client application sends a report. These reports would ideally be sent periodically, upon completion of any independent content unit, but this must not be relied on. Users in mobile environment might not be able to connect to the Internet at periods, and the system and client must be able to keep functioning even in such cases.

The learning manager is the main component of the system, tasked with receiving client requests and reports, and generating and delivering personalized learning objects. The learning manager contains the adaptation logic, and uses the ontological framework in its decision-making. The learning manager also runs the profile processor after receiving a request from a client and updating the user model. The profile

processor attempts to correlate profiles of different learners and produce groups of similar learners. This information can then be used for predicting learners' needs.

Using all of these inputs available, the learning manager browses the core language learning ontology, selects a number of educational units, and packs them in a learning object. With all of the components at hand, producing a learning object requires only selecting an appropriate syntax for encoding the educational data in a textual format that can be transferred to clients. We suggest using lightweight objects appropriate for the mobile environment (Milutinović et al., 2013), but other formats could be generated, including SCORM. The generated object is then sent to a client, which takes the responsibility for presentation and further information gathering. The clients can run on different devices, and can even be different themselves, e.g. some clients can offer a full learning environment, while others can concentrate on a single aspect of language learning like vocabulary. As long as the clients use the standardized ontology to report the device's and their own capabilities, the centralized adaptation algorithm can select appropriate content and activities. Clients also need not be mobile; a special case of desktop clients can be considered as just another type of device on record. Existing learning management systems like Moodle LMS can also be modified through plugins in order to integrate with the system. Such plugins would take the role of gathering information, reporting, and downloading learning objects, while the presentation would be performed by standard LMS routines.

Learning systems must expand and evolve in order to adapt to changing requirements, and several types of expansion can be envisioned in the presented model: expansion of ontology concepts, expansion of knowledge base with additional educational content, supporting a growing number of users with different use patterns and frequencies, supporting a growing number of types of client systems. In order to support high flexibility and scalability of the entire system, the implementation can be placed on a cloud computing infrastructure (Blakley & Reeves, 2010). Mobile learning can especially benefit from cloud computing since processing, storage, and adaptation of educational resources can be performed using cloud resources instead of those on heavily constrained devices (Ferzli & Khalife, 2011).

5. CONCLUSION

This paper presented a model for mobile adaptive language learning based on an ontological framework and several criteria of adaptation. Used criteria encompassed learner knowledge, interest, behaviour, device capabilities, and context, and all related concepts were defined using ontologies in order to provide a standard, generic vocabulary of terms. This vocabulary was then utilized to enable a separation of concerns between the core system, and mobile and other client applications. Some suggestions were given concerning the development and integration of educational ontologies, with the goal of producing an optimal and efficient ontology. In order to account for possible expansions of ontologies, content, users, and client types, the infrastructure was envisioned as cloud and web-service based, providing needed scalability and generic access.

Future research should be directed towards exploration of existing educational ontologies and development of individual components of the ontological framework. Thanks to the separation of concerns, the minimal implementation of the system can be developed and tested manually, without the existence of actual clients, while individual clients can use a dummy web interface during the development of user tracking and reporting functionalities. A possibility of adapting existing learning applications should also be explored, especially for established learning management systems like Moodle. Other options of gathering information about learners like social networks are also a possible direction of future research.

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REFERENCES

Arnone, M. P., Small, R. V., Chauncey, S. A., & McKenna, H. P. (2011). Curiosity, interest and engagement in technology-pervasive learning environments: a new research agenda. *Educational Technology Research and Development*, *59*(2), 181–198. doi:10.1007/s11423-011-9190-9

Basaeed, E., Berri, J., Zemerly, M. J., & Benlamri, R. (2007). Learner-centric context-aware mobile learning. *IEEE Multidisciplinary Engineering Education Magazine*, *2*(2), 30–33.

Blakley, B., & Reeves, D. (Eds.). (2010). *Defining cloud computing*. Gartner Inc.
Boyce, S., & Pahl, C. (2007). Developing Domain Ontologies for Course Content The Development of Ontologies. *Educational Technology & Society*, *10*(3), 275–288.
Chen, C.-M. (2009). Ontology-based concept map for planning a personalised learning path. *British Journal of Educational Technology*, *40*(6), 1028–1058. doi:10.1111/j.1467-8535.2008.00892.x
Chorfi, H. O., Sevkli, A. Z., & Bousbahi, F. (2012). Mobile Learning Adaption through a Device Based Reasoning. *Procedia - Social and Behavioral Sciences*, *47*, 1707–1712. doi:10.1016/j.sbspro.2012.06.887
Churchill, D. (2011). Conceptual model learning objects and design recommendations for small screens. *Educational Technology & Society*, *14*(1), 203–216.
Despotović-Zrakić, M., Marković, A., Bogdanović, Z., Barać, D., & Krčo, S. (2012). Providing adaptivity in moodle LMS courses. *Educational Technology & Society*, *15*(1), 326–338.
Fellbaum, C. (2010). WordNet. In R. Poli, M. Healy, & A. Kameas (Eds.), *Theory and Applications of Ontology: Computer Applications* (pp. 231–243). Springer Netherlands. doi:10.1007/978-90-481-8847-5_10
Ferzli, R., & Khalife, I. (2011). Mobile cloud computing educational tool for image/video processing algorithms. In *2011 Digital Signal Processing and Signal Processing Education Meeting (DSP/SPE)* (pp. 529–533). IEEE. doi:10.1109/DSP-SPE.2011.5739270
Godwin-Jones, R. (2011). Emerging technologies: Mobile apps for language learning. *Language Learning & Technology*, *15*(2), 2–11.
Gruber, T. R. (1993). A Translation Approach to Portable Ontology Specifications. *Knowledge Acquisition*, *5*(2), 199–220.
IEEE Learning Technology Standards Committee. (2002, July). Draft standard for learning object metadata. Institute of Electrical and Electronics Engineers, Inc.
Jong, T. De, Specht, M., & Koper, R. (2009). A study of contextualised mobile information delivery for language learning. *Educational Technology & Society*, *13*(3), 110–125.
Jovanović, J., Gašević, D., Knight, C., & Richards, G. (2007). Ontologies for Effective Use of Context in e-Learning Settings. *Educational Technology & Society*, *10*(3), 47–59.
Kreger, H. (2003). Fulfilling the Web services promise. *Communications of the ACM*, *46*(6), 29. doi:10.1145/777313.777334
Li, M., Ogata, H., Hou, B., Hashimoto, S., Liu, Y., Uosaki, N., & Yano, Y. (2010). Development of Adaptive Kanji Learning System for Mobile Phone. *International Journal of Distance Education Technologies*, *8*(4), 29–41. doi:10.4018/jdet.2010100103
McGreal, R. (2004). Learning objects: A practical definition. *The Internatonal Journal of Instruction Technology & Distance Learning*, *1*(9), 21–32.
Miller, G. a. (1995). WordNet: a lexical database for English. *Communications of the ACM*, *38*(11), 39–41. doi:10.1145/219717.219748
Milutinović, M., Labus, A., Stojiljković, V., Bogdanović, Z., & Despotović-Zrakić, M. (2013). Designing a mobile language learning system based on lightweight learning objects. *Multimedia Tools and Applications*. doi:10.1007/s11042-013-1704-5
Milutinović, M., Stojiljković, V., & Lazarević, S. (2014). Ontology-Based Multimodal Language Learning. In M. Despotović-Zrakić, V. Milutinović, & A. Belić (Eds.), *Handbook of Research on High Performance and Cloud Computing in Scientific Research and Education* (pp. 195–212). IGI Global, Hershey, PA, USA. doi:10.4018/978-1-4666-5784-7.ch008
Noy, N. F., & McGuinness, D. L. (2001). *Ontology Development 101: A Guide to Creating Your First Ontology* (pp. 1–25).
Paramythis, A., & Loidl-reisinger, S. (2004). Adaptive Learning Environments and eLearning Standards. *Electronic Journal of E-Learning*, *2*(1), 181–194.
Power, M. (2012). *Delivering Web to Mobile* (pp. 1–23). Bath, United Kingdom. Retrieved from http://blog.observatory.jisc.ac.uk/techwatch-reports/delivering-web-to- mobile/
Vossen, P. (2002). *EuroWordNet General Document* (pp. 1–108). Amsterdam. Retrieved from http://vossen.info/docs/2002/EWNGeneral.pdf
Wang, M., Shen, R., Novak, D., & Pan, X. (2009). The impact of mobile learning on students' learning behaviours and performance: Report from a large blended classroom. *British Journal of Educational Technology*, *40*(4), 673–695. doi:10.1111/j.1467-8535.2008.00846.x

IMPROVING E-LEARNING PROCESS WITH WEARABLE COMPUTING

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Abstract: *This paper shows an application of wearable computing in e-education. The main aim of this paper is improving existing e-education infrastructure and e-learning process with current trends in wearable computer-based gadgets. According to actual tendencies in application of wearable devices, a model of wearable computing application in e-learning is developed. The model integrates wearable computer-based gadgets with e-learning services of a higher educational institution. Ethical and social impacts of using this solution are also considered.*

Keywords*: wearable computing, e-education, e-learning, cloud computing, learning management system*

1. INTRODUCTION

The advance of computer technologies had high influence on wide area of human life and it still has. Computer era radically changed ways of communication, business, education or entertainment as well as human perception and socialization.

E-learning concept in Learning management systems (LMS) has been used in higher education for years. Learning services are constantly advancing by application of new information technologies such as multimedia content on the Internet or wireless technologies (Anderson, 2008). The appereance of different devices and gadgets, which are available to improve learning process independently of temporal and spatial constrains, leads to a need of implementing such devices or gadgets in the current e-learning environment.

This paper shows possibilities of wearable computing application in e-learning. A model of wearable computing application in e-learning is developed in a higher educational institution in aim to enhance existing e-learning process.

2. WEARABLE COMPUTING

Considering decrease in scaling, computers forced their way beyond boundaries of isolated appliances. Unlike original idea of machine which occupies space for certain period of time and which is used for alphanumerical calculations, second half of 20th century puts forward different way of thinking. Concept of ubiquitous computers was made in order to describe "computers everywhere" - apparatus which is in wide set of locations, flexible and mobile, small in size and available for communication with other similar devices (Weiser, 1999). Accordingly, this led to the concept of computer devices which are placed not in indoors, but in some sense on human body, to witch these devices are connected and available to communicate.

Terms like wearable computing, wearable devices or wearable technology may be perceived synonymously, in the widest sense. Wearable paradigm generally consists of a device associated with human in sense of interaction. Therefore, the wearable computer device is a gadget that is always connected with its user, while the user is using and wearing it in comfortable and unobtrusive way (Toh, 2013). Wearable computing, as a computing view, may also be understood in sense of having apparatus which is always able for usage, since it is worn in the same way as clothing, and it is also able to perform various kinds of computing (Mann, 2002).

It is difficult to determine exact origin of this idea, since there were some analogue devices associated with human organism, so the conceptual model for wearable computing in today's sense could be even pocket watch. However, first genuine wearable device, which was electrical and based upon digital signal transmission, is Edward Thorp's and Claude Shannon's roulette result simulator (Thorp, 1998). During the second half of the 20th century, there were lots of similar projects and researches, but it was until 1981, when Steve Mann developed wearable battery-operated personal imaging system (Mann, 2002).

Wearable computing in general covers broad range of devices and possible usages. Although it is impossible to highlight a single approach in understanding this idea, there are significant similarities between the main contributors of this area. It is necessarily that wearable computing architecture fulfils the requirements of persistence and constancy in order to be accepted as such, as it is constantly available and being used in concurrent way (Witt, 2008). In addition, wearable devices should also stable in sense of power supply, therefore it is required that they are not connected in a way to restrict their mobility (Mann, 1997). Important characteristic includes context sensitivity in a way of computer device becoming aware of user's surroundings and state whenever it is worn (Billinghurst, & Starner, 1999).

There are three basic operational modes that define wearable computing which have been widely adopted:

- constancy - computer device is ready to accept request from user at any time, unlike the on and off concept of personal computers, so the signal running form device to user and from user to device provides constant user interface

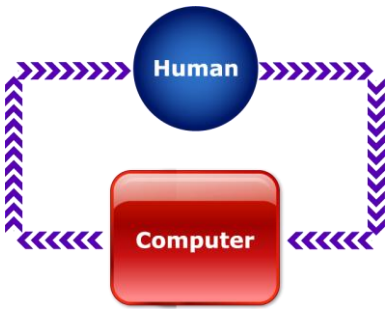

Figure 1: Mode of constancy

- augmentation - in wearable computing, the process of computing is not the primary function of the computer device, since it is combined with augmenting the intellect or senses of the human user

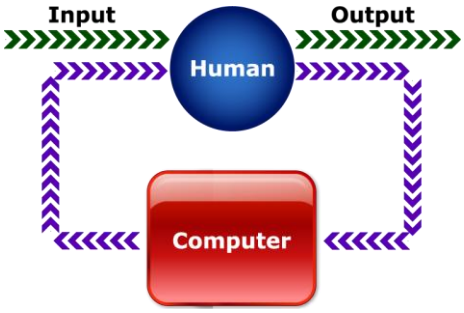

Figure 2: mode of augmentation

- mediation - wearable device is a form of mediator between its human user and the real world since it encapsulates information from the real world and it is possible to be considered as a form of interaction filter

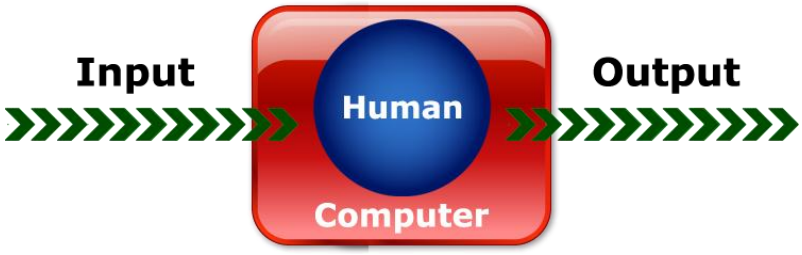

Figure 3: Mode of mediation

In sense of three above mentioned operational modes, the basic idea of wearable computing, wearable devices or wearable technology imposes the concept of framework for enabling various degrees of constancy, augmentation and mediation (Mann, 1998).

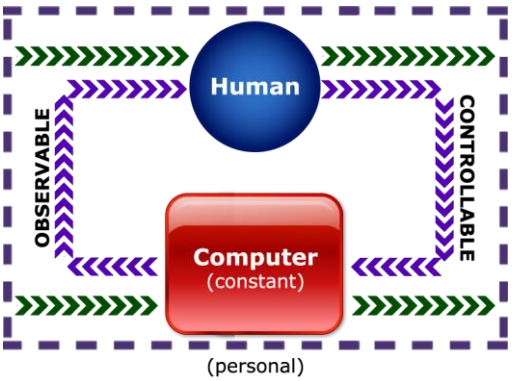

Figure 4: Comprehensive view of wearable computing

Another approach is given by Rhodes (Rhodes, 1997) who defines following characteristics of wearable computing device:

- Device is portable while it is operational
- Usage of such device is hands free
- At least one sensor is part of the device
- Wearable device should be able to convey information even if it is not being actively or directly used
- Wearable device is always in "power on" state, and it is assumed to be shut down only in cases of maintenance

The possible applications of wearable computing are numerous, encompassing various industries, military and modern-day medicine (Randell, 2005). Use of wearable computer devices has been present for two decades in airline industries and manufacturing in general (Caudell, & Mizell, 1992). Present-day implementations of wearable computing are virtually limitless, depending only on developers' creativity and contribution.

Some of currently significant areas for wearable computing implementation:

- Military (aiming optical sights, sensors on soldier's helmet which detects when he is wounded etc.)
- Medicine (sensors inside wearable devices allows continuous monitoring of a patients and decision making)
- Entertainment (smart glasses which provide augmented reality in computer games, for example Oculus Rift)
- Sports and fitness (wearable textiles which provide information on training performance)

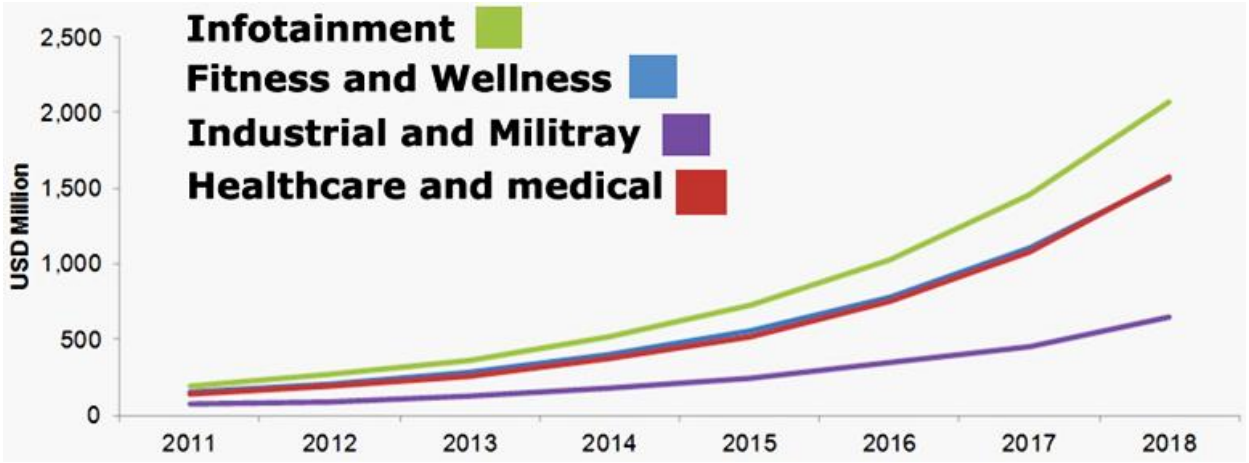

Figure 5: Market growth trends: Wearable technology end use

Contemporary reports (Rizzo, 2013) indicate that it is likely to expect further market growth as well as implementation development of wearable technology.

Recent researches and studies emphatically indicate that wearable computing could become one of emerging technologies considering educational implementations. Wearable and hand-held devices are also mentioned in sense of Web 3.0 trends and e-learning.

3. WEARABLE COMPUTING IN E-LEARNING

In accordance with widespread implementation of computer technologies, the fundamentals of education have also experienced revolutionary modifications. These changes are significantly influenced by new learning theories and the ideas of acquiring knowledge outside the ingrained access, consisting of gaining knowledge only by repetitive process. Ideas of visualization, data availability or interactive learning fundamentally change perspectives of learning and education, and therefore, there are the concepts of e-learning and even e-education, which were formed as effects of cohesion of the mentioned ideas along with the modern technologies. Concept of e-learning (Labus, 2012), for instance, considers electronically mediated process of communication, created for the sake of constructing and confirming knowledge (Garrison, 2011). Such system involves student-lecturer relationship independent from spatial and time constrains with availability of various forms of learning materials (Despotović, & Radenković, 2005). It is difficult to restrict which of the widespread technologies and devices are involved in digital learning, and still it is certain that Internet is the base of modern educational frame. In the broadest sense, there are a lot of technologies which are used in e-learning concept, such as learning management system, various multimedia content and technologies, web white boarding, various wireless technologies (Anderson, 2008).

At this point, there are three dominant Internet-based technologies which are becoming more and more widespread, so that their impact is ensured for future purposes (Garrison, 2011):

- Web 2.0
- Social Media
- Mobile technologies (Labus, Simić, Vulić, Despotović-Zrakić, & Bogdanović, 2012)

The process of e-learning itself is conducted and monitored by the learning management system. The learning management system is a software platform created in order to provide complete management of e-learning course process, as well as performance and talent evaluation (Hirtz, & Kelly, 2011). Both asynchronous and synchronous types of courses are available, depending on the way of leading the lectures. LMS itself is available for use in both primary educational facilities and commercial institutions. Basic functionalities include complete course management, user's management and content management, in a line with multilingual support and support for various devices (Hirtz, & Kelly, 2011).

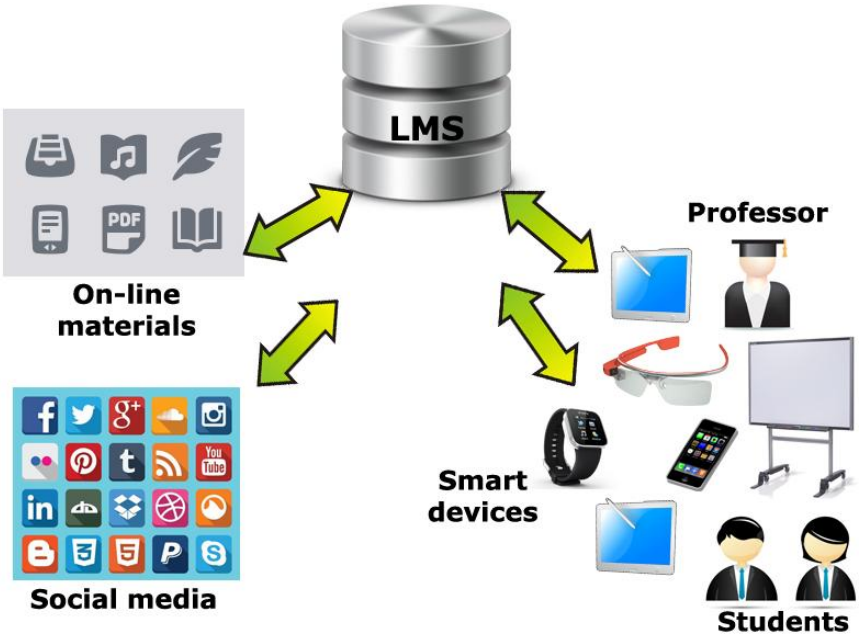

Figure 6: Wearable computing in e-learning

E-learning and especially learning management systems are quite loose-coupled with standard personal or laptop computers. Considering rapid and radical innovations in areas of portable devices, such as smart phones or tablets, LMS itself becomes more flexible in order to meet possibilities of developing services for smart portable devices. In the current learning process, mobile gadgets have an increasing importance, hence their options and possibilities. For instance, one of progressive methods is a so-called "Formative assessment-based mobile learning" (FAML) which provides learning activity together with evaluation, based on wireless networking system (Hwang, & Chang, 2011). Mobile devices are especially convenient because of various platforms and possibilities for developers generally.

Teaching process has become significantly facilitated, both in terms of teaching performance as well as communication and cooperation. Students and lecturers are able to access online materials available through LMS courses by using smart devices like smart glasses and watches or mobile devices and tablets

Wearable devices like glasses or watches rest upon similar principles of application development: development platforms are programmable easily and supported by community. Likewise, considerable part of those applications is free to download from "play stores". For instance, Google with currently most famous wearable gadget, Google Glasses, offers a programmable API for developers (Lardinois, 2013).

4. MODEL OF WEARABLE COMPUTING APPLICATION IN E-LEARNING

Model of wearable computing application in e-learning is developed in scope of Laboratory for E-business (Elab) which exists within the Faculty of Organizational Sciences, University of Belgrade. In this paper, model gives all the information about how it works in real environment and how it should be implemented with existing technologies and infrastructure, as those that are in emerging state. Structure of this model is shown in figure 7.

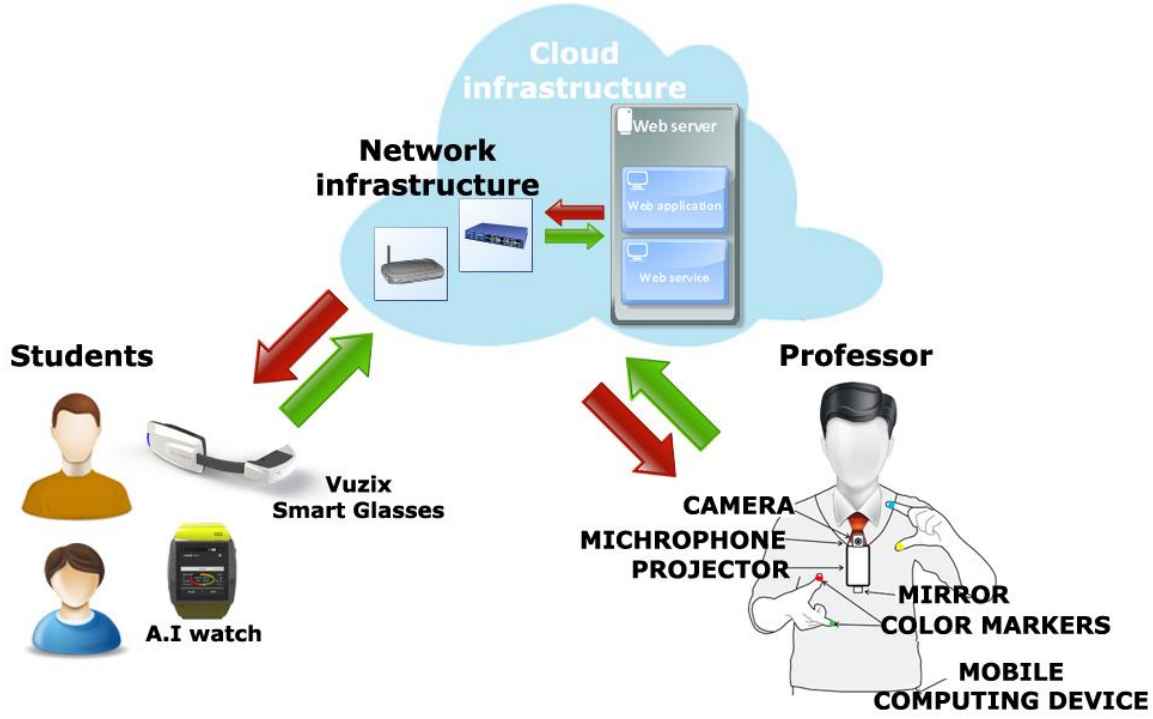

Figure 7: Model of wearable computing application in e-education

Proposed model of wearable computing application in e-education consists of three parts:
- Cloud infrastructure
- Wearable computing devices and software which are used by students
- Wearable computing devices and software which are used by professor.

The most important part in this model is cloud infrastructure, which represents mediator between students and professor in the classroom. On the inside of that infrastructure there are:
- Software system
- Hardware.

Software system is composed of all the applications and services which are located on web server and integrated into the cloud, so their main purpose is to authenticate its users and provide them authorized access to all resources that are intended for education purposes (such as Learning management system, for example open-source Moodle LMS, which implements concept of Blended Learning, a combination of traditional and distance learning, and it is used in Laboratory for E-business for e-learning since 2001).

Hardware, in this case, is represented by a massive server infrastructure which has a lot of processor units, ram memory, data storage and respectable network infrastructure (both wired and wireless network hardware) to provide communication with users from the outside world.

Until now, there were recognized many benefits from cloud computing for education: “centralized computer systems can process large amounts of data (specifically graphics), manage complicated functions and store enormous amounts of keyword searchable data while users can access this information and interact with other users with low-cost simple smart devices (such as smart phones, tablets etc.)” (Sampson, Isaias, Ifenthaler & Spector, 2013).

Wearable computing devices and software which are used by students includes interface which connects students with cloud infrastructure (which can perform or refuse users requests), and further with professor. This type of communication is possible in both directions. In most cases, those devices use wireless or Bluetooth technologies to send user requests and they are controlled by various operating systems and platforms (such as Windows, Android, iOS etc.). In this particular case, the model represents usage of smart watches that provide ability for student to sign in into the class with their digital signature which was automatically recognized (with appropriate application, like “Signature Capture” for Android) as computer text and submitted over the cloud infrastructure to professor so he can access information about list of present and absentee students. Also, there is ability to use some applications that can read textual documents and convert them to speech (for example, Android application “Ivona Text-to-Speech”), and make classes and lectures easy to follow. Smart watches can also be used to notify, so students could be aware of time that is left to complete their tests or other class defined chores.

Next wearable computing device that is intended for usage by students are smart glasses. Their role in this model is to provide visual contact and communication with available resources that are enabled by professor and the system. They can also communicate with other devices in the classroom, such as smart watch which student wears on his hand or with professors Sixth Sense technology wearable computing device, which role in this model and learning process will be explained later. In this moment, on the market various types of glasses can be found for this purpose, such as Vuzix Smart Glasses which can run both on Android and iOS, lately very popular Google Glasses with Android OS or Golden-i headsets which are intended for Windows CE OS.

Wearable computing devices and software which are used by professor for education purposes, in this model, represents interface which connects professor with cloud infrastructure and further with students. It is based on Sixth Sense technology and can be used to take photographs, recognize objects and even bring the information from real to virtual world. With this device, professor in the classroom can easily use resources from cloud infrastructure, communicate with students which are able to participate in demonstrations and activities, get access to their work and administrate its content, provide additional information and have full control of lecture course. In this way, activities can be made and conducted in more interactive way, and there is possibility of constant performance monitoring.

Pranav Mistry, author and pioneer in this technology, defines Sixth Sense (which is open source and in development stage, costs approximate $350 to build) as: “wearable gestural interface that augments the physical world around us with digital information and lets us use natural hand gestures to interact with that information” (Mistry, 2010).

Components of this device (shown on figure 7) are connected to each other, where every part has its function: Projector projects light on object from our environment such as piece of paper, wall, table or anything else, even part of the body like hand which can be used as communication interface between user and this device, shown in figure 8:

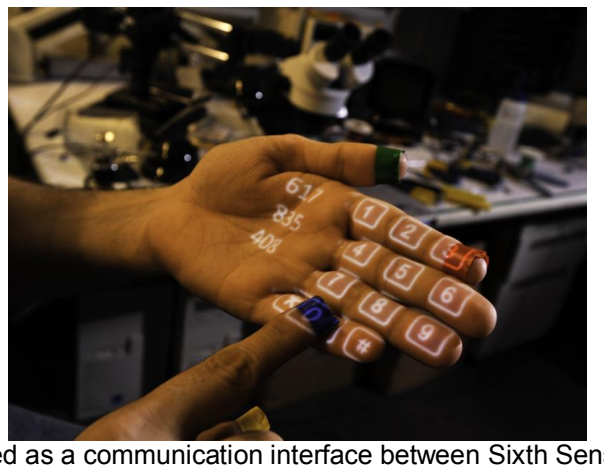

Figure 8: Hand used as a communication interface between Sixth Sense device and user

Camera detects and recognizes user's movements, especially those of colour markers on user's fingers which are later interpreted as actions or commands on mobile computing device (both projector and camera are connected to it) which is located in professor's pocket, so there is no need for usage of devices with multi-touch screens.

5. CONCLUSION

Technologic development has vastly shaped human society and civilization and furthermore continues to form various elements of lifestyle. Taking into consideration the development of computer sciences along with telecommunication improvements, ever since the first telephone was presented, these inventions altered social foundations. This trend is accompanied with advancement of wearable computer devices in the last decades.

The students with disabilities would greatly benefit from wearable computing implementation in education. Along with full inclusion, these students would be able to overcome their disadvantages in various ways, such as motion or vision disabilities.

Described model represents one of potential implementations of wearable computing in existing e-learning environment based upon present software solutions and platforms. Legal and ethical aspects remain opened for discussion of public.

ACKNOWLEDGEMENT

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REFERENCES

Anderson, T. (2008). The theory and practice of online learning (2nd ed.). Edmonton., AB., Canada: Athabasca University (AU) Press

Billinghurst, M., & Starner, T. (1999). Wearable devices: new ways to manage information. *IEEE Computer, 32(1)*, 57-64. doi: 10.1109/2.738305

Bonk, C. J., & Graham, C. R. (2012). The handbook of blended learning: Global perspectives, local designs. Hoboken., NJ., USA: John Wiley & Sons.

Caudell, T. P., & Mizell, D. W. (1992). Augmented reality: An application of heads-up display technology to manual manufacturing processes. Twenty-Fifth Hawaii International Conference on System Sciences, Vol. 2, Proceedings (pp. 659-669). IEEE Computing Soc.

Despotović, M. & Radenković, B. (2005). Integracija sistema za upravljanje procesom učenja i poslovnog informacionog sistema. In Postel 2005. Belgrade.

Dominic, M., Francis, S., & Pilomenraj, A. (2014). E-Learning in Web 3.0. *International Journal of Modern Education & Computer Science*, 6(2), 8-14. doi: 10.5815/ijmecs.2014.02.02

Dvorak, J. L. (2007). Moving Wearables Into the Mainstream: Taming the Borg. New York City, NY, USA: Springer US

Garrison, D. R. (2011). E-learning in the 21st century: A framework for research and practice. Oxon., UK: Taylor & Francis.

Labus, A. (2012). *Edutainment in electronic education, PhD thesis*. University of Belgrade, Serbia.

Labus, A., Simić, K., Vulić, M., Despotović-Zrakić, M. & Bogdanović Z. (2012) An Application of Social Media in eLearning 2.0. 25th Bled eConference eDependability: Reliable and Trustworthy eStructures, eProcesses, eOperations and eServices for the Future, Proceedings (pp. 557-572). Bled, Slovenia.

Lardinois, F. (2013, November 25). Retrieved April 30, 2014, from Google Opens Glass Mirror API To All Developers Even If They Don't Have Glass (http://techcrunch.com/2013/11/25/google-opens-glass-mirror-api-to-all-developers-even-if-they-dont-have-glass/)

Mann, S. (1997). An historical account of 'WearComp' and 'Wearcam' inventions developed for applications in "Personal Imaging". *Proceeding ISWC '97 Proceedings of the 1st IEEE International Symposium on Wearable Computers,* 66-73

Mann, S. (2002). Wearable Computing: A First Step Toward Personal Imaging. *IEEE Computer, 30(2)*, 25-32. doi: 10.1109/2.566147

Mistry, P. (2010). SixthSense integrating information with the real world. Retrieved from http://www.pranavmistry.com/projects/sixthsense/

Rhodes, B., J. (1997). The wearable remembrance agent: A system for augmented memory. *Personal Technologies*,1(4), 218-224. doi: 10.1007/BF01682024

Randell, C. (2005). Wearable computing: a review. Technical Report CSTR-06-004. Bristol.,UK: University of Bristol.

Rizzo, T. (2013, January 22). Retrieved April 30, 2014, from Wearable Technology - The Next Mobility Market is Booming!(http://www.wearabletechworld.com/topics/from-the-experts/articles/323855-wearable-technology-next-mobility-market-booming.htm).

Sampson, D., Isaias, P., Ifenthaler, D., Spector M. J. (2013). Ubiquitous and Mobile Learning in the Digital Age. Weill Cornell Medical College in Qatar, Doha, Qatar.

S. Hirtz & K. Kelly (2011). Education for a Digital World 2.0 (Vol. 1). Vancouver, BC, Canada: Commonwealth of Learning.

Hwang, G. J., & Chang, H. F. (2011). A formative assessment-based mobile learning approach to improving the learning attitudes and achievements of students. *Computers & Education*, 56(4), 1023-1031.

Toh, K., Peng. (2013). The New Age of Consumer Wearables: Internet of Smart Things (Wearable Computers). North Charleston., SC., USA: CreateSpace Independent Publishing Platform

Thorp, O., Edward. (1998). The Invention of the First Wearable Computer. *Proceedings of the 2nd IEEE International Symposium on Wearable Computers,* 4-10

Weiser, M. (1999) . The computer for the 21st century. *ACM SIGMOBILE Mobile Computing and Communications Review - Special issue dedicated to Mark Weiser*, *3(3)*, 3-11

Witt, H. (2008). User Interfaces for Wearable Computers: Development and Evaluation. GWV Fachverlage GmbH., Wiesbaden., Germany: Vieweg+Teubner Verlag

ENHANCING STUDENT RELATIONSHIP MANAGEMENT WITH SOCIAL MEDIA MARKETING

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Abstract: *This paper presents an application of social media marketing of a higher educational institution. Performance of higher educational institutions on social media and social media marketing usage, have as a goal improving their business operations, the credibility and implementation of the student relationship management concept. This paper presents student relationship management model of a higher educational institution on social media. It describes social media marketing implementation, specifically for social networks, as well as a model of social media metrics. The main aim of this paper is to improve the process of student relationship management, and emerging brand of the Laboratory for e-business by applying social media marketing.*

Keywords: *Social Media, Social Media Marketing, Internet media plan, Student Relationship Management, Social Media Metrics*

1. SOCIAL MEDIA MARKETING

Social media are presenting as the most commonly used tool for online advertising, as a part of Internet marketing (Kim W., Jeong O.R. & Lee S.W). Internet marketing presents usage of online activities that helps build and manage customer relationships, with a purpose to satisfy the needs of both parties by exchanging products or services (Mohammed, Fisher, Jaworski and Cahill, 2002). Social media is technique of online marketing and a complement to traditional marketing approaches. The idea of 4P in traditional marketing is expanded for social media as 5C: content, collaboration, community, collective intelligence and conversation (Mishra, G., 2012). Social media marketing (hereinafter: SMM) encourages advertisement using social communication channels. An advantage of SMM is to make a larger reach of the target group, where can be easily monitored their needs, reactions to products or services that are promoted through these channels. Before SMM, getting feedback was a process of intersect several channels to collect the opinions of customers; through surveys, guest book, forums etc. Another advantage is achieving this in a short time and at low costs. Using SMM eases to follow the competition, events that they are planning. Flaw of using social media as a tool for Internet marketing is the frequency of the news that has to be maintained. More precisely, those who advertise this way must be constantly active, more often than with traditional marketing channels. If this applies on all who use social media for their advertising, by sending posts for sometimes a few times a day, leads to overcrowding with information. Social media marketing has changed the marketing from only sending the information to customers, to communication process between the company and the consumer where a company can gain the feedback in a second after posting the news. Now users have the opportunity to comment about their satisfaction or dissatisfaction transparent, through social media. For the purpose of SMM different tools can be used, depending on type of the company. There are tools for brand tracking, such as Hootsuite, SocialMention, Klout, Social Media Custom Reports, Bitly, Buffer and many others. Previously listed tools are free and effective, but of course with limited capabilities compared to a complete paid solution. One of the complete paid solutions is the Oracle solution for Social Relationship Management, that can be used for following a brand and managing social pages. Making customers to come back to the company's news source, on their own initiative, can be an indicator that connection is strong with these users. In order to set up strong relationship takes time and high quality content.

2. SOCIAL MEDIA APPLICATION IN HIGH EDUCATIONAL INSTITUTIONS

Analysing the world's top-ranked universities and their performance on social media sites, leads to data that all social networks are included when it comes to communication with students. As the most effective is Facebook, which was created exactly in Harvard University for the purpose of communication between students. In addition to the Facebook appears LinkedIn, for business purposes. LinkedIn works to cut the

age of users, explaining that they want to allow the younger generation, such as future students, to more easily find a college for continuing their education. This shows that universities are highly presented in LinkedIn social network. At the University of North Carolina research showed students prefer discussion over Facebook rather than any other online platforms that are used for learning (Stutzman, 2008). Students said to not wanting their studying to move on social networks, as they can be distracted with the constant notifications about what do their friends. Instead, notification regarding the obligations and time limits for their courses, duties, would be desirable (Kosik A., 2007). Majority of students on social media are the undergraduate ones and use them to wide up a social network, while Master students usually are employed, and use Facebook less because of working hours, and mostly for business purpose. Research conducted at the University of Cape Town, showed that these students also have Facebook profiles, but they do not log on every day and the list of their friends is lower than for undergraduate students. Students on Facebook are divided into three groups, those who enter daily on their profile, the second group are those that are present on a daily basis, but passive and just watching someone else's profile or activities. The third group consists of those who are active on a daily basis, posting statuses, images, and comments (Tanja E Bosch, 2009). Teaching staff should behave as to show that they belong to the same community as students. This reduces the barriers between professors and students that results in better cooperation. Around the world, the practice of universities is to strive better qualification of students and to teach them efficient practical work. They have an interest in a faster and easier way to get closer to students, and inform them about obligations that they have. A study shows that using social networks, each member of the faculty has ability to reach a 75 percent of the target group (Matthews, 2006). It is important having in mind the privacy of students. To make closer contact with them does not have to initiate a friendship on Facebook, just to send a direct message. How important is usage of social media in education is shown by analysing the leaders' behaviour in that field. Analysis of the leaders includes the study of their performance on social media. As the leaders in the field of education were considered the top ranked universities in the Shanghai list (Shanghai list, 2014): Harvard, Stanford, and Oxford, that was taken as a representative in Europe. The following is a summary of all three universities posts on all social media, important to communicate with students:

- Research and studies in progress
- Quotes
- Awards
- Questions on how well are they familiar with University
- Pictures of the atmosphere in lectures or environment of University
- Lectures by experts
- Videos and opinions of students about University
- Alumni achievements
- Student Competition
- Success of students
- Conferences
- Fill in the blank Posts
- Congrats holidays, beginning of the year and successful ending of studies
- Inspirational advice.

Laboratory for e-business (hereinafter: Elab) also uses social media such as social networks and YouTube channel. Choice of using Facebook for a main campaign tool is based on the results of a questionnaire conducted by Elab for students who attempted any of a Moodle LMS courses. The questionnaire showed that 96.43% of students use social networks, but more than half, 55.56% exactly, use Facebook. Other social networks that Elab uses are LinkedIn, Twitter, Google+ and MySpace, and on these go the rest of 44.44%. One of the most important question was why did the students give a Like to some Fan page, 44.64% answered that they want to get notifications about new posts from that specific page. Elab has Fan page and groups for undergraduate and postgraduate studies. In addition, Elab has an edutainment Facebook application that can be used by students who have their enrolment in any Moodle course and have a Facebook account (Labus A., Simic K., Vuluc M., Despotović-Zrakic M., Bogdanovic Z., 2012).

3. SRM MODEL OF A HIGHER EDUCATIONAL INSTITUTION ON SOCIAL MEDIA

Laboratory for e-business exist in scope of Faculty of Organizational Sciences, University of Belgrade. The main motive is improving scientific, researching and educational work of teaching staff and students of the Faculty of Organizational Sciences in the field of e-business, application of the internet and mobile technology in business, as well as teaching at the undergraduate and postgraduate studies. Elab's work is based on the usage of modern technology and permanent innovations. The Elab organizes the following courses: E-business, Internet technology, Simulations and simulation languages, Internet marketing, Mobile business, Risk management in the development of IS, Internet of things, and many other.

Considering the presence of youth on social media, primarily students, occurred the need to have Elab advertise via them. Focus is on free advertising tools, rather than paid advertisement that is just the small part of the Internet media plan (hereinafter: IMP). All the activities that are presented in this paper are designed within the Elab. Goals pursued in this Internet marketing campaign are improvement of Student Relationship Management and emerging brand of Elab. Student Relationship Management (hereinafter: SRM) is a continuous process, which takes a longer period and involves constantly listening to students (Vulić M. Marko, Labus B. Aleksandra, Simić M. Konstanstin). Also means to work on attracting and retaining students, by raising the goals from a level to collect likes, to a level where students are habituated to return to the pages of the Elab on their own initiative. Further, branding the Elab and increasing traffic on its social media, should lead to an increased number of students in Master and PhD studies. Elab performs on social media as it is designed in the IMP. Its main purpose is planning a social media campaign, defining marketing activities, a flow of realisation and defining metrics for following accomplished effects. SRM model of a higher educational institution on social media is developed and applied in scope of Elab (figure 1).

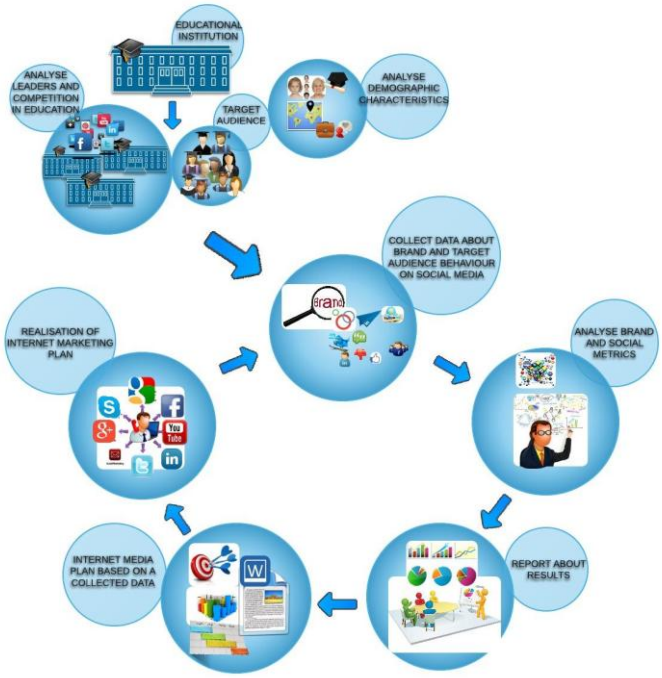

Figure 1: Student relationship management model of a higher educational institution on social media

A model has six phases and after one, full circle it goes to repeat last five phases until the goal is achieved. It is important to target group, what's they like, so in the plan could be designed how to talk to them. First step needed is to do a demographic research of a target group; age, gender, where they live, their interests etc. Competitors have to be well known and analysed, are they better in educational processes; if they are, what parts of education should be improved to reach them. After this, gaining data about leaders, their behaviour on social media, could start. Next phase is exploring how the Internet users see brand and how target group see presentation via social media, until now. Reporting about results includes sharing opinions, observations and having creative ideas about what to do next. That next phase is emerging goals, activities and resources into an IMP as a document that should be a base for conducting the campaign. Sixth phase is an implementation of an IMP on social media as it is planned. Although, it is a last phase of a first cycle, it must not be the last thing to do needed to accomplish SRM. Inasmuch target group and leaders cannot change fast in a short time, it should be continued in the second phase and start analysing data about brand presence on the Internet and opinions of a target group after the campaign is done. After analysing collected data and report meeting, the IMP should be updated with details that reports showing as important. The procedure is further repeated in the same manner in order to eventually get a clear insight into the SRM. In order to create a clearer picture of the model, further is presented model into details.

Target groups for Elab are determined in IMP. It included collecting information about age, gender, job, former or current education, likes, interests, attended groups etc. The target group is between 22 and 45 years, both genders are equally interested in this type of industry for further education, and they belong to:

- Students from following faculties: FON, ETF, PMF (IT Department), FIT, Economics, High school dealing with IT, Megatrend, Singidunum, University of Novi Sad, Kragujevac and Nis.
- All who are interested in e-business: Banks, IT and marketing companies, the National Bank of Serbia, the Ministry of Local Government.

Their interests are everything that Elab could teach them: Computer Programming, PHP, Android, iOS, Mobile Application, Internet marketing, e-Banking, e-Learning, e-Business, Social Networks, Social Media, Cloud Computing etc. Also should be targeting the ones that liked following pages of students' organisations: FONIS, AIESEC, ESTIEM, FON's career Development Centre.

When analysing the leaders, it is necessary to use relevant sources to set up them initially. In this case is used the Shanghai list, considered a recognized and relevant in the field of education. Analysed are Harvard, Stanford and Oxford University. Their activities were shown earlier in this paper so further explanation about leaders is skipped. An overview of the competition in the area of e-business, shows that Elab does not have competitors in this part of Europe. Bearing this in mind, the goal of emerging the brand in national and international level is possible to maintain.

Move forward to analyse brand and placement of Elab can be proceeded with different social media tools. To analyse previous placement in social media in use are insights and analytics tools. When trying to figure out the brand status on the Internet there are many possible tools, as well as a choice to use free or paid tools. For Elab is used free and simple tool SocialMention. In received results, special attention should be on the negative comments and responses (figure 2).

Figure 2: Social media tool - SocialMention

The obtained data analyse professional staff. In case of the Elab all members carried out the work, as they fulfil professional qualifications needed. Report of the results was used for making an IMP. Activities were planned and designed for the following social media: Facebook, LinkedIn, Google+, YouTube channel, Skype, SlideShare. Twitter is not specifically designed for this campaign because it is connected with Facebook and direct pastes the news that posted to Facebook.

Activities for reaching the goals are displayed in IMP with Gantt charts, calendars and schedules on different levels; weekly, for two campaigns (national and international level) and annually. Every activity is presented with the day, social media that should be used, how often and what is the goal of conducted activity. This plan contains activities that relate not only to the period of the campaigns, but the activities conducted independently, every year; such as presentation of elective courses.

Table 1: News on a weekly basis on the social network Facebook

Day	Activity	Time
Monday	Undergraduated studies atmosphere, Master studies promotion	06pm 04pm
Tuesday	Promotion of Monography, Lecture IEEE Chapter Computer Science(CO-16), PhD studies promotion	02pm 11am 02pm
Wednesday	Undergraduated studies atmosphere, Master studies promotion	05pm 04pm
Thursday	PhD studies promotion	02pm
Friday	Promotion of Monography, Master studies promotion	02pm 04pm
Saturday		
Sunday		

Activities of IMP are designed to be educational and entertaining at the same time, which leads to the principle of edutainment that is the core of all activities conducted by Elab. The way Elab is going to get closer to students is by placing them useful materials about e-business, IT and some important notifications about the courses they study.

Facebook is the main channel for campaign conduction. Some of the posts that are going to be used in a campaign are explained in further part.

Activity *The atmosphere in lectures and exercises* is posting pictures with explanations about what have been done that day in courses Internet of things (IoT) or Internet marketing. IoT is one of the areas that grow and it is interesting for future generations to learn about it. It is more interesting because the course conducts in a smart classroom, in the Faculty of Organizational Science. Its aim is to increase the number of students who would choose one of these courses next year in undergraduate, Master or PhD studies. *Alumni reunion* would be conducted annually. Alumni is going to be interviewed, and video materials or posts with pictures, in English and Serbian languages, are promoting about the quality of the studies, as well, how can it help to get a job or to move forward in career after finishing this particular study programme. Activity *Our students about us* is mini Interviews with current students. Students talk about how they improve knowledge in e-business in courses, what is the most interesting to them, and what practical knowledge they gained. *Fill-in-the-blank Post* is posting sentences about some term in e-business with a blank field that gives the student opportunity to answer with the word they think is right. These posts are posting before exercise starts so the students can answer and gain points for participation in social network activities. Each response is free advertising because their friends see the name of the Elab every time the question is answered. *Seminars, conferences and IT events* are conducted throughout the year. At the beginning of each month is important to make review of conferences in IT field and regularly report on it. When there are no other activities, post *Video material, useful tutorials* to help students learn practical things of e-business. Post with *Inspirational advice from experts* or *Quick Tips in IT field* have a purpose to attract students to follow the page on a daily basis because they will receive useful information. Activity *Get to know the Elab Tim,* gives students an opportunity to see who the teaching staffs is, to feel good atmosphere to study and work with them. The activity includes pictures of members in some daily work at the University, interview about their achievements, motivational speech etc. The tone of activity should be friendly. Activity *Summer/New Years Logo of the Elab* is about making mini competition with the task for students to make new logo for the Elab. Student who has the most likes can be released of exam or can get extra points. Conducts open *Workshops* to the target group that may be outside the Faculty of Organizational Sciences. Workshops include short courses lasting from 1 to 5 days, and could be different levels. Use them to gather impressions of participants in e-form. Gallery from the workshop is necessary to be posted. Workshops are organized in collaboration with student organizations, advertised by their sites, which expands the number of people who see the brand of the Elab. In the second half of March Elab starts posting links, on a weekly basis, with *Descriptions of courses* that inform about Master and PhD study programme. Post *Top Jobs* whose list presents some areas that Elab maintains. The goal is to promote that the most popular and highest paid jobs are those included in the courses of the Elab.

Table 2: Schedule of Social Media global activities of Elab for May 2014th

Promotional activities of the Laboratory for e-business, 2014th	May																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1. Promotion of Monography "High Performance and Cloud Computing in Scientific Research and Education"																															
1.1 Posting pictures and promotional articles on social media																															
1.1.1 Facebook		02pm			02pm		02pm		02pm			02pm		02pm	02pm	04pm															
1.1.2 Twitter		02pm			02pm		02pm		02pm			02pm		02pm	02pm	04pm															
1.1.3 LinkedIn		02pm			02pm		02pm		02pm			02pm		02pm	02pm	04pm															
1.1.4 YouTube									02pm																						
1.2 e-mail and viral activities																															
2. Marketing campaign for master and PhD entrance examination																															
2.1 Promotion on social media																															
2.1.1 Facebook															04pm				04pm	04pm	04pm	04pm	04pm	04pm		04pm		04pm		04pm	
2.1.2 Twitter															04pm				04pm	04pm	04pm	04pm	04pm	04pm		04pm		04pm		04pm	
2.1.3 LinkedIn																															
3. Promotion of lectures and exercises on undergraduate studies																															
1.1 Posting pictures and promotional articles on Facebook social network					06pm		05pm					06pm		05pm					06pm		05pm					06pm		05pm			

Since Facebook Fan Page of Elab is in Serbian language, LinkedIn page is in English, so the international students could find the information about courses they needed. This is necessary due to the lack of bilingual social networking sites. Facebook ads are in Serbian, LinkedIn has an only ability to advertise in English, which perfectly fits the planned.

LinkedIn page contains posts about human resources of the Elab, including students' achievements. Staff of the Elab uses the Recommend option to inform followers and their connections about services of the Elab. In

order to strengthen the brand Elab needs to be found on LinkedIn profiles of its teaching staff. This can be achieved by tagging Elab in the Experience section. To implement this in the part of Company Name find and tag Elab, and mark the checkbox - I currently work here.

YouTube channel is in use for uploading Alumni videos, Webinars and Tutorials related to Elab, in Serbian and English languages. Uploaded materials should be posted with links to Facebook, LinkedIn and Google+ social networks.

4. A MODEL OF SOCIAL MEDIA METRICS

After the Internet media campaign is finished, there is a need to analyse metrics to measure the success of conducted activities. The purpose of social media metrics is to collect data about the performance and to be able to improve activities. Sometimes metrics established at the beginning of the campaign are not entirely relevant at the end; it happens if a campaign is running for a longer time and a fast change in social media. Presented model of social media metrics shows the process of building and improving SRM. It is based on continuous monitoring of the students' behaviour, their activities at the pages of Elab and their opinions - expressed on the outside sites that are not under authority of Elab; forums, groups on Facebook, portals on the study and similar sites.

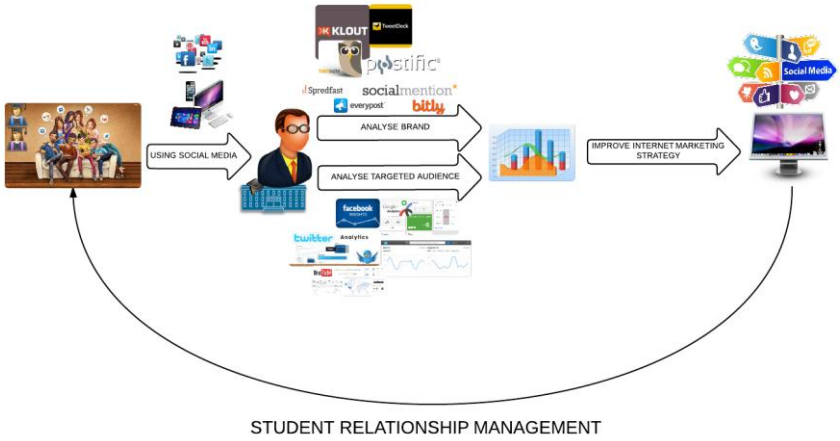

Figure 3: Model of social media metrics

Free tools that offer the possibility of monitoring brand on a global level are: Klout, SocialMention, Everypost, Spredfast, Postific, Bitly, Hootsuite, Tweetcheck etc. As any other free tools, these also have limited capabilities, but with the extra pay, some are able to analyse more detailed.

For tracking the success of social media activities, every social media developed its own tool. It is necessary to summarize the results for conducting campaign, after the first campaign is finished, and later to follow reactions on a monthly basis. The effects of implementation media plans can be seen after three months.

Metrics of a Facebook campaign can be monitored through Facebook Insights tool that provides a complete overview of statistics on a Facebook Fan page. The clearest picture of the fans habits and interests gives an option Posts. Appears that students are equally active on their profiles every day in a week when use their profiles more often in an examination period, for searching materials and communicate with colleagues, and less during the rest of the year, when they are more active on Friday, Saturday and Sunday. The time when most of them are online during one day is a period between 7pm and 11pm, which should be the period for posting. Otherwise, if Elab sends something in the morning, and students are active in the evening, there is a big possibility post is not going to show to them; other newer news sent in the afternoon hours are priority. Because of frequent changes section posts has to be monitored on a monthly basis. Type of post that attracts students the most is picture, which is why they must be high quality. The option People, gives details about Fans, their location and age. In general, the highest number of Fans is from Serbia, Belgrade and age between 18 and 24, which is exactly students' age. It is not important to have as many likes, Fans, on the page, but to interact with students as a sign that they follow the information and topics that appear on the Fan page. When it comes to Likes, optional is Start-End date and can adjust the dates to follow, which is beneficial if needed data is on a campaign level. Here can be kept track of when it was the highest number of likes or, more important, to review the dates when was the lowest number of likes, or even dislikes on a Page. Based on that to see which posts do not cause enough attention. Post Reach shows the number of

people who saw the posts. The result gives an overview of the Organic and Paid. It is necessary to have as much Organic Reach, because it is free. The highest reach Elab had for post thanking about the lecture conducted by one of the alumni of Elab. Post is simple, one picture and brief explanation in one sentence, what was the lecture about. Out of 568 people reached, the post has 292 clicks, which is 51% of the number of people reached. The highest reach is bigger chance to have better engagement. More detailed is part Likes, Comments and Shares, that show sum of 51. That is the most important part to follow, because it shows the actual engagement with Fans (figure 4).

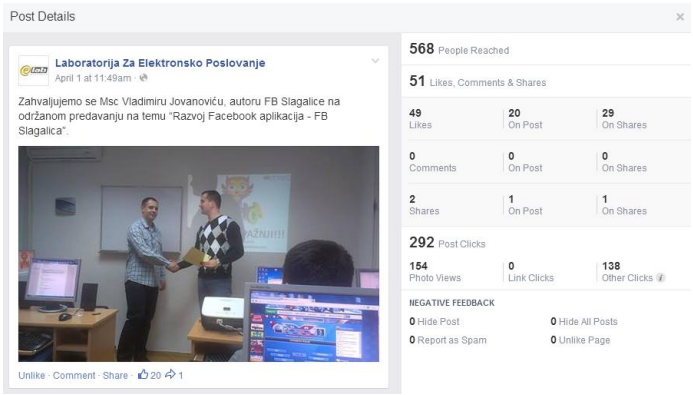

Figure 4: Post details with the highest Reach

The second post is a gallery from the class of Elab's subject IoT where reach is 287 people, post clicks is 4.038, and engagement is 15. The number of Post Clicks is this high because the gallery contains 37 pictures and every click counts as post click. This shows that a high number of post clicks does not mean higher engagement.

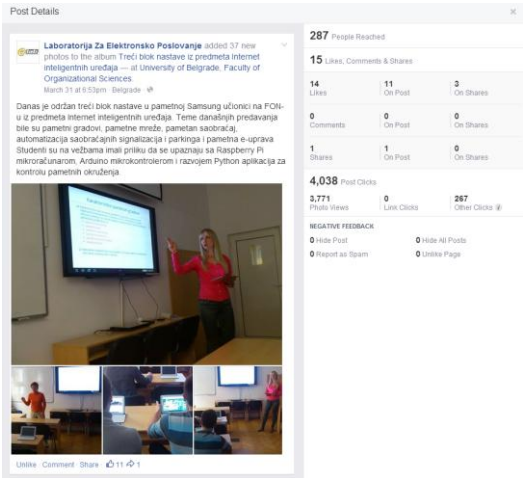

Figure 5: Post details with the highest Post Clicks

Reach has to be high, so chance of someone new can see posts and like a Fan page. This can be achieved if more people like, leave comment, or share the post to others. If the reach is high, it does not mean all the rest metrics are high. Post has to be visually attractive to students to click on. So, if the Reach is high and Clicks are low, means that the post is not enough interesting to students. After the Reach and the Post Clicks are high, if likes, comments or shares are excluded or are close to zero, then the students did not like what they read or saw. In order to achieve high number of metrics, Elab continuously analyses students on a Fan page, and what it is they find interesting in posts.

LinkedIn has its own tools for monitoring the company site. Can be seen Follower; who is and how many, in case of Elab is 63 connections. Reach can be achieved: organic or paid. Engagement is the most important because it gives the overall view of engaging percentage. Demographic characteristics of the Follower in case of the Elab are: Seniority: Entry 45,5%; Industry: Information Technology and Services 33,9%; Company Size: 200-500 25%; Function: Information Technology 17,4%; Employee: Non-Employee 100%.

If some student post a negative comment, or there is a misunderstanding, responds immediately, personally, by name. This is a technique used for conversation with each student, whether it is a positive or negative comment. Elab makes personal communication as much as possible to give the effect of a face-to-face conversation. SRM is based precisely on the fact that students feel close to Elab.

If metrics data stay zero, IMP should be reviewed and improved. Promotion of Master and PhD studies is reflected in activities that promote courses of Elab, with an accent on a practical ability and their usage at work. Activity Top Jobs has a motivating effect on application for further studies in this area. Important activities that may lead to an increase the number of applicants to Master and PhD studies are activities related to direct contact with prospective students. such are workshops. These activities should be carried out as often as possible, because they give the largest space to connect with students through personal contact and answering questions.

After extraction of all metrics, approach to analyse and process obtained results. By analysing all the metrics, IMP updates, activities are replaced and students are let to express their reactions again. Quarterly is necessary to do a detailed analysis, according to plan and the model presented in this paper.

5. CONCLUSION

Social media can be used for entertainment, but equally good as an Internet marketing tool. The paper discusses the concept of social media; how and why educational institutions use this tool for online marketing campaigns. The main advantages of their use are great reach target groups and free usage. This free advertising may be enough in some cases and some period, but it is convenient to pay periodically for advertising on Facebook or LinkedIn to expand the number of fans and connections. In this paper was presented a model that includes a procedure needed to achieve Student Relationship Management. It is necessary to constantly listen and measure the needs and expectations of students, conduct activities accordance the result and continuously improve Internet marketing strategy. The priority for Elab is to provide interesting, reliable and comprehensive information. By fulfilling all these demands, Elab provides a stable and long-term communication with students on social networks. In addition, the Elab maintains course Internet marketing, and consequently must be presented as a leader in this field and to present properly themselves through activities that are tends to be. Some students do not have a social network profile. Reaching them problem can be solved by developing an Android application that sends notification of all activities. This will be further considered as extension of Student Relationship Management.

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REFERENCES

Kim W., Jeong O.R. & Lee S.W. On Social Web Sites. Information Systems. Vol.35. No.2.. P.215-236., 2010.

Mohammed, R. A., Fisher, R. J., Jaworski, B. J., Cahill, A. M., Internet Marketing-Building Advantage in a Network Economy, International edition, McGraw-Hill/Irwin MarketspaceU, pp. 203– 313, 2002

Mishra, G., Social Technologies and Citizen Activism: The 5Cs Framework, 2012, Online: http://gauravonomics.com/social-technologies-citizen-activism/

Kosik, A. 2007. The implications of Facebook. Sharing the Commonwealth: Critical issues in higher education 9–10., Online: http://www.pcpa.net/March2006.pdf

Tanja E Bosch, Using online social networking for teaching and learning: Facebook use at the University of Cape Town, November, 2009, Online: http://dx.doi.org/10.1080/17439880902923606

Stutzman, F., The vibrancy of online social space. In B. Rigby, Mobilizing generation 2.0: A practicalguide to using web 2.0 technologies to recruit, engage & activate youth. New York, NY: Jossey-Bass, 2008.

Matthews, B. 2006. Do you Facebook? Networking with students online. College & Research Libraries News 67(5): 306–307.

Shanghai list, 2014: http://www.shanghairanking.com/ARWU2004.html

Labus A., Simic K., Vuluc M., Despotović-Zrakic M., Bogdanovic Z., An application of Social media in eLearning 2.0, 25th Bled eConference, Reliable and Trustworthy eStructures, eProcesses, eOperations and eServices for the Future, Bled, Slovenia, June 17, 2012 – June 20, 2012.

Vulić M. Marko, Labus B. Aleksandra, Simić M. Konstanstin, Unapređenje SRM koncepta primenom Social cloud servisa, XII Međunarodna konferencija E-trgovina 2012, Srbija, Palić, 25.-27. april 2012.

GATHERING AND ANALYSIS OF FACEBOOK FRIENDSHIP RELATIONS

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Abstract: *The abundance of various data which are accumulated and transferred via online social networks and their ability to be extracted and analysed have become the topic which scientific and professional public is becoming more and more intensively interested in. As the activities on online social networks are becoming more and more present sociological phenomenon, online social networks are regarded as reliable indicator of social condition and course of future social development. The objective of this work is to awake the understanding in regard to the overall connection among the students and the position which its members have in the structure through statistical analysis of the structure of friendship relations of the closed Facebook group the members of which are the students of the Vocational College of Technology in Arandjelovac. For the needs of gathering data the created Facebook application was used, which offers the possibility of gathering data on structure and members of any Facebook group whose member is the user of the application. The results that were reached by the research in domain of network density, centralisation and modulation, identified communities and influential individuals, as well as in domain of the identification of the discrepancies in position within a structure depending on member's sex, can be used as the starting point in defining the strategies of managing the relations with the students, viral marketing and generally in managing the flow of information in the Vocational College of Technology in Arandjelovac.*

Keywords: *Online Social Networks, Facebook, Data Mining, graph, analysis, nodes.*

1. INTRODUCTION

The growth of the World Wide Web service led towards the evolution od various types of information sharing systems among which the greatest popularity was achieved by online social networks such as Facebook, MySpace, Flickr, LinkedIn, LiveJournal, Digg, LastFM, Bebo, Twitter, hi5, Orkut and other. Online social networks enable the users to access the network, create connections with other network users, propagate information that represent the users and their preferences, providing an environment for sharing the wanted content with other users. The growing popularity of social networks has been the result of their relevance for various processes within the society, such as the growth of cultural influences, personal beliefs, formation of communities, groups, etc. At the same time, online social networks represent favourable ground for various shapes of research and primarily for sociological one since they provide the access to great quantity of heterogeneous data on individuals, social occurrences, social tendencies and similar. Regarding the growing popularity of online social networks and the availability of great quantity of content which is created by the users themselves, social network analysis has become a burning issue especially in the domain of development and accepting new techniques for social network modelling and analysis in the sphere of Machine Learning and Data Mining.

The subject of the work is research and analysis of friendship relations on Facebook social network among the students of the Vocational College of Technology in Arandjelovac. Nowadays, high-education institutions are facing highly-competitive relations on the market; therefore, they are in such a position that they cannot marginalise the issue of adequate managing the relations with the students. Understanding of the students' position in a society, the ways, and flow of information in a school community, students' affinities, and characteristics are of decisive importance for reaching students' contentment with their studies. As a specific sphere of interest, in the conditions of market economy in an education system, the issue of working out and realisation of promotional activities arises, where familiarity with the students' position in a social community, their connection and degree of influence, can have paramount results regarding the virtual marketing. Under such circumstances the concept of Customer Relationship Management and especially the application of techniques for the analysis of social networks are becoming more and more relevant, in this case, for the users of the education services, that is, the students.

2. ANALYSIS OF SOCIAL NETWORKS

Analysis of social networks is a multidisciplinary sphere targeted at analysing and modelling the connections and diffusion processes among diverse objects in the nature and society with the aim to understand the ways

in which the behaviour of individuals and their interactions are transferred into global sociological phenomena. The analysis of social networks which is according to *Wellman and Berkowitz (1988) also called structural analysis (p.1)* represents, above all, the strategy for exploring the social structures. Traditional individualistic sociological theories and techniques for data analysis have had as their subject research of individual participants who reach decisions, not taking into consideration the behaviour of other individuals, and ignoring the social context of participants. Nevertheless, when analysing social networks, connections among the participants gain the highest priority while the characteristics of the individuals become marginal making the relational data the focus of the research. According to *Wetherell et al.(1994) analysis of social networks (1) conceptualises social structures as networks with connections which link members and resources, (2) focuses on the characteristics of connections instead on the characteristics of individual members and (3) perceives communities as 'personal communities', that is as networks of individual relations developed, maintained and used by people in everyday life (p. 645).*

Two main forms of social network analysis are distinguished depending on the subject of their research: (1) analysis of complete networks which encompass all relations within the defined population and (2) analysis of personal networks (which are also called egocentric networks) which encompass connections that individuals have in the shape of their personal communities. For groups such as enterprises, schools and other communities, analysis should own thorough information about who is on network, and due to this all of the participants are 'egos' and 'alters'. Analysis of personal networks are usually carried out when the 'ego' identities are known but not their 'alters'.

3. REPRESENTATION OF SOCIAL NETWORKS

Aspect and the degree of analysis which can be carried out, as well as the quantity of knowledge which can be obtained through analysis of social networks depend on the technique which is used in their representation. Certain techniques enable mathematical analysis, while others are only dealing with theoretical research and reasoning. The choice of the way of a representation is determined by the nature of the problem and operations that are necessary to carry out on a network as well as the desired degree of network's abstraction. In practice, social networks are most often represented by using graphs, as a cluster of nodes and their connections which are generally called relations. In a social network, a node is usually called a social participant and it can represent a person, a group, a document, an organisation or even an entire nation. Edges between the pairs of nodes represent relations which maintain a friendship, a kinship, mutual interests, financial exchange, physical relations, hyperlinks, etc. In a representation such as this when analysing social networks, depending on the research issue, general indicators of the graph theory are used, such as: degree centrality, betweeness centrality, closeness centrality, average path length, modularity, clustering coefficient, graph density, etc.

Except for the graphic representation, it is also possible to represent social networks by using matrices where adjacency matrix is often used. Adjacency matrix is a matrix A with dimensions $n \times n$, where n represents the number of nodes in a graph. Element a_{ij} is equal to the number of branches which start from a node i, and end at the node j. On weight graphs in the scope *(i, j)* the weight of a edge which connects nodes i and j is located. If types are marked by nodes, and columns by edges of a graph and if element a_{ij} has value 1, and if i node is incidental to the j edge, and if contrary equals 0, in that case a matrix is called incidence matrix. Besides these previous, other matrix representations are used, such as Laplacian matrix of a graph which represents the difference between the degree centrality matrix and its closeness matrix or for example the normalised Laplacian matrix.

Semantic representation of social networks is based on the concept of Semantic Web which, according to *Breslin and Decker (2007), provides mechanisms for representation and navigation by connecting people and objects wit a view to representing heterogeneous relations which connect them (p.88)*. Semantic Web provides representation and exchange of data on social networks by using RDF (eng. Resource Description Framework), query language (SPARQL), and framework for defining schemes (RDFS and OWL). The key concept for semantic representation of data is ontology which *Gruber (1993) defines as: formal, explicit specification of a divided conceptualisation in the form of an explicitly specified vocabulary which describes diverse aspects of a domain being modelled (p.2)*. Among the ontologies used in the representation of social networks, according to *Ereteo et al. (2011) FOAF (Friend-of-a-Friend) is currently used the most (p.5)*, ontology for describing people, their relationships, and activities. A great number of attributes are used in describing the users' profiles (such as surname, user name, interests, etc.), the use of Web (online accounts, weblogs, membership, etc.), relations which connect members (familial, friendly, businesslike, etc.) etc. In addition to the previous ontology, other ontologies are used as well, among which are SIOC (Semantically Interlinked Online Communities), SKOS (Simple Knowledge Organization Systems), RELATIONSHIP ontologies.

4. MAIN RESEARCH TOPICS IN SOCIAL NETWORK ANALYSIS

One of the key research problems in social network analysis is the way to determine the possibility of existence of relations among objects on the basis of their attribute clusters and topology traits of individual objects in a network, for which different social network model variants have been developed, such as: p1 model, which is represented in *Holland and Leinhardt (1981)*, p2 model, Dynamic Preferential Attachment Model which was represented by *Barabasi and Albert (1999),* Watts-Strogats model of a small world represented by *Watts and Strogatz (1998),* model from the domain of the theory of games, adaptive network models, etc.

Analysis of similar nodes is another problem which was noticed by the research community. Usual approach to measuring the similarities between the nodes is the so called structural equivalence, where two nodes are considered to be structurally equivalent if they have a great number of mutual nodes by which they are connected. Jaccard's coefficient which is described in *Han and Kamber (2006) (p. 391)* belongs to this approach group. Alternative approach starts from the concept regular equivalence, where two users are similar if their acquaintances are similar as well. Regular equivalence is self-referential concept: it is primarily obligatory to know the similarity between two neighbouring nodes before the similarity between those two nodes is calculated. Some of the most important algorithms for calculating the regular equivalence are REGE and CATREGE.

Diffusion in networks is a research problem which was the subject of various studies' analysis which studied diverse scenarios of spreading of computer viruses, knowledge, products, etc. Basic mathematical models which can be found in literature for the analysis of information diffusion in social networks are threshold models and cascade models. In threshold model, node *v* in a network can adopt some activity (become active) only if a certain number of nodes within the neighbourhood of the given node are active, that is when the number of active nodes in the neighbourhood of node *v* exceeds the threshold value when node v becomes active. In cascade models of information diffusion each individual in a network which becomes active has a unique probabilistic chance to activate each inactive node within its neighbourhood.

Mesoscopic description of network structures explains the structure of communities within networks. The greatest number of algorithms for the detection of communities is based on the concept of network modularity. A series of diverse techniques and algorithms have been developed for identifying the communities in social networks, such as: Girvan-Newman algorithm, which is described in *Girvan and Newman (2002) (p.7823)*, hierarchical clustering, which is described in Wasserman *and Faust (1994)*, stochastic block of modelling, CPM (Clique Percolation Method) method which is used for detecting communities which overlap (for more see *Palla et all (2005)*), CHRONICLE which is used for discovering communities which change over time (one of the approaches can be found in *Kim and Han (2009)*) and other.

5. EXPERIMENTAL WORK

The objective of the research has been to awake the understanding in regard to the overall connection among the students and the position which its members have in the structure through statistical analysis of the structure of friendship relations of the closed Facebook group, the members of which are the students of the Vocational College of Technology in Arandjelovac. Conclusions which the research has reached can be extended on interpretation of global relationships among the College students and used in defining the strategy for managing the relations with students. The results of data analysis which have been gathered enable: better understanding of the density and relationship character among the group members, community identification within a group, better understanding of the differences in character of connection among the group members who are of male or female sex. In order to test the starting hypothesis in the work, the reached results were compared with average values of referential indicators for the tested group which encompassed ten Facebook network users who submitted needed data which was obtained via application for data gathering as a way to construct ego networks of their friendships on Facebook network. The starting assumption in the analysis was that the network would be considered as centralised, dense, and connected, highly modular, if it has values of relevant indicators which are bigger or equal to values of average indicators for the test group.

The network of Facebook group members is represented by using an unweighted graph, while the derived analysis is static and which refers to data gathered by using the Facebook application which was developed for a specific purpose on April 1st, 2014. Facebook is chosen as a social network from which data on structure of friendship relations was gathered, regarding that this social network provides referential sample

for the Vocational College of Technology in Arandjelovac, who by far uses less other services for social networking.

3.1. GATHERING DATA

Facebook is a robust, documented platform with data organised both in horizontal and vertical sense. Model od friendship relations on Facebook is symmetrical and demands reciprocal consent of users in order to gain access to other user's data and to enable interaction with another user. Facebook provides fine control of privacy, enabling friendships to be organised and maintained as lists with diverse degrees of visibility for users and divers activities. There are three main ways to access the data on Facebook social network. The first one is direct access to data on server which is available only to the intern users or in cooperation between service providers of social networks and a research institution. Another approach is access through sanctioning API[1] which implies that the machine interface is used and which is provided by many Web 2.0 services and especially for programmers so as to stimulate the development of applications and integration with other services in order to provide additional functionality and usefulness for the users. These interfaces ensure structured data, but they are generally limited in scope and the data content as well as in time when data can be gathered. The third approach is browsing the user interface which can be done manually, but most often includes deploying softvare agents which read HTML documents which are used as graphic interface for users, directly through HTTP protocol or through the automatisation of a browser via DOM. These techniques can avoid limits of API, but often disrupt technical or legal authorisation which gives provider platforms. For Facebook platforms mechanisms for detecting bots are used, so suspicious activities often lead to the suspension of the account.

Main restrictions that implements Facebook platform are as follows: each access to data is signed by privileges of a Facebook user whose current status on a platform defines the scope of data which can be accessed; user's settings related to privacy protection influences which information can be gathered; each application has to ask for permission to access various data; there is a restriction regarding the quantity of information which can be obtained from a user's profile that aren't in a mutual friendship relation; there are certain technical limitations such as the one where friend lists are dispatched through asynchronous script. Certain Web servers such as Graph API were introduced in year 2010. However, these services do not abolish previous limitations, but introduce some additional ones. Besides, service providers for online social networks keep the right to modify or close the service interface which can bring about new problems in gathering data from online social networks.

To collect the data about friendship relations between members of the Facebook group in consideration dedicated application had been created using PHP and Facebook SDK for PHP. Facebook SDK for PHP provides a number of server side functionality for accessing Facebook API, including access to functionalities Graph API and FQL's. Graph API is the main way to obtain data from the Facebook Social Graph, a massive data structure that represents social interaction covering nodes and edges between nodes. At issue is the API that is based on HTTP, which can be used for data collection, respect, uploading photos and a host of other functions.

Application for gathering informations about firendship relations, can be found on Facebook platform as Graph Projekat and can be used for any Facebook group of which the user of the application is a member of. Application generates a HTML page with a list of links representing Facebook groups of which the user is a member, whose choice triggers metods for collecting information about group members and their relations. Data collected on members of the group are: Facebook ID, gender, location and friendship relations with other members of the group.The application includes a script that checks if there are repeating nodes and their connections, and as a result generates file with .gdf extension that can be used in Gephi and other similar programs for network analysis and visualization of network graphs.

3.2. DATA ANALYSIS

The overall number of nodes encompassed by graph is 546 with 5680 edges which reciprocally connect nodes. For the purpose of carrying out the analysis and the visualisation of the graph, free open source program Gephi was used. Gephi is an interactive platform for visualisation and study of all types of connections and complex systems, dynamic and hierarchical graphs. It works under Windows, Linux, Mac OS X operating systems.

[1] API- Application Programming Interface

Maximum value of degree for the whole network is 173. Average degree for the whole network is 20.806. The former implies that each node in the network is on average connected with 20.8 other nodes in the network. Twenty nodes aren't connected with any other node in a network. By eliminating these nodes we get the indicator of network's average degree which is 22.188. Since the average degree of the analysed group is greater than the referential value (13.545) it can be concluded that the network has a relatively high average degree.

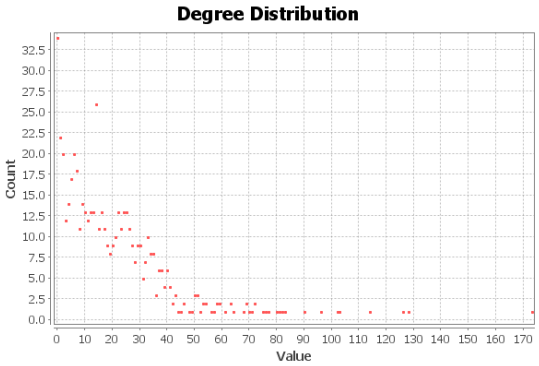

Figure 1: Degree distribution for the whole network

Relatively small number of nodes on the network (7%) has degree in scope from 50 -173. Up to 346 nodes has degree in scope from 1-25 with average degree of 4.2. This implies that a small number of nodes have a significantly higher degree in relation to other nodes.

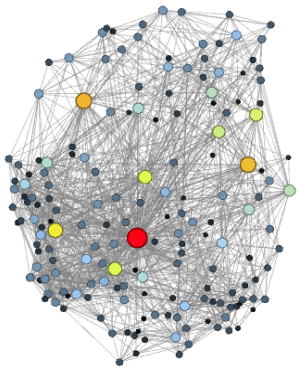

Figure 2: Ego network of the node with the highest degree centrality

The maximum value for betweeness centrality is: 15,724. The former suggests that the node with the highest betweeness centrality is located on 15,724 shortest paths on the network. Extremely high betweeness centrality is the consequence of the fact that it is a closed Facebook group. In Figure 3, nodes with low betweenness centrality are coloured in black, those with betweeness centrality from around 50 are light blue, yellow are those with betweeness centrality around 700, while bright red are those which signify high betweeness centrality (over 3,000).

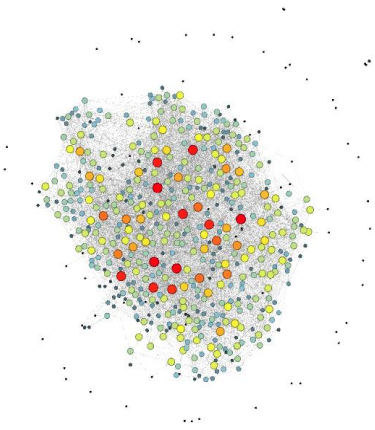

Figure 3: Network graph for the scope of betweeness centrality: 0-15724

It can be said that 11 nodes have a very important betweeness centrality (position) in the network. Thirty three nodes have the betweeness centrality 0. Thirty nine nodes (7%) have got the betweeness centrality higher than 1,000. The node with the highest betweeness centrality (15,724) has a significantly higher betweeness centrality than the second placed one (8,000). The former confirms that there is a small number of nodes which have a significantly higher betweeness centrality when compared to other nodes.

Graph has a diameter 6 and an average path length 2.47 which attests that there is a closely connected group of individuals. The total number of the shortest paths is 256,550. By eliminating the nodes with a low degree and keeping the ones with a degree higher than 3, the graph diameter has the value of 4, radius 2, whereas the average path length value on the graph is 2.35. The maximum value of closeness centrality on the network is 3.97. The former indicates that the average distance for the node with the highest closeness centrality in relation to other nodes on the network amounts to 3.97. Higher values of this indicator suggest greater network distribution. More then 90 nodes of the given network possess five-branch eccentricity, while nearly 400 nodes possess four-branch eccentricity. The average diameter with the test group is 10, whereas the average path length is 3.67. The former emphasises the fact that the distances on the graph are relatively short, meaning to say the graph is compact.

Graph density is 0.038. Eliminating the nodes not connected to the other nodes on the network one gets the graph density value 0.043, while the graph density average value in the test group is 0.30.

The average clustering coefficient is 0.299 for the entire network. The total number of registered triangles is 15,106. Nine users have the clustering coefficient with the value 1. The former indicates that 9 nodes on the network are neighbours with each given node connected with all other neighbours of the given nodes which says a lot about the high network connectivity. The clustering coefficient average value for a test group is 0.438, whereas the average triangle number is 7,481.

The existence of 37 weak components for all the nodes on the graph has been identified. Such a high value is the result of the fact that as many as 33 nodes in the given group have no connection towards the other members of the network. For those nodes which possess a degree higher than 8 (389 nodes), the existence of one component has been identified.

In order to detect communities within the network, Gephi program uses a special algorithm for examining the modularity. This algorithm enables the randomisation which improves decomposition, but requires greater processing time and resolution defining, whereby the resolution value is less than one which facilitates the production of a greater number of smaller communities, whereas values higher than 1 enable the production of smaller number of greater communities. For the resolution value 1, and the graph which consists of nodes with the average degree higher than 8, there is a modularity degree 0.365 and the number of the detected communities is 6. The greatest community comprises 110 nodes, and the next one comprises of 100 nodes.The modularity indicator average value in the test group is 0.595, for resolution 1 and the number of registered communities is 41. The modularity of the group is lower when compared to the test group average modularity which implies that the members of the observed group are more closely related according to the average test data.

For the resolution value 0.5 the existence of 14 communities for the same nodes has been registered (average degree > 8, modularity 0.322), whereas for the resolution value 2 (modularity 0.2198) the existence of 2 communities has been identified. The former group has 270 members and the latter 110 members. A great number of connections which represent local bridges among the communities and high discrepancy in the number of communities for different resolution values are indicators that the communities of the group members are mutually closely connected.

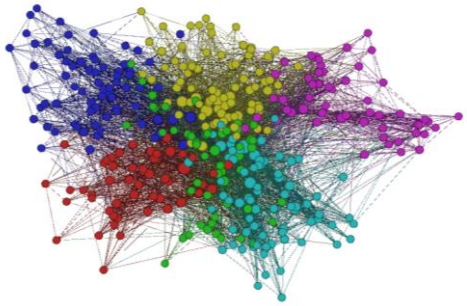

Figure 4. Six discovered communities for the resolution 1 and the network with nodes whose average degree is higher than 8.

The average degree for female group members is 10.557 (291 nodes), whereas for the male ones (253 nodes) the average degree is 8.933. Lower average degree values are the consequence of the fact that the exclusion of the opposite sex the entire network becomes reduced. Network diameter for the females is 6, whereas the average shortest length path is 2.68. Network diameter for the males is 7, whereas the average shortest length path is 2.73. Based on this it can be concluded that females are slightly more connected within the network than males.

In the aspect of analysis on the community forming tendencies which depend on sexes of the group, for the resolution value 1 and nodes with a higher degree than 0, the existence of 8 communities for the males has been identified, whereas the clustering coefficient is 0.258 (the total number of triangles is 1.224). For same parameters for the females there has been identified the existence of 9 communities and clustering coefficient average value of 0.343 (the total number of triangles 2,365). Based on the former, it can be concluded that there is a greater tendency toward clustering when it comes to females when compared with males.

4. CONCLUSION

The premises regarding the network structure of the analysed closed Facebook group have been confirmed by conducting analysis of friend relationships by using standard indicators from the Graph theory area. It has been proven that the network has a relatively high connection among the elements.

Group members with the highest values of centrality measures have been identified, which can be generally interpreted as the influence degree which these members achieve in the group. The data gained in this way can be used in the domain of promoting relationships with the students of the College, that is to say the realisation of the CRM concept, through directing more attention to demands and opinions of students with a higher degree of influence.

Through the identification of the communities, the correlation can be made between students' year of studies/study program and the community within the Facebook group they belong to. In this way, the interaction quantity between students of different years of study and study programs could be ascertained and we could come up with activities with a view to promoting the relations between the existent structures at College**.** When it comes to position of nodes on the network in relation to criteria half member, the results have shown that females are more prone to clustering, meaning to say that they are connected in strongly connected groups with a high number of relations among group members and they are stricter within specific limits among communities when compared to male communities. In addition, possessing information on community membership can be useful in the domain of figuring out methods for transferring relevant information to students.

With this study it has been confirmed that the analysis of the online social network structure is a powerful tool which can provide relevant information for promoting the quality of regulating the relationships with service users/product buyers and directing the information diffusion in an organisation. From the point of view of higher education, the information on students which can be acquired in this way offers endless possibilities for promoting the quality of relationships with students and enhancing the education process.

REFERENCES

Barabasi, A. L., Albert, R. (1999). Emergence of scaling in random networks, Science 286, 509-512.

Breslin, J. Decker, S. (2007). The Future of Social Networks on the Internet: The Need for Semantics, IEEE Internet Computing 11, 6, 86-90.

Ereteo, G., Limpens, F., Gandon, F., Corby, O., Buffa, M., Leitzelman, M., & Sander, P. (2011). Semantic Social Network Analysis, a concrete case. In Handbook of Research on Mehtods and Techniques for Studying Virtual Communities: Paradigms and Phenomena. IGI Global: Hershey, PA. 122-156.

Girvan, M., Newman, M. E. (2002). Community structure in social and biological networks. Proceedings of the National Academy of Science 99(12), 7821-7826 . Retrieved from http://www.pnas.org/content/99/12/7821.full.pdf+html

Gruber, T. R. (1993). A translation approach to portable ontology specifications. Knowledge Acquisition 5, 199-220. Retrieved from http://lisas.de/~david/brunel/references/Gruber_ontolingua-kaj-1993.pdf

Han, J., Kamber, M. (2006). Data Mining: Concepts and Techniques - 2nd Edition. Morgan Kaufmann Publishers.

Holland, P. W., Leinhardt, S. (1981). An exponential family of probability distributions for directed graphs. (With discussion.) Journal of the American Statistical Association *76*, 33-65.

Kim, M., Han, J. (2009). CHRONICLE: A Two-Stage Density-Based Clustering Algorithm for Dynamic Networks. In: Proceedingsof the International Conferenceon Discovery Science, Lecture Notes in Computer Science, 152-167. Springer . Retrieved from http://www.cs.uiuc.edu/~hanj/pdf/ds09_mskim.pdf

Palla, G., Derényi, I., Farkas, I., & Vicsek, T. (2005). Uncovering the overlapping communitystructure of complex networks in nature and society. Nature 435, 7043, 814-818. Retrieved from http://hal.elte.hu/cfinder/wiki/papers/communitylettm.pdf

Van-Dujin, M. A. J., Snijdres, T. A. B. , & Ziljstra, B. J. H. (2004). p2 : A random effects model with covariates for directed graphs. Statistica Neerlandica 58, 234–254.

Wasserman, S., Faust, K. (1994) , Social Network Analysis: Methods and Applications, Cambridge University Press.

Watts, D., Strogatz, S., (1998). Collective dynamics of small-world networks. Nature 393(6684), 440- 442.

Wellman, B., Berkowitz, S. D. (1988). Structural Analysis, in Social Sciences 2: Social Structures: a Network Approach , Cambridge University Press, Cambridge.

Wetherell, C., Plakans, A., & Wellman B. (1994). Social networks, kinship, and community in Eastern Europe, Journal of Interdisciplinary History 24 , 639–663.

APPLICATION OF THE INTERNET OF THINGS IN HYDROLOGY

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Abstract: *This paper describes application of the Internet of Things (IoT) in hydrology. The aim of this paper is to investigate possibilities of harnessing Internet of things in business systems, particularly hydrology. Main characteristics and applications of IoT are discussed. Using IoT increases business efficiency, reduce costs and increase safety. Specific context of the research is related to the application of the IoT on dams in Serbia. Several recommendations and approaches are discussed in order to improve the system functionality of dams.*

Keywords*: Internet of Things, M2M, IoT, Dam, Safety of Dams, Dam Prvonek.*

1. INTRODUCTION

The appearance of wireless technology has raised the world of communication to a higher level, making it possible to interact with the Internet at any place and at any time. Lately, term "ubiquitous" is frequently used. The ubiquitous term describes a situation in which the previous constraints of time and space have been overcome and the boundaries between the real and digital worlds become blurred, and the computer becomes fully integrated into the environment of the individual.

The implementation of intelligent devices within the communication-controlling network created Internet of Things (IoT), with sensors and actuators seamlessly blend with our surroundings, and the information is used across different platforms in order to create a unified whole (Gubbi, Buyya, Marusic, & Palaniswami, 2013). In the literature the term "Internet of Things" refers also as the M2M (machine-to-machine), The Web of Things and the Industrial Internet. By the recent upgrade of devices with numerous wireless technologies, such as radio-frequency identification tags (RFID tags), built-in sensors and nodes drivers, IoT has gone one step further in the development, and become a new breakthrough technology that transforms the classic Internet in a brand new all-integrated Internet. The essence of M2M is based on the idea of small sensors that collect data and automatically transfer them to the server or the cloud, where the data can be easily analyzed. The implementation of RFID tags has influenced in the way of using intelligent devices and allows users to have access to all necessary information at any time. The reason for the implementation of IoT technology is fast feedback. Information obtained in real time and detailed insight into them, allows more efficient decision making. All received information is linked to big data, which will be in the near future very important for the areas such as manufacturing, healthcare, construction, public utilities, and so on. Due to the global warming of the Earth, which resulted in the occurrence of extreme climate change and frequent natural disasters, the need for surveillance and dams security control increase.

This paper describes how IoT can help in more accurate measurement of critical points, better management tools, and providing timely notification to the population of the flood wave.

The first heading gives short introduction to the Internet of Things. The second heading describes related literature. Third heading gives different definition, structure pros and cons of using IoT and application of the IoT. Application of the IoT on dams and possible improvement functionality dam using IoT are described in forth heading. The last two headings are conclusion and literature.

2. LITERATURE REVIEW

In (Gubbi, Buyya, Marusic, & Palaniswami, 2013), the authors state that the ubiquity, which was enabled by wireless sensor networks, has been implemented in all areas of life. With the implementation of new wireless technology such as RFID, IoT have improved the use of the Internet. This paper illustrates the idea of a global realization IoT using the central cloud. Authors described the implementation of the cloud application

Aneka (.NET platform based on a cloud), which is based on the interaction between private and public clouds.

In (Sun, Zhang, & Li, 2011), the authors write about the importance of dam safety. In this paper authors specifically deal with tailings dam issues. Tailings disposal is very important in mining. In recent years there has been a number of accidents on the tailings dams as well as in mines with such dams, what leaded to catastrophic consequences for people's lives. In order to improve dam safety, dam monitoring and alarms for alert are modernized with IoT and cloud, which can in real time 24/7 monitor the water level and deformities that occur in the dams. In this paper, the authors explain the system TDMPAS (The Tailings Dam Monitoring and Pre-alarm System) and its implementation. In (Castillejo, Martinez, Rodriguez-Molina, & Cuerva, 2013), the authors described the applications based on wireless sensor networks. The application is developed to implement the collected data in the smart spaces in order to obtain a better athletic performance. The system has been tested in high school to the real nodes and devices, and graphical interface gives possibility to the athletes, who use them, to improve their physical qualities with minimal changes in their training regime. Users can use a variety of devices (such as smart phones, smart watches or tablet) to allow easier monitoring of the whole body. In (Alcaraz, Roman, Najera, & Lopez, 2013), the authors state that the main task of remote substations to the central system is to provide sensitive information about the critical infrastructure such as power systems for power generation and transmission. Thanks to its features, such as simplicity, reliability and cost savings, wireless sensor networks have recently been applied in this area. Number of control and data acquisition systems, which use the Internet infrastructure to be hooked up to the sub-station in the function of time has been increased. It is very important to make a decision of use between complete isolation from the Internet or full integration with the Internet. Full integration with the Internet involves the use of IoT. This paper describes both options whereby analyzed security and infrastructure requirements that are appropriate for all TCP / IP protocols.

Many algorithms and positioning systems have been developed by using wireless sensor networks in indoor and outdoor environments. In order to achieve higher positioning accuracy, in most cases there is need for more equipment. Primary IoT services are based on positioning, so the precise location is a key problem. In (Chen, Xia, Huang, Bu, & Wang, 2013), the authors propose a specific scheme which can meet the needs of different devices for precise locating. The proposed solution consists of two phases:

- Phase dividing, in which a certain region is divided into smaller units with the help of the network grid.
- Phase detail, in which it is possible to implement an algorithm for better positioning, as described in this paper.

Test system is set up to verify the accuracy of the proposed schemes and to illustrate its capabilities and availability. In conclusion of this work can be seen that this scheme improves the retrieval facilities.

3. INTERNET OF THINGS. TERMS AND DEFINITIONS.

According to analysts and visionaries in technology, Internet of Things (IoT) is a network of physical objects connected via Internet. These objects embedded technology that allows interaction with the internal state of the object or the outside environment. If subject can perceive and communicate, then the way how decisions are made, where and who makes them change (IoT Overview, n.d.). IoT is part of the future Internet that includes billions of intelligent communication "things" or objects connected to the Internet (Internet Connected Objects or ICOs), which will have the ability to perceive, initiate and processing capabilities (Perera, et al., 2014). IoT is massive electronic equipment with interconnected large virtual networks, including RFID, sensors and actuators devices based on Internet connections (Lin, Hu, & Qui, 2013).

IoT is ubiquitous connections between things that everyday interest people, which provides connectivity anytime, anywhere and with anything (Barthwal, Misra, & Obaidat, 2013). In the past one-dimension bar code had a significant role in the supply chain and other business models. It was quickly overcome because it was a general identifier without specifications. Unlike the one-dimensional, two-dimensional bar code provides a larger set of data, but the problem is that a printed bar code is not possible to change. IoT is a concept that has a huge impact on business and society. The whole concept is still based on the capabilities and limitations of the technology identified as RFID. RFID is the successor to bar codes.

ARCHITECTURE OF IOT SYSTEM

The word "thing" in the concept of Internet of Things or the word "machine" in the M2M represents a physical object which identification or condition may be transmitted to the infrastructure that is connected to the

Internet. Almost everything what can be connected with sensor (cows in a field, a container on a cargo ship, air conditioning in the office, street lighting...) can become part of the Internet of Things.

The sensors are part of the things that collect or distribute information whether it is on location, altitude, speed, temperatures, brightness, motion, force, humidity, sugar levels, air quality, humidity, country, etc. Regardless of whether is it a communication device on a local or wide area, all IoT sensors need technology for transferring data to the outside world. There are number of available local short-range wireless technology. Such include RFID, NFC, Wi-Fi, Bluetooth, XBee, ZigBee, Z-Wave. In addition to wireless links also cable connections can be used, such as Home Plug, Home PNA, HomeGrid/G.hn and Lon Works. When it is necessary to use worldwide connection, it is possible to use mobile network (e.g. GSM, GPRS, 3G, LTE or WiMAX) and satellite links. New wireless networks such as ultra-narrowband (using the channel that almost have a flat signal) and the TV white-space (used for broadcasting services outside the local area) are specifically adapted and used for M2M. The architecture of IoT with all necessary elements is shown in next Figure.

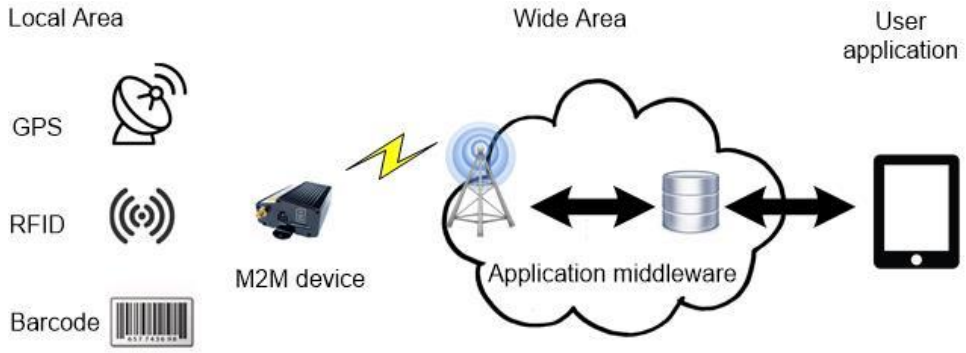

Figure 1 Structure of IoT

It is important to place the storage of all collected data. In the case of a large number of data, IoT will require massive, variable data warehouses which are mainly located in the cloud, unless it is not about some sensitive data which will be processed locally. Some types of M2M settings, such as a smart house or office, use a server that physical is on the same location as the devices and serve to collect and analyze data in real time or periodically.

Figure below presents a flow of data in the modern systems such as IoT.

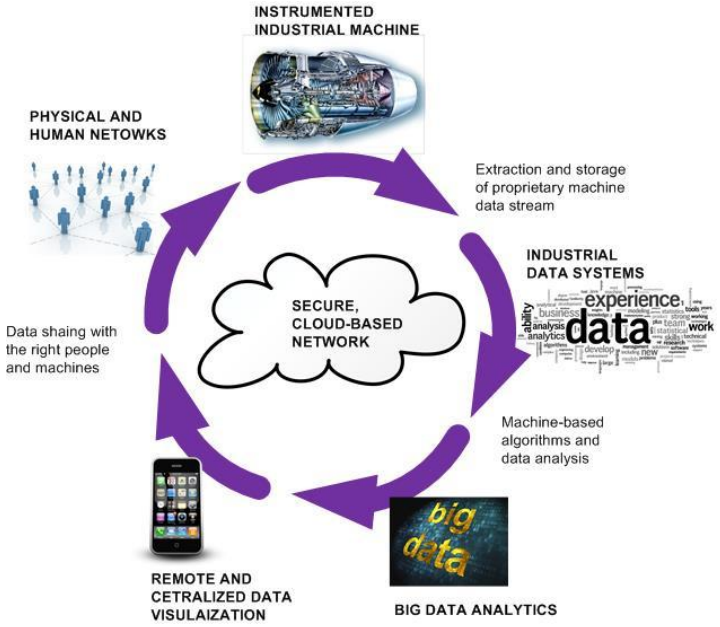

Figure 2 Secure network based on the cloud

BENEFITS OF USING IOT

Internet of Things is still in the early, developmental stage. In the coming period, it is expected that people will become more creative and will appear the new ideas of implementation new sensors. With the rise of creativity, Internet of Things industry will be faster developing. Experts predict that the implementation billions of connected devices, change the world where we live into the better world, so it will be less sick people who will be in life-threatening situations, because doctors will be on the time informed. Less aircraft failures and less fall down of planes, because planes will be electronic followed by the condition of the parts. Quality of wine will be better because they winemakers will be able to monitor the percentage of sugar in the grapes and know when is the ideal time for harvesting, etc. (Johnson, 2014)

Water, electricity and natural gas are among the most important resources. As population and standard of living growth, in the situation that was mentioned people need to use resources more efficiently.

Devices used in a household can be improved with the IOT, which would change the living environment and lifestyle. Improving devices, people will make smarter decisions that will enhance safety in the home, improve health conditions and make better use of resources.

Company Belkin has introduced a pilot program, which uses sensors in houses and with the help of various algorithms make scheme of using water, power and gas, and provide recommendations on how to use them rationally (The Internet of Things, n.d.). The technology provides a graphical display of accurate consumption of each device, enabling more rational consumption.

PROBLEMS IN USING IOT

The biggest observed problem using IoT is in the area of data protection (theft and abuse), and the other problem is identified in assigning IPv4 address to devices.

Application of Internet of Things is divided into two broad areas: Critical infrastructure (energy production and distribution, manufacturing, transport…) and identity infrastructure (personal medical devices, auto industry, home entertainment and control devices and retailing) (Internet of things summit, 2013). Possession of devices connected to the Internet opens the possibility hackers to remotely take control of the device. Critical infrastructure is an attractive target for national and industrial espionage. Things are connected to the Internet and in contact with highly sensitive personal data are interesting target for cyber criminals (identity theft, electronic fraud...). Every day, developing new methods that can be extremely effective in providing data: secure operating systems, applications that are installed in devices, flexible and simple monitoring system, new forms discovers and blocks active threats. With the development of IoT, more devices will be connected to the Internet, which would pose a greater risk of attack by hackers, and all devices will have to be monitored.

Robert Le Busque said that all things which have IP address should have specific security protocol and the policy of protection should be identical to policy which the company uses. Rawlson King said, today there are various versions of the OS for mobiles, for desktop computers, a large number of different devices and so on. He also said that similar thing for all these devices is the network, where all devices are connected. Network, which is a bottleneck, should be the most important thing where companies should implement theirs security (Lee, 2013).

A key part of the business is to protect communications. So far the security of communication was based on encryption methods. Using certificates in IoT encountering problems because certificates have limited validity period, after which they must be renewed. Another problem that arises the implementation of IoT is assigning IPv4 address to the devices. The network won't have enough number of free addresses to allocate all devices, unless move to IPv6 addresses. IPv4 is using modern equipment and modern operating system and has adequate security, opposed to IPv6, which still have to go through certain stages in the elimination of failure.

There is another side of the problem which is not related to the technology, and concerns of people. The implementation of automation will make people losing the habit of thinking and their brains will slowly dye. People will less move, because it won't have the urge to get up and everything will be customizable thanks to sensors. Reducing activities will lead to various health problems. The problem of privacy is possible to solve if legislatures write rules, that clearly define what the company can do with the data and what are the sanctions for violators.

APPLICATION OF IOT

Next figure shows the taxonomy of IoT, areas wherein is applied IoT.

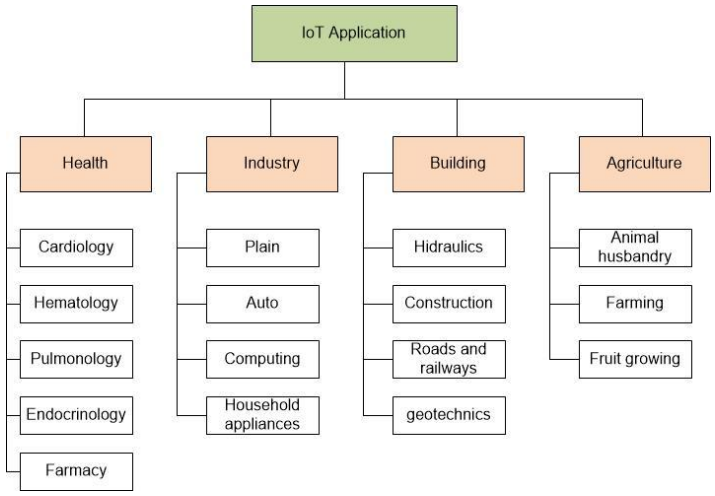

Figure 3 IoT taxonomy

A very important application of the IoT is in healthcare. Sensors are installed on the packages of pills that resemble one that should bring or take the pills at a certain time. The sensors are installed in artificial organs and keep statistics on the state of the organism. For instance, in England, cows are connected to the Internet in order to monitor their movements. In San Diego trash cans are connected to the Internet, so when the trash is fully loaded, the container sends the message to sanitation that should be emptied garbage (Johnson, 2014).

Interesting application of IoT may be seen in San Francisco and Los Angeles where the sensors are placed in the parking lots, and with the help of the application can be seen in the street where is a free parking place or the price of parking in the garage is formed based on the availability of parking and at any time there is 80% free space.

4. APPLICATION OF IOT IN DAMS

Area where IoT is already implemented is construction, hydrology - dams. In recent years there have been several failures of dams. Most of these unfortunate events led to enormous damage in terms of human life, property, environment and economic losses (Sun, Zhang, & Li, 2011).

The problems of instability of large dams and the possibility of failure can menace the safety of people and industrial property, and can leave consequences on the environment. Therefore, in recent years, great attention is paid to control the functioning of the measuring instruments on the dam and the dam itself. Special attention is paid to the protection of possible floods and flood waves.

DAM "PRVONEK"

Dam "Prvonek" is on the Banjska river, right tributary of the South Morava river. Partition space is located about 9 km from the mouth of the South Morava, at the site of the village Prvonek.

Dam "Prvonek" is a regional multi-purpose water management facility, which main purposes are: water supply, flood protection, improvement of low flows during periods of unfavorable hydrological conditions in the basin, as well as the production of electricity.

On dam Prvonek, meteorological observations are used to measure: precipitation, air temperature, humidity, solar, radiation, wind (speed and direction), depth and atmospheric pressure.

Hydrological observations are used to measure: water level in the reservoir, the level of ground water, discharge at the entrance to the reservoir, discharge at the outlet of the reservoir (measuring profile downstream from the dam) and water quality.

Equipment for monitoring water quality follow next parameters: temperature, pH value, electrical conductivity, redox potential, depth, turbidity and dissolved oxygen.

Hydrogeological observations: groundwater level in the field and groundwater level in the dam.

Observations in the body of the dam: pore pressures in the clay core, total pressures in the clay core and adverse effects of water in an injection gallery.

Flow in the outlet valve chambers foundation drain. Real-time (20 minutes) is secured by performing measurements of the flow: water supply, to waterfalls, towards the chute, to small aggregate shp (small hydro-power plant) and to a large aggregate shp (Divac, Milivojević, Pavić, & Jovičić, 2013).

IMPROVING THE DAM "PRVONEK" USING THE IOT

In the dams design and functionality important segment is related to dam safety, particularly in flood control and flood wave. The most important devices which are responsible for monitoring are probes for measuring the water level in the reservoir and piezometers for measuring groundwater levels. At all dams exists boreholes, in which devices measure water level. The devices can be configured in two ways: in graphical user interface or directly in the developer's code.

For implementation of sensor it is necessary to: measure the depth of the borehole, determine the range of measurement devices (0-10, 0-20, 0-40...), set the device into the borehole, measure the height of water column (the water level above the unit), the formula to calculate the elevation of the device and with the aid of the cable which is fixed to the device, the device connected to the data logger (which is connected to the data acquisition server). There are two types of sensors: ceramic and with vibrating wire. Ceramic sensors are the new generation and used for measuring the water level in the reservoir and it is done in the intake tower. In the instruction manual ceramic sensors receive basic parameters that are needed during installation. Devices with vibrating wire used calibration list. Calibration list is a set of parameters provided by the factory and each unit is different. In addition to the calibration data obtained from the list, it is necessary to read data (frequency) by means of the device. By using both types of data in the appropriate formula, formula gives the height of the water column.

Figure below shows the current structure of the data on dam "Prvonek".

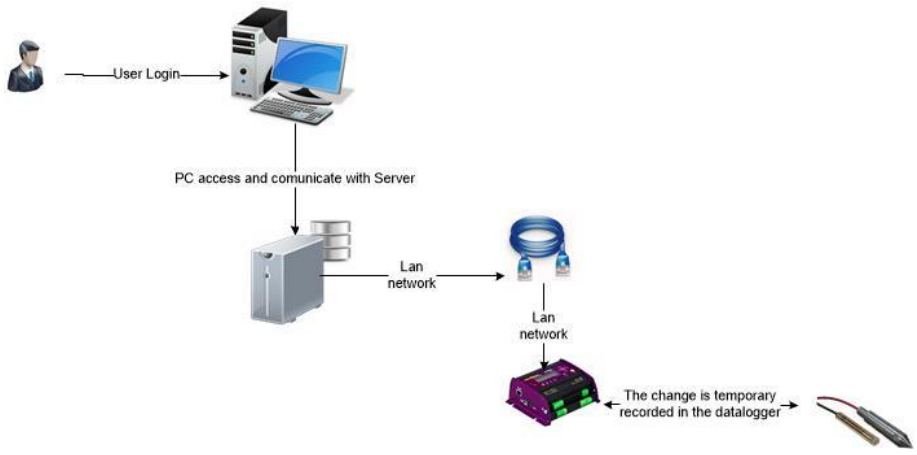

Figure 4 The structure of the data transfer from the probe to the end user

The present way of controlling the dams could be improved in several ways. The use of RFID sensors in devices would provide better evidence and better tracking of the device. It is necessary to mark each device with RFID tag where will be written device ID, year of manufacture, year of installation, calibration list that is data with calibration certificates, service and breakdowns.

It is an essential to install RFID readers in the borehole. The reader can read the ID of the device that is placed in the borehole and send signal to the operator, which is monitoring functionality of the device. This is

very important, because if there is a malfunction of a sensor, in his place may be moved other similar device that is already in use (if the company doesn't have a new device to change), but less important for the functioning of the whole system. The implementation of RFID tags allows employees fewer errors during operation, because the employee will be able easily to read the required data and can rarely replace calibration certificate. If RFID reader is installed in a workshop for repairing the device, it is possible to automatically record the date, length of service and type of failure that occurred. In holes can be installed sensors, which provide information - the depth of the probe or metal rings that register while placing the probe in the borehole. Incorporating RFID sensors in the borehole can be obtained from the specification of each borehole. The specification can include ID hole, deep hole, its location, date of last measurement and the measured value.

By placing sensors on the devices that need to be read manually, such as vertical, horizontal displacements or relative subsidence, allows worker easier reading. If technology is used to transfer data such as NFC, the employee can read data touching your computer at a specific measuring instrument.

In the body of the dam, which is located in the ground, it is impossible to receive a GPS signal, and also there isn't Internet connection. To have the device located (without the use of paper maps) and to allow direct data transfer from the device to the base it is necessary implementation of wireless Internet. By setting more wireless router to work in "repeat" mode (the mode that allows the expansion of the scope of coverage of a wireless network) the entire dam will have possibility to be covered by the Internet. The spread of the Internet on the dam allows direct transmission, processing and storage, and full implementation of the Internet of Things. By placing additional sensors at various locations in the dam, would allow the employee at any time to obtain a map with locations of all devices.

To end-user or operator is possible to implement smart ID cards. The cards can be used when entering the office to monitor the state of the system and logging software. In the body of the dam can be installed RFID sensors that were read smart cards of employees. The implementation of smart cards would allow automation of recording employees who read the data and the device on which the data is read. Automation of the process of reading and data transmission, and additional software development would allow the operator the current (real-time) overview of the changes at the dam. The software would show a graphic in a variety of colors and blinking functionality of the device and the changes that occur.

Figure below shows improved reading and structure data.

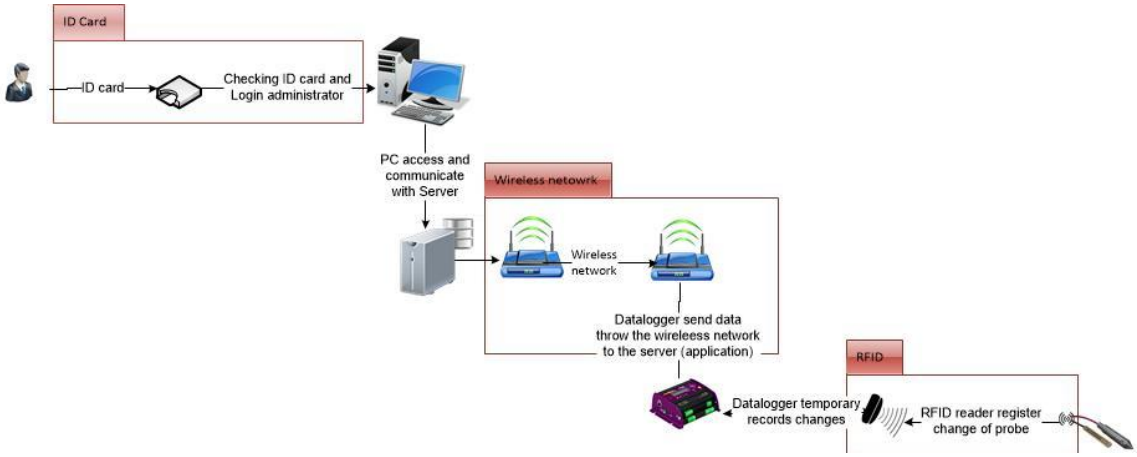

Figure 5 Improved structure reading and data transfer

5. CONCLUSION

Benefits and risks related to IoT will have a huge impact on individuals, organizations and governments in many countries. The use of smart devices is simplified, but the risk of use is high. Users have become aware of the opportunity provided by the Internet of Things, and their expectations for Internet services will change over time. Criteria for the purchase will be developed, and users will achieve greater power over providers of service and goods. M2M technology is growing rapidly and becoming part of a global economy, especially in areas such as auto industry, transports, logistics, energy, construction, health care and so on. Internet with the help of sensors allows each device in the environment to become smart. Soon the human environment will become an eco-system where the devices will use the OS and will be able to automatically connect to other devices and extend their knowledge and intelligence. The implementation of IoT brings better protect,

improves instrumentation, makes easier tracking of the history of instrument failures, improves operations and increases the safety of dams.

The next huge step is to connect the development of IoT data smart devices, services based on the Internet and existing databases. In the future, the field of application of the Internet of Things will continue to expand. People should pay more attention to the safety and protection from abuse of the collected data, and not just on the tags we use for marking. While RFID has a very important role in the IoT, RFID technology is only one kind of technology that is used to transmit data and for a short time will be overcome.

This paper describes term Internet of Things, architecture of IoT, benefits and problem of using IoT. It describes application IoT on dams in Serbia and given proposal of improving dam functionality and flood alarming.

In the future it will be taken further improvements in dams functionality and in better flood and flood wave control, and will be developed new IoT applications for other measuring devices.

REFERENCES

Alcaraz, C., Roman, R., Najera, P., & Lopez, J. (2013). Security of industrial sensor network-based remote substations in the context of the Internet of Things (Issue 3, Vol. 11, p. 1091−1104).

Barthwal, R., Misra, S., & Obaidat, M. (2013). Finding overlapping communities in a complex network of social linkages and Internet of things (Issue 3, Vol. 66, p. 1749-1772).

Castillejo, P., Martinez, J., Rodriguez-Molina, J., & Cuerva, A. (2013). Integration of wearable devices in a wireless sensor network for an e-health application (Issue 4, Vol. 20).

Chen, Z., Xia, F., Huang, T., Bu, F., & Wang, H. (2013). A localization method for the Internet of Things (3 issue, Vol. 63).

Divac, D., Milivojević, N., Pavić, M., & Jovičić, A. (2013). Brana „Prvonek“ - Objekti i oprema za osmatranje - projekat izvedenog objekta (Vol. 1, p. 1-3). Institut za vodoprivredu "Jaroslav Černi".

Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural elements, and future directions (Issue 7, Vol. 29, p. 1645-1660).

Internet of things summit. (2013, Oktobar). (Sans) Retrieved from http://www.sans.org/event/internet-of-things-summit

IoT Overview. (n.d.). (Cisco) Retrieved from Cisco: http://www.cisco.com/web/solutions/trends/iot/overview.html

Johnson, S. (2014, January). Internet things seen bonanza bay area businesses. (San Jose Mercury News) Retrieved from http://www.mercurynews.com/business/ci_24836116/internet-things-seen-bonanza-bay-area-businesses/

Lee, M. (2013, January). M2M and the Internet of Things how secure is it? (ZD Net) Retrieved from http://www.zdnet.com/m2m-and-the-internet-of-things-how-secure-is-it_p4-7000008389/

Lin, L., Hu, Q., & Qui, Y. (2013). Information Processing and Key Technology Based on Internet of Thing Architecture for Intelligent Refrigerator (Vols. 278-280, p. 2012-2015).

Perera, C., Zaslavsky, A., Liu, C., Compton, M., Christen, P., & Georgakopoulos, D. (2014). Sensor Search Techniques for Sensing as a Service Architecture for the Internet of Things (Issue 2, Vol. 14, p. 406-420).

Sun, E., Zhang, X., & Li, Z. (2011). The internet of things (IOT) and cloud computing (CC) based tailings dam monitoring and pre-alarm system in mines (Issue 4, Vol. 50, p. 811-815).

The Internet of Things. (n.d.). Retrieved from Belkin business: http://www.belkinbusiness.com/internet-things

IMPLEMENTING NFC SERVICE SECURITY – SE VS TEE VS HCE

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Abstract: *This document presents potential technologies for implementing security requirements of services that use Near Field Communication (NFC) technology. Depending on application design and its security requirements there are three possible alternatives for storing sensitive data and application code within NFC enabled mobile phone: secure element (SE), Trusted Execution Environment (TEE) and device's operating system memory - using Host Card Emulation (HCE) service. Paper provides comparative analysis of mentioned alternatives in terms of technical issues as well as business ones.*

Keywords*: NFC, Secure Element (SE), Trusted Execution Environment (TEE), Host Card Emulation (HCE)*

1. INTRODUCTION

Until recently, we had ID cards, driving licence, healthcare card, loyalty cards and all other cards in the form of paper documents. In time, all those paper cards transformed into plastic cards – some of those called "smart" (the ones with chip). Today we have new trend coming up – transforming those plastic cards into applications – "virtual smart cards"- residing on our mobile phone. That mobile phone has the ability to interact with its surrounding using Near Field Communication (NFC) technology – wireless standard based on the same principles as RFID, that allows communication between two devices within maximum distance of 10 cm. NFC allows user to exchange the data from "virtual smart card" on the phone with reader (e.g. POS terminal) in contactless fashion. All he has to do is to "tap".

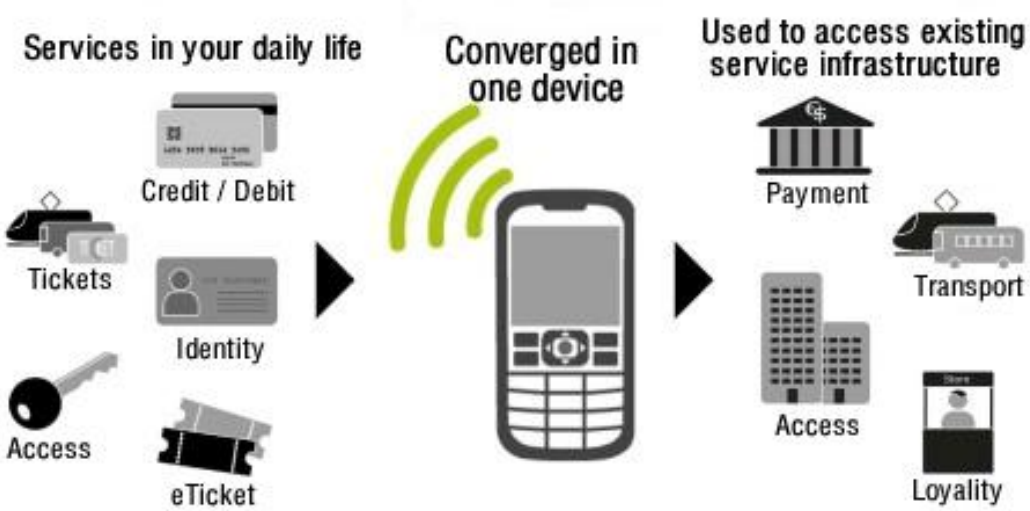

Figure 1: Usage of NFC enabled smart phone (Giesecke & Devrient, 2014)

By using NFC mobile phone, one could tap his phone to pay the bill, open the door of his home or office, use public transportation or send parking ticket. Use cases are numerous. However, in order to achieve that, many open questions must be resolved. Many of those questions are related to security. For an example, if NFC payment service should be implemented, where those sensitive personalized data and applications could be stored, in order to achieve the same security level as with classic payment smart-card (such as Visa or MasterCard)? Could it be in memory of operating system or in some dedicated hardware that will provide tamper-resistant environment? How any of these solutions should be implemented and what are the pros & cons of each? Following aims to give preview of possible answers to this security related questions.

2. SECURE ELEMENT (SE)

A secure element (SE) is a tamper-resistant platform (typically a one chip secure microcontroller) capable of securely hosting applications and their confidential and cryptographic data (e.g. key management) in accordance with the rules and security requirements set forth by a set of well-identified trusted authorities (GlobalPlatform, 2014). To put it more simple – SE is a smart cart in mobile phone (Lepojevic, 2012). As such, SE provides the highest level of security for applications residing on it (SE level of security is the same as security level of classic smart cards).

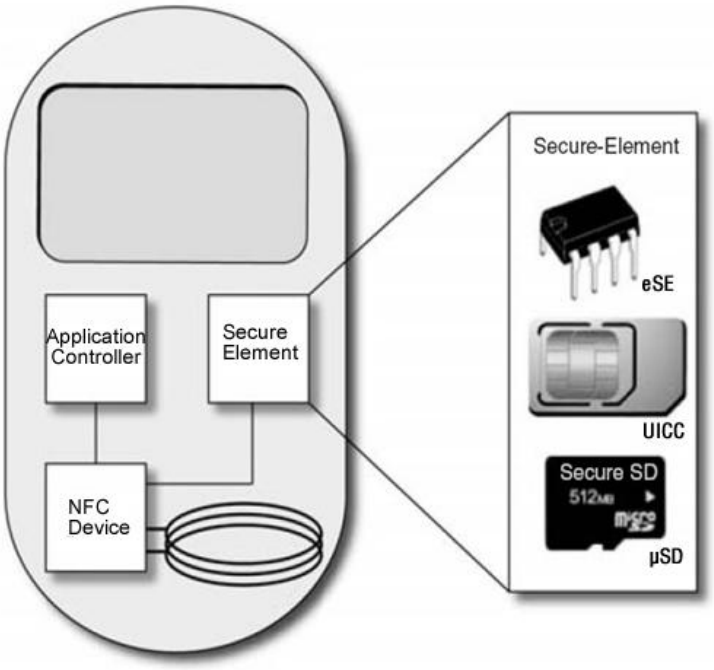

Figure 2: Secure element form factors (Finkenzeller, 2010)

There are three different form factors of SE: Universal Integrated Circuit Card (UICC), embedded SE (eSE) and microSD. UICC is advanced type of SIM card. eSE is smart card soldered to device's main board. Third is also smart card chip in form factor of microSD. While the UICC and microSD are removable, eSE is not (part of mobile phone hardware). All SE form factors are complying to the GlobalPlatform and EMV standards (Lepojevic, 2012).

Each form factor links to a different business implementation and satisfies a different market need. While UICC, as advanced version of SIM card, is controlled by the Mobile Network Operator (MNO), eSE, as a part of mobile phone, is being controlled by mobile phone manufacturer. In order for service provider (SP) to use UICC to host its application, SP must make business agreement with MNO. In the case of eSE, agreement must be made with mobile phone manufacturer. On the other hand, when microSD is about, SPs need to make arrangements with each other (to share the space on microSD) in order not to force user to have multiple microSD cards - for each NFC service. To reach acceptable agreement between any of these parties happened to be not so easy in practise, because each party wanted to hold favourable business position. That is why these agreements weren't achievable easy and, despite high security and standardization of the SE, it hasn't reached mass market so far.

3. TRUSTED EXECUTION ENVIRONMENT (TEE)

The TEE is a separate execution environment that runs alongside the mobile device's OS (Rich OS[1]) and provides security services to that rich environment. The TEE offers an execution space that provides a higher level of security than a Rich OS; though not as secure as a secure element, the security offered by the TEE is sufficient for most applications. In this way, the TEE delivers a balance allowing for greater security than a Rich OS environment with considerably lower cost than an SE (Global Platform, 2011).

TEE is secure area that resides in the main device processor (CPU), running its own operating system separated from device Rich OS, ensuring that data is stored, processed and protected in a trusted environment. As shown in the Figure 3, TEE provides safe execution of authorized security software - "trusted applications". It also enforces protection, confidentiality, integrity and access rights of the resources and data belonging to those trusted applications (Global Platform, 2014). Inside TEE, each trusted applications is independent from the others and one trusted application can not access trusted resources from another trusted application – which enables secure storing of applications of many different service providers.

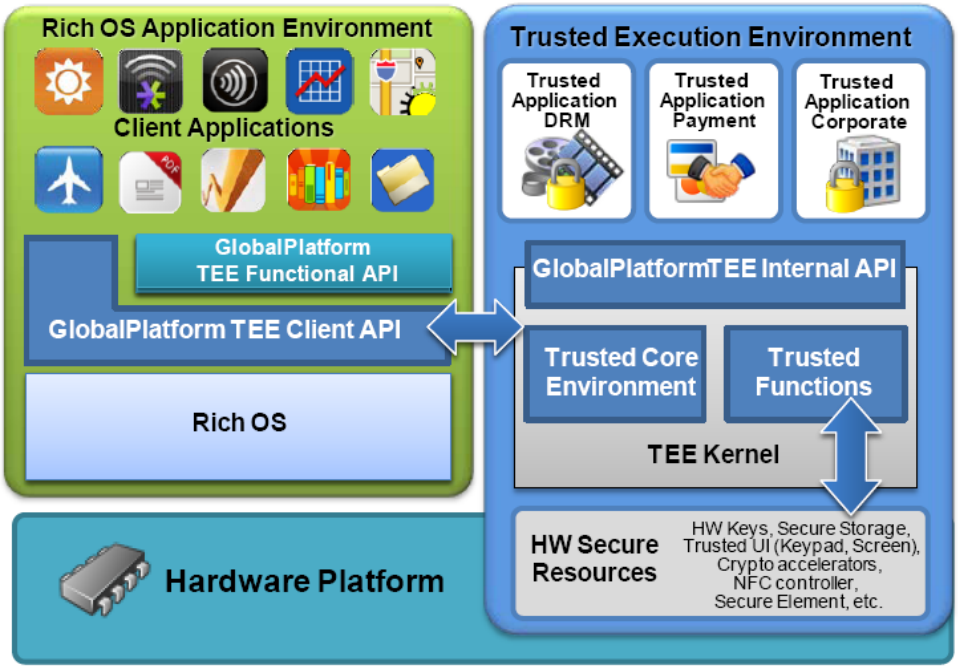

Figure 3: Trusted Execution Environment (Global Platform, 2011*)*

TEE provides layer of security between device OS (low security level) and SE (high security level). Although some NFC services such as payment or identification require high level of security (only provided by SE), there are applications that do not need to fulfil highest security standards, requiring, at the same time, better user experience and performance that resource-limited SE can't provide. That is the peace of puzzle where TEE fits in, as a compromise between Rich OS performance and SE security (Global Platform, 2011).

It is important to note that TEE standardization is still in progress.

4. HOST CARD EMULATION (HCE)

Android's release 4.4., so-called "KitKat", brought to life Host Card Emulation concept[2]. What is HCE? NFC device can operate in 3 modes: reader/writer mode, peer-to-peer mode and card emulation mode (CE). In first two modes NFC controller routes data to the host CPU (device OS), while when in card emulation mode data is routed towards SE. Android KitKat changed this – allowing commands in card emulation mode to be routed towards HCE service in CPU (Janssen & Zandstra, 2014). HCE service emulates contactless smart card or SE, allowing user's device to act as smart card from the contactless reader perspective, without presence of actual smart card or SE (Consult Hyperion, 2013).

[1] Rich OS refers (in Global Platform terminology) to operating system of mobile device, which is considered to be untrusted and vulnerable to attacks.

[2] HCE was already implemented by RIM's Blackberry in 2011. But HCE is often referred as Android 4.4 feature, because Android dominates smart-phone market.

Although Android 4.4 changes the default routing behaviour in CE mode, it doesn't prevent routing to SE in CE mode (Figure 3). Routing is based on application identifier (AID). When user taps his device to contactless terminal, terminal needs to "say" which application it wants to "talk to" – that is AID (Janssen & Zandstra, 2014; Android Developer, 2014). When this information reaches device's NFC controller, it looks for that AID in its routing table. If AID is found in NFC controller routing table communication shell be routed to the SE – if not, communication flows by default to the appropriate HCE service in the device's OS.

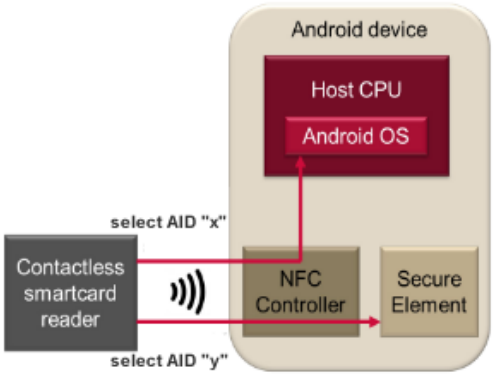

Figure 4: Android 4.4 routing based on AID
and NFC controller routing table (Janssen & Zandstra, 2014)

From the point of view of service provider – HCE looks quite good. No need for exhausting negotiation with MNO or mobile phone manufacturer, aimed at finding appropriate business model for using SE. No profit sharing. On the other hand, HCE has many functional drawbacks compared to SE (SimAlliance, 2014):

- Low power mode (no function when battery runs out)
- Roaming and "no data connectivity" scenario (no access to cloud)
- Depending on connection speed

When it comes down to HCE security – many issues arise. Most of those regarding the case of Android "rooting"[3]. If Android is routed, attacker could access all the informations stored in the applications, including sensitive informations such as payment credentials. When "pure" HCE is about, there is no secure area for storing sensitive data, that could not be affected by rooting. Mitigating HCE related risks can be done in two different ways (Janssen & Zandstra, 2014):

- Provide more secure location for storing sensitive data
- Apply security mechanisms to make existing location more secure

In order to provide more secure location for sensitive data, storage and processing of sensitive data could be done in the "cloud". Fundamental issue, when it comes to the "cloud security services", is how to enable handset to securely identify itself to the cloud. This could be resolved by requiring user interaction for accessing the cloud, which would in turn negatively impact the user experience. Also, accessing the cloud poses functional question regarding need for constant and quick connection (e.g. according to the MasterCard standards mobile payment transaction must be completed within narrow time limit – up to 400ms for MasterCard PayPass M/Chip or 170ms for PayPass magstripe (MasterCard, 2013)), something that can not be guaranteed.

Second way to mitigate HCE risks is about applying security mechanisms. Tokenisation is one of those. Each time HCE service access the cloud, a number of tokens is issued to that HCE service. Token is "limited version of security information" (Consult Hyperion, 2013) that is valid for specific period of time (one hour, one day) or limited to specific number of transactions. Tokenisation partly solves problem with constant need for connection to the cloud. Besides tokenization, mechanisms that can mitigate HCE risks are user and hardware verification - based on "what user knows" (e.g. PIN code) , "what user has" (e.g. sticker) and "what user is" (biometrics like fingerprint scan) – as well as Android checks prior transaction (check if user has root privileges).

[3] Android "rooting" is the process of allowing users of smart phones, tablets, and other devices running the Android mobile operating system to attain privileged control (known as "root access") within Android's sub-system.

5. CONCLUSION

Each of presented security solutions alternatives, when NFC services are about, has it's pros & cons. Which security implementation to use for specific NFC service, depends on that service design and requirements. How secure should it be? Does it contain very sensitive data which, if compromised, can produce severe damage for the user? How important is user-experience and service performance? What is the estimation of extra costs, and is it affordable? Can we (as a service provider) do this on our own, or we need to form strategic partnership with other stakeholders (MNOs, smart card or mobile device manufacturers, security solution providers, etc)? These are just some of many question that must be taken into account in order to make appropriate choice when it comes to NFC service security.

Table 1: Comparative analysis of NFC service security alternatives (based on GlobalPlatform, 2011)

	SE	TEE	HCE
Rich resources	*no (limited)*	*yes*	*yes*
Level of security	*high*	*middle*	*low*
Performance	*low*	*high*	*high*
Need (number of apps that need it)	*small*	*high*	*high*
User Interface	*none or very limited*	*middle rich*	*very rich*
Processing speed	*low*	*high*	*high*
Extra costs	*high*	*low*	*low or none*

From the technical point of view SE as an alternative has many advantages. It is mature technology, that provides high level of security. It is fully standardised and supported by the industry. Only technical drawback is it's limited resources and low performance. From the business point of view, SE is complicated, because service providers need to make agreements with other actors in order to use and share space on the SE. It always comes down to question of ownership of the SE. The one who owns it has monopoly role in that business case.

HCE is solution for business drawbacks of SE alternative. It is "no secure element" – NoSE (Consult Hyperion, 2013) solution. Although it has great added value for SPs that can accept a reduced level of security in exchange for an improvement of other factors such as time to market, development costs and the need to cooperate with other parties, HCE has serious lacks when security is about. HCE can not be used for NFC services that require high level of security (such as open-loop payments, identification, access control). It should be perceived as more-simple-but-less-secure solution, intended to accelerate adoption of NFC services (Janssen & Zandstra, 2014; SimAlliance, 2014).

TEE is alternative "in the middle" on security scale. It provides much better security environment than HCE, with much lower cost than SE. Besides, it provides much better user experience and performance than SE. Main drawback of TEE is it's not yet accomplished standardization process. However, TEE must be taken into account as a promising security solution alternative.

It is important to note that SE, TEE and HCE are not mutually exclusive. On the contrary. These security solutions can and should be used to complement each other.

REFERENCES

Android Developers. (2014). *Host-based Card Emulation*. Retrieved on March 23, 2014, from http://developer.android.com/guide/topics/connectivity/nfc/hce.html

Consult Hyperion. (2013). *Host card emulation – Why it matters*. Retrieved on March 23, 2014, from http://www.chyp.com/assets/uploads/Documents/2013/11/hce.pdf

Finkenzeller K. (2010). *RFID HANDBOOK : Fundamentals and applications in contactless smart cards, radio frequency identification and near field communication*. 3.rd ed., John Wiley & Sons Ltd.

Giesecke& Devrient. (2014). NFC: *Secure transactions via mobile phone*, Retrieved on May 01, 2014 from http://www.gi-de.com/en/trends_and_insights/nfc_mobile_phones/nfc-mobile-phones.jsp

GlobalPlatform. (2011).*Trusted Execution Environment: Delivering Enhanced Security at a lower cost to the mobile market – White paper*. Retrieved on April 17, 2014, from http://www.globalplatform.org/documents/GlobalPlatform_TEE_White_Paper_Feb2011.pdf

GlobalPlatform. (2014). *Secure Element Access Control v1.0.20*. Retrieved on April 21, 2014, from http://www.globalplatform.org/specifications/review/GPD_SE_Access_Control_v1.0.20.pdf

Janssen T., Zandstra M. (2014). *HCE security implications – Analyzing security aspects of HCE*. Retrieved on April 17, 2014, from http://www.ul-ts.com/downloads/whitepapers/finish/6-whitepapers/289-hce-security-implications

Lepojevic B. (2012). Management of secure element in systems based on NFC technology. (M. Sc. thesis), Faculty of organizational sciences, University of Belgrade, Serbia

MasterCard. (2013). *Mobile MasterCard PayPass Application Note #7*. Retrieved on May 03, 2014 from http://www.mastercard-mobilepartner.com/pdf/MMPP_AplicationNote7_Performance_Requirement_v10.pdf

MasterCard. (2014). *MasterCard to Use Host Card Emulation (HCE) for NFC-Based Mobile Payments*. Retrieved on April 21, 2014, from http://newsroom.mastercard.com/press-releases/mastercard-to-use-host-card-emulation-hce-for-nfc-based-mobile-payments/

SIM Alliance. (2014). Secure Element Deployment & Host Card Emulation v 1.0. Retrieved on March 08, 2014, fromhttp://www.simalliance.org/en?t=/documentManager/sfdoc.file.supply&fileID=1398960008176

APPLICATION OF RFID TECHNOLOGY IN WAREHOUSE MANAGEMENT

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Abstract: *In recent years, RFID technology achieves expansion of commercial use in logistics, primarily because of the possibility of use in all areas - transport, transshipment, warehousing, and distribution. The implementation of RFID technology allows companies to achieve efficient warehousing, with immediate access to all of its details. RFID technology (Radio Frequency Identification) has become an important "means of labor" that not only captures the data in real time, but also directs the business, establishing full control over the warehouse. This paper presents examples of successfully completed implementation of RFID technology in logistics activities in retail companies. The basic operation principles of this technology are presented. The key segment of this paper is dedicated to creation of a model of RFID technology application, based on improving warehousing in analyzed company. Along with the description of integration process, in the above mentioned model is also presented integration with existing corporate information system. Last segment of paper sublimates advantages of RFID technologies and potential limitations.*

Keywords*: RFID technology, warehousing, logistics in trade, retail, supply chains.*

1. INTRODUCTION

The development of logistics processes is conditioned by the development of technology. In constant striving for faster and easier flow of information and the product distribution, logistics is an area of business that has recognized the possibility of using RFID technology. RFID is not just about to promote business and increase productivity, but also significantly reduces the cost, creating space for strategic investments and focus on the primary goals of the company.

Changes in the global economy significantly redefined the way business enterprises. One of the major changes is that the main activity of warehousing in the supply chain is no longer limited to the storage of large amounts of stock. Supply chains have become more dynamic, customers ordered more frequently and in smaller quantities than before. All of these require smaller warehouse and greater rotation of stock *(Ramírez D., Ramírez L., Jimenez, Miguel, Castro and Maldonado, 2013, June).*

After a concise description of the RFID technology, the main components and system characteristics, paper presents examples of the successful implementation of RFID technology in logistics activities of trading companies. Application model presented in this paper is based on the improvement of warehousing in selected business entities. In the model, the emphasis is on the integration of RFID technology with existing customer information system. Increase efficiency, automation and optimization of warehousing are some of the most important benefits that are expected by adoption of the proposed model. Also, the paper specified potential limitations and disadvantages of the RFID technology applications.

2. RFID TECHNOLOGY

RFID is an automatic identification technology, which means a system for wireless reading and data transmission via radio waves *(Aysegul, Nabil and Stéphane, 2010).* RFID enables identification from a distance unlike earlier bar-code technology, it does so without the need for direct line of sight *(Kaur, Sandhu M, Mohan and Sandhu P, 2011).* RFID is an effective wireless technology for managing and monitoring of goods in the supply chain.

In addition to RFID tags and RFID readers, in each RFID system must be RFID central computer-host (Figure 1).

Figure 1: Basic components of RFID system

RFID tags are placed on objects that need to be identified. RFID readers are devices with an antenna, which one of the roles is scanning of tags. They verify the tag, read and convert the radio waves emitted from the tag into a form suitable for further processing. The central computer - host and software (which collects data and connects tags and readers into a single system) is a very important component of RFID systems.

In RFID system, it is necessary to establish a connection between the RFID reader and the computer system in which collected informations are stored and updated. This connection can be made through Middleware and Edgeware platform. Middleware is a software platform that connects the RFID reader to the computer system, enabling the exchange of data between the RFID reader and business information systems, such as WMS Warehouse Management System and ERP - Enterprise Resource Planning. Middleware filter, format, and translates the data registered by the RFID reader, forwards them to the computer, combining the work of a number of different applications that monitor objects. Edgeware platform, which includes software and hardware enables business systems to provide the necessary control and management for interface devices such as RFID readers, sensors and hand-held terminals, but also allows the collection, processing and cooperation with other applications and systems.

According to the type of power supply, RFID tags are classified into the following groups: active, passive and semi-passive *(El Khadar, Boulmalf, Harroud and Elkoutbi, 2011).* Active have their own power, a battery with a limited lifespan, which powers the microchip and broadcast the signal to the reader. They are more expensive and bigger, but have a greater range of signal transmission. Passive do not have their own power, the energy is obtained through the RF emissions from the readers. The main drawback is the lower range of signal processing, data storage capacity and lower resistance to electromagnetic noise in the environment. Their advantage is low cost and durability, which allows large-scale use. Semi-passive has a battery that powers the chip, but to communicate use energy of reader. These tags have a good performance in terms of capacity, range and service life.

3. ANALYSIS USING RFID TECHNOLOGY IN BUSINESS

Survey indicates the possibility of using RFID technology in nearly all aspects of life and business, ranging from traffic through commodity flows, medicine, pharmacology, military, aerospace industry to electronic documents and labeling of living beings.

Successful implementation of RFID technology, or pilot project implementation, is seen through the examples of the most dominant U.S. and European retailers, which are considered to be the pioneers of the RFID technology application in their operations. Wal-Mart (the leading retail chain in the world), in mid-2003 asked its 100 largest suppliers to place RFID tags on pallets, which were delivered in order to improve operational efficiency, giving them a deadline for implementation, in the beginning of year 2005. According to power on market and representation, the number of people it employs in stores worldwide, market share which it has realized and the number of suppliers with whom it work with, claimed request was attainable. The use of bar-code technology expanded greatly as a technique for labeling products on the world market, only when the Wal-Mart asked its suppliers that all shipments are marked with bar-code passwords. History repeated itself, and in 2003, when Wal-Mart sent a request, but this time related to RFID technology, which once again proved its supremacy and visionary role. Full effect of RFID Technology Company Wal-Mart considered to achieve by highlighting individual products with RFID tags, however suppliers were not ready for this step from the start, and the RFID technology primarily used for marking of containers and packages. In the period from mid-February to mid-September 2005, 24 stores (12 RFID test stores and 12 control stores) representing all Wal-Mart format, followed by the OOS (Out of Stock) on daily level. Results, observed from several perspectives, showed that RFID makes the difference between test and control stores. In test stores, which were RFID-oriented, OOS reduction of 26% was realized compared to those who were not oriented RFID *(Hardgrave, Waller, Walton and Miller, 2007, June).* Just one year later, Wal-Mart has announced that from January, 2006 this request will be extended to 200 more suppliers.

The largest retailer in the UK, the company Tesco, has announced that in early 2004 will mark non-food products with RFID tags in its distribution centers and that will follow up them to retail stores. Tesco expects

that the deadline for the implementation of RFID technology for all suppliers will be in 2007 *(Bob, 2003, November).*

Marks&Spencer, the famous retail company in the UK, firstly applied in 2004 labeling of certain products with RFID tags in a number of shops (120 shops) in its supply chain. Afterwards, the company has spread application of RFID technology on about 10.000 items in 550 stores, to about a year and a half ago, the company management decided to extend the application of RFID technologies to an assortment of household equipment. Also, Marks&Spencer is planning further improvements in terms of replacing the system with a newer RFID technology, which includes EPC Gen 2 Read-Write tags and readers *(Bob, 2013, March).* By applying the mentioned technologies, the company's management expects to record even more impressive results in terms of a faster return on investment. The company started the implementation of Gen 2 tags in the spring of 2012. Full implementation is expected by the spring of 2014. Many trade organizations in the UK, including House of Fraser, Selfridges and Woolworths have also recently participated in the experiments with RFID technology.

Retail chain Metro went further than any other company with the implementation of RFID technology in Europe. In order to fully utilize the potential of RFID logistics, Metro Group has decided to implement in the retail and wholesale establishments, of which almost all major formats in Germany are equipped with RFID portals. In addition, in 2003, after years of research in collaboration with IT companies like SAP, Intel, IBM and others, German Metro (member of Metro Group) in April 2003, in Rheinberg, opened the first Extra Future Store *(Bob, 2004, April)*, a hypermarket designed for testing over 20 advanced technologies, and most of all the possibilities and advantages of RFID technology, both for the company and for the end customer.

A large number of authors who are engaged in the study of RFID technology are interested in eliminating the problem of supply chain which RFID technology has the ability to resolve, such as inaccurate inventories *(Kang and Gershwin, 2005; Atali, Lee and Özer, 2006; Fleisch and Tellkamp, 2005).* In order to assess the impact of RFID technology in the supply chain system, four approaches were investigated: analytical *(Lee and Özer, 2007; Rekik, Sahin and Dallery, 2008),* simulation, case studies and experiments *(Lefebvre L., Lefebvre E., Bendavid, Wamba and Boeck, 2006, January; Wamba, Lefebvre L. and Lefebvre E., 2007).*

Some carried out studies considered the sustainability of logistics systems through the use of knowledge based systems (KBS - Knowledge Based Systems). For this reason, in many logistic facilities, particularly in warehouses, intelligent systems are integrated with RFID technology. *Chow, Choy and Lee (2007*) presented aknowledge based system applications in real time, incorporating RFID and mobile technologies to collect information in a dynamic way through the multi-agent approach. *Chow, Choy, Lee and Lau (2006)* presented a RFID-based system resource management using RFID technology and artificial intelligence for the collection of dynamic and static logistic data.

4. MODEL FOR THE APPLICATION OF RFID TECHNOLOGY IN WAREHOUSE MANAGEMENT

4.1. Description of the business entity

Business entity that was analyzed is the company Centro Stampa Holding Ltd., one of the five largest private companies in Serbia, with over 3.500 employees. Within a holding exist three business companies:

- Retail company - a chain of retail outlets (Stampa sistem, Futura plus, Moj kiosk), with over 1.100 retail outlets.
- Wholesale Company (Centrosinergija) - distribution of top ups, newspaper category management.
- Logistic Company (Centrologistika) - the provision of logistics services to network of retail outlets within the retail companies, as well as external customers (3rd part logistics provider).

A wide range of activities within the Holding company requires the existence of a large number of complex processes in which there is space for integration and implementation of new technologies in order to achieve business improvement.

Very important part in the business of retail stores is the timely and accurate delivery of goods. Considering that timely and accurate delivery is directly determined by optimizing processes within the warehousing, which are under the jurisdiction of the said logistics company, the company pays a lot of attention to their analysis in order to find and implement possible improvements. In this paper, the focus is on process improvement warehousing, through the use of RFID technology.

4.2. Description of the warehouse operations process with the applied RFID technology

Logistics is a business function that requires constant technological innovation and improvement. One of the reasons for the application of RFID technology is realised cost saving (RFID technology achieves the greatest savings in logistics costs).

It is important to note that the introduction of RFID technology in the retail SCM (Supply Chain Management), recognize three phases:

- Pallet Tagging - labelling of containers and/or pallets,
- Case Tagging - labelling of boxes (or smaller packages that are on pallets), and
- Item Tagging - labelling of individual products.

In the described model, the introduction of RFID technology in warehouse management is envisaged, through marking and identification of transport packaging (boxes) and pallets. Use of RFID technology in warehouse management provides control of the goods from the entrance to the exit from the warehouse. Description of all processes of warehousing with the use of RFID technology is shown below.

Receipt of goods
Based on the input documents (invoices/receipts), the goods receipt is created in RFID technology. Each transport package and pallet is assigned with a unique mark, printed in the form of label with the help of RFID printers, which encode RFID tags on the label. Information comes to the RFID printer through software or wireless network. RFID labels that are positioned on the surface of transport package (palett), contains a unique ID number, and other necessary information (name, date of receipt, quantity, expiry date, etc.). When warehouseman using handheld RFID reader scans the labels affixed to the pallet, the pallet gets its own unique identification number in the system.

Palletizing goods
Pallet positions where the goods will be stored are designated by RFID tags as well. RFID application determines the position where the certain pallet will be stored. By reading the label on a pallet, RFID application assigns appropriate storage place (optimal position), conditioned by the article type.

Warehousing and storage
Storekeeper stored goods placing it at a defined location. Upon completion of the above mentioned activity, storekeeper confirms the end of receiving process with the help of a handheld RFID reader. In this way, it is confirmed to the system that goods are received and stored in the appropriate place.

Commissioning/picking goods
Upon receiving and confirmation of the Purchase Orders, entering in the RFID application is done, based on which orders are generated for picking up the goods. An employee responsible for the receipts carries out the distribution of receipts that needs to be implemented by warehousemen. Created orders are displayed on the handheld RFID reader that uses warehousemen.

Shipping goods
Warehousemen drags goods in the dispatch area, according to the direction of macro-or micro-distribution lines. Upon completion of the above mentioned activity, warehouse confirms the end of the order by the handheld RFID reader.

Inventory Tracking
Tracking and managing of inventory levels is done with the help of RFID technology. When the minimum of predefined values is reached, RFID application automatically creates an account for the transfer of the optimal quantity of goods with the necessary commission.

RFID enables the development of partnerships between retailers and suppliers on the highest level. The advantages that this form of partnership achieves are at the same time imperative for its conclusion. High level of mutual trust is required in order to be able to implement inventory management by suppliers - Vendor Managed Inventory. It is expected that the high level of development of relations in which the supplier decides on the appropriate level of stock in the retail store, to an even higher level when tagging of individual products RFID tags is carried out.

4.3. Integration of RFID technology with information system of monitored company

The scheme given below (Figure 2) shows the existing Holding information system, upgraded with segment related to the integration of RFID technology.

Description of Information system:

- ASW - integrated information system (ERP - Enterprise Resource Planning System) which is a comprehensive solution for business process management and enterprise resource management. It is structured in a modular way thereby achieving flexibility and adaptation to different needs of users.
- WMS (Warehouse Management System) - enables the management of all processes in the warehouse (receiving, storage, picking, shipping of goods). Storage is organized based on FIFO (First In - First Out) or FEFO (First Expired - First Out) principle, respecting all the standards for monitoring traceability of goods and fulfillment of existing standards. It is designed for logistics and distribution companies and retail chains.
- Pantheon Professional - business information system for fast growing companies. In the present IS the company, is designed for carrying business segment.
- Jitex - a software solution designed for business operations related to the commodity group of newspapers.
- Oracle iAS (Oracle Application Server) - application server, which allows the integration of WMS with RFID reader.

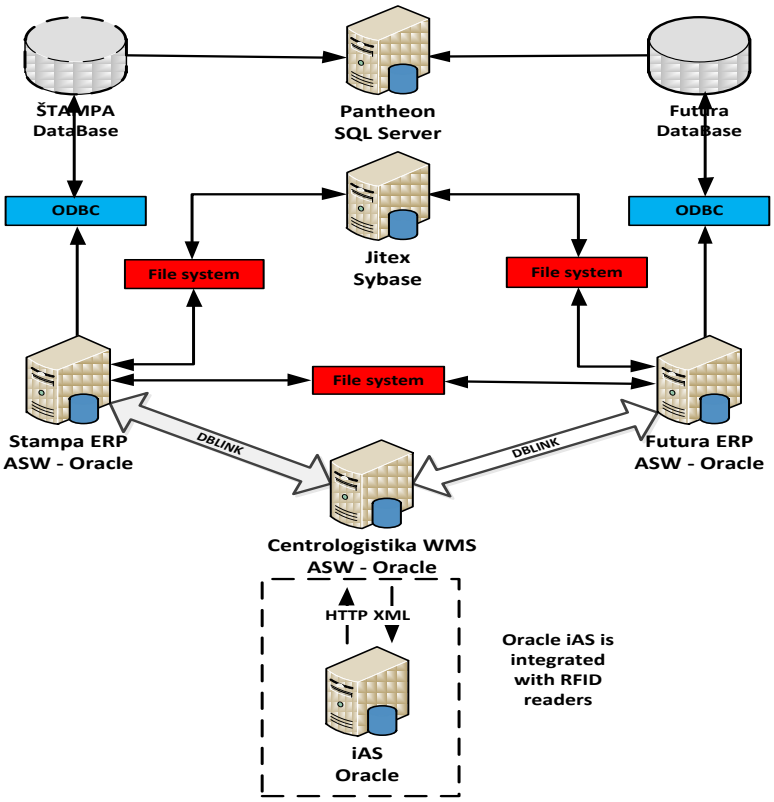

Figure 2: Holding Information System

Integration model of RFID technology in the IS observed Holding (Figure 3), is shown below:

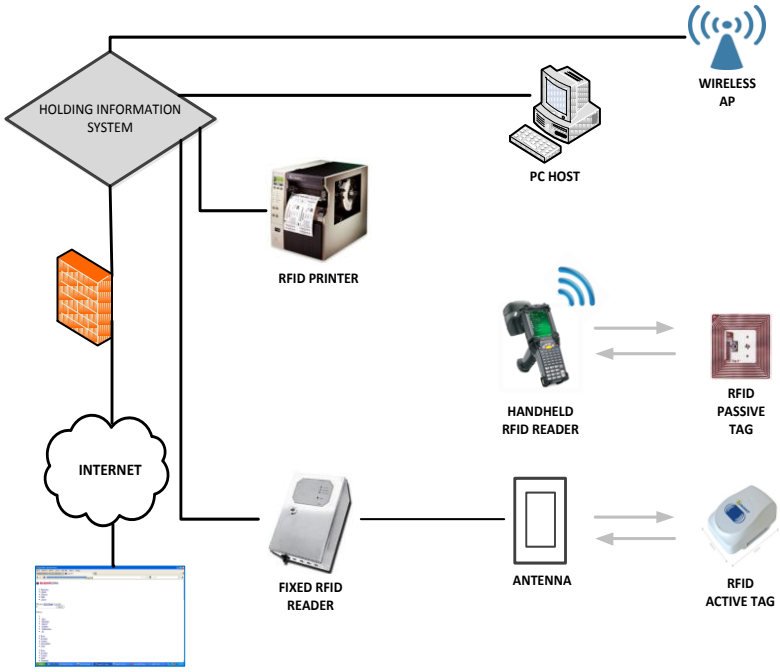

Figure 3: Integration Model

5. ADVANTAGES AND DISADVANTAGES OF RFID TECHNOLOGY APPLICATION

The advantages of using RFID technology are the main reason why organizations are examining the potential of RFID technology and considering its adoption *(Waters, 2013)*. Literature describes the direct benefits, including cost savings and the progress in time needed for the delivery and indirect benefits, such as the establishment of new business processes *(Bhattacharya, Chu and Mullen, 2007, November).* The advantages of using RFID technology are conditioned by the ability to provide timely information, where the data exchange between the object and the system is realized automatically.

The primary advantages of RFID technology are: process automation, which leads to a reduction in labor costs, creating new process in which products have greater visibility, providing innovative services and improving the quality of the information obtained, and thus ability to make better decisions *(Sellitto, Burgess and Hawking, 2007).* Optimization of the process supported by RFID technology is also important *(Wamba, 2012).* Additional advantages of RFID technology include increasing accuracy, reducing inventory levels and OOS *(Lee and Özer, 2007),* the establishment of closer relations with business partners, the ability to track goods throughout the supply chain and efficient shipping and receiving of goods *(Vijayaraman, Osyk and Chavada, 2008).*

Using RFID technology, the described model is expected to increase efficiency, as well as the automation and optimization of warehousing. Facilitated quantity and quality control during receipt and dispatch of goods provides constant access to inventory in real time. By introducing optimal storage and automatic respect of FIFO or FEFO principles, better planning of availability and stock is achieved. Better layout organization of warehouse and better analysis of return are provided. Contact bearer of the RFID system is made from tough and durable material suitable for prolonged use in different environmental conditions. The time required for the implementation of processes within the warehouse is reduced, and the level of human error is minimized. The identity of the RFID tag is not suitable for copying, therefore it is expected to contribute in raising the level of protection against counterfeiting and to prevent possible abuses.

Besides many advantages, the literature recognizes the disadvantages that can negatively affect the adoption of RFID technology in business systems. These includes high costs, problems related to compatibility, reliability, difficulty in upgrading existing systems for the introduction of RFID technology *(Wamba, 2012).*

The high cost of the necessary hardware equipment adversely affect, especially the smaller companies that are often unable to invest in RFID technology. The high costs of introducing RFID technology may adversely affect, or reduce ROI - Return on investment *(Lin, 2009).* Compatibility with ERP (or other customer information system), is also a challenge that is set before RFID technology. Reliability and accuracy of reading tags is still not consistently high *(Soon and Gutierrez, 2008)*. Functioning and capabilities of RFID technology is largely dependent on the standard of electronic labels and readers, as well as the capabilities

of the software for business integration, to cheaply record and store data obtained by the RFID technology. Even with the generally accepted standard Gen 2 for RFID labels, there are still limited interoperability problems when it comes to the different available browsers or different custom integrative software. When introducing RFID technology it is important to consider that the probability of the resulting data may not be in a standard format, which requires the implementation of customized software to enable the integration of RFID data from corporate databases. Also, the proximity of metal or magnetic fields can adversely affect the operation of RFID systems. The restrictions that are less noticeable, but may also be present in some form, are the difficulty in finding qualified staff as well as the resistance of employees due to the changes brought by the new technology.

6. CONCLUSION

Despite certain imperfections and limitations that accompanies RFID technology, the growing number of companies worldwide decides to integrate RFID technology in business, because RFID is the future of monitoring the flows of information, goods and resources.

Entity that carries out the implementation of RFID technology in business system must be very careful not to jeopardize the functioning of the process in transitional period. In the described model, the use of RFID technology in logistics company, in the area of warehouse operations, implementation of RFID technologies needs to be implemented gradually over several stages that are crucial for success, and include: defining the project plan, the understanding of the technology that is used, the procurement of appropriate hardware and software equipment, system integration with existing equipment and existing information systems, system testing before moving to full implementation and the inevitable training and education of employees.

Also, for the company that decides to implement RFID technology in their business system, the tendency to form partnerships with all stakeholders in the supply chain is of strategic importance, through the introduction of RFID technology in the entire chain, from manufacturers to retailers. The above method allows the application of RFID technology to achieve the maximum positive effect.

REFERENCES

Atali, A., Lee, H. L., & Özer, Ö. (2006). If the inventory manager knew: Value of RFID under imperfect inventory information. Technical report, Graduate School of Business, Stanford University.

Aysegul, S., Nabil, A., & Stéphane, D. (2010). A literature review on the impact of RFID technologies on supply chain management. International Journal of Production Economics, Volume 128, Issue 1, 77-95.

Bhattacharya, M., Chu, C. H., & Mullen, T. (2007, November). RFID implementation in retail industry: Current status, issues, and challenges. In Proceedings of 38th Annual Meeting of the Decision Sciences Institute, Phoenix, AZ, 2171-2176.

Bob, V. (2003, November). Tesco RFID Rollout Starts in April. RFID Journel. Retrieved from: https://www.rfidjournal.com

Bob, V. (2004, April). Metro Future Store. RFID Journel. Retrieved from: https://www.rfidjournal.com

Bob, V. (2013, March). Marks & Spencer Rolls Out RFID to All Its Stores. RFID Journel. Retrieved from: https://www.rfidjournal.com

Chow, H. K., Choy, K. L., & Lee, W. B. (2007). A dynamic logistics process knowledge-based system–an RFID multi-agent approach. Knowledge-Based Systems, 20(4), 357-372.

Chow, H. K., Choy, K. L., Lee, W. B., & Lau, K. C. (2006). Design of a RFID case-based resource management system for warehouse operations, Expert Systems with Applications, 30(4), 561-576. Retrieved from: www.elsevier.com/locate/eswa

El Khadar, M. A., Boulmalf, M., Harroud, H., & Elkoutbi, M. (2011). RFID Middleware Design and Architecture. Designing and Deploying RFID Applications, Dr. Cristina Turcu (Ed.), ISBN: 978-953-307-265-4, InTech, 307-308. Retrieved from: http://www.intechopen.com

Fleisch, E., & Tellkamp, C. (2005). Inventory inaccuracy and supply chain performance: a simulation study of a retail supply chain. International Journal of Production Economics, 95:373-385.

Hardgrave, B. C., Waller, M., Walton, S. M., & Miller, R. (2007, June). Does RFID Reduce Out of Stocks? A Preliminary Analysis.University of Arkansas, Sam M. Walton College of Business, Information Technology Research Institute, 16.

Kang, Y., & Gershwin, S. B. (2005). Information inaccuracy in inventory systems: stock loss and stockout. IIE transactions, 37(9), 843-859.

Kaur, M., Sandhu, M., Mohan, N., & Sandhu, P. S. (2011). RFID Technology Principles, Advantages, Limitations & Its Applications.International Journal of Computer and Electrical Engineering, Vol.3, No. 1,151.

Lee, H., & Özer, Ö. (2007). Unlocking the value of RFID. Production and Operations Management, 16(1):40-64.

Lefebvre, L. A., Lefebvre, E., Bendavid, Y., Wamba, S. F., & Boeck, H. (2006, January). RFID as an Enabler of B-to-B e-Commerce and its Impact on Business Processes: A Pilot Study of a Supply Chain in the Retail Industry. In System Sciences, 2006. HICSS'06.Proceedings of the 39th Annual Hawaii International Conference on (Vol. 6, pp. 104a-104a), IEEE.

Lin, C. Y. (2009). An empirical study on organizational determinants of RFID adoption in the logistics industry. Journal of technology management & innovation, 4(1), 1-7. Retrieved from: http://www.scielo.cl

Ramírez, D., Ramírez, L., Jimenez, B., Miguel, Castro, L., & Maldonado, E. (2013, June). The design of a real-time Warehouse Management System that integrates simulation and optimization models with RFID technology. The International Journal of Computer Science & Applications (TIJCSA) ISSN-2278-1080, Vol. 2 No. 4,19-22.

Rekik, Y., Sahin, E., & Dallery, Y. (2008). Analysis of the impact of the RFID technology on reducing product misplacement errors at retail stores. International Journal of Production Economics, 112(1), 264-278.

Sellitto, C., Burgess, S., & Hawking, P. (2007). Information Quality Attributes Associated with RFID-Derived Benefits in the Retail Supply Chain. International Journal of Retail & Distribution Management, 35, 1, 69-87.

Soon, C. B., & Gutierrez, J. A. (2008). Effects of RFID Mandate on Supply Chain Management. Journal of Theoretical and Applied Electronic Commerce Research, 3, 1, 81-91.

Vijayaraman, B. S., Osyk, B. A. & Chavada, D. (2008). An Exploratory Study of RFID Adoption in the Paperboard Packaging Industry. Journal of Technology Management and Innovation, 3, 4, 95-110.

Wamba, S.F., Lefebvre, L.A., & Lefebvre, E. (2007). Integrating RFID technology and the EPC network into a b2b retail supply chain: a step toward intelligent business processes. Journal of Technology Management and Innovation, 2(2):114-124.

Wamba, S. F. (2012). Achieving supply chain integration using RFID technology: The case of emerging intelligent B-to-B e-commerce processes in a living laboratory. Business Process Management Journal, 18 (1), 58-81.

Waters, S. (2013). The Impact of Radio Frequency Identification (RFID) Technology on Retail Supply Chain Performance (Doctoral dissertation, RMIT University). Retrieved from: http://researchbank.rmit.edu.au

SUPPLY CHAIN MANAGEMENT IN FOOTWEAR INDUSTRY

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Abstract: *This paper shows an e-business model of footwear industry. For managing production process an Information system is used as a support. The main goal of the paper is improving existing e-business process in footwear industry by applying concept of supply chain management and contemporary information technologies. A model for supply chain management in e-business of footwear industry is shown, as well as an application for supply chain management.*

Keywords*: E-business, Supply Chain Management, Logistics, Information System, Application for Supply Chain Management, RFID*

1. INTRODUCTION

With rapid growth and continual changes in industrial footwear production, companies are facing with problems related to competition on market, management of supplier relationships and logistics. Dynamic of industrial footwear production affects on shaping of footwear, activities and goals in supply chain system according to following requirements:

- improving quality of product and services,
- shorter time of delivery,
- reducing logistics and other costs,
- integrating information technologies with flowcharts,
- planning and directing the flow of movement of raw materials and finished products in the supply chain,
- products and services flexibility for consumers satisfaction.

The supply chain includes all activities related with the flow and transformation of goods, from raw materials stage through to the end user (Handfield and Nichols, 1999). Supply chain management (hereinafter: SCM) is process of planning, implementation and control of supply chain with aim to satisfy customers' needs (Seuring and Mueller, 2008). Represents term related to optimizing the delivery of product, services and information from supplier to customer (Bertolini, Bottani, Rizzi and Bevilacqua, 2007). A supply chain usually includes manufacturer and its suppliers, various wholesalers and distributors, to the owner of a retail store.

In manufacturing, the supply chain is an integrated set of business functions, which directs all activities of procurement of raw materials to delivery of finished products to the end user. Basic goals of effective and efficient supply chain are related to "Just in time" concept that implies delivery of specific product in real time, place and quantity. For the realization of these requires certain measures must be taken in order to insure of efficient functionality of all operative components of a supply chain. Main components are supply, storage and distribution. Sometimes variance of orders may affect on sales and produce stocks surpluses, cost increase, errors in production activities due to overload and other. This is so called bullwhip effect (Lee, Padmanabhan and Whang, 1997).

Information technologies have significant role in tracking of raw materials, semi-finished and finished products from the origin place to the point where they will be spent. This paper presents a model for supply chain management in e-business of footwear industry. Model is developed and applied in footwear industry Falc East d.o.o., Ruma in aim to enhance existing e-business and supply chain management process. Model also proposes application of RFID technologies in production and warehousing process. Furthermore, an application for supply chain management in footwear industry is shown.

2. E-BUSINESS IN FOOTWEAR INDUSTRY

This paper presents an e-business process of footwear industry Falc East d.o.o., Ruma. The main business of Falc East is production and distribution of Italian footwear to a number of countries around the world. All footwear models are design and technically prepared for the production process in subsidiary Falc from Italy.

For the realization of e-business Falc East uses modern technologies. For accounting records and records of workers Falc East uses software package and Italian AS400 database that allows access to all customers orders from the date of delivery, access to state of the material both in Italy and in Serbia, to the state of development of the model and all other processes that are carried out in Italy. E-business model of Falc East is shown in figure 1 (Milinović, 2009).

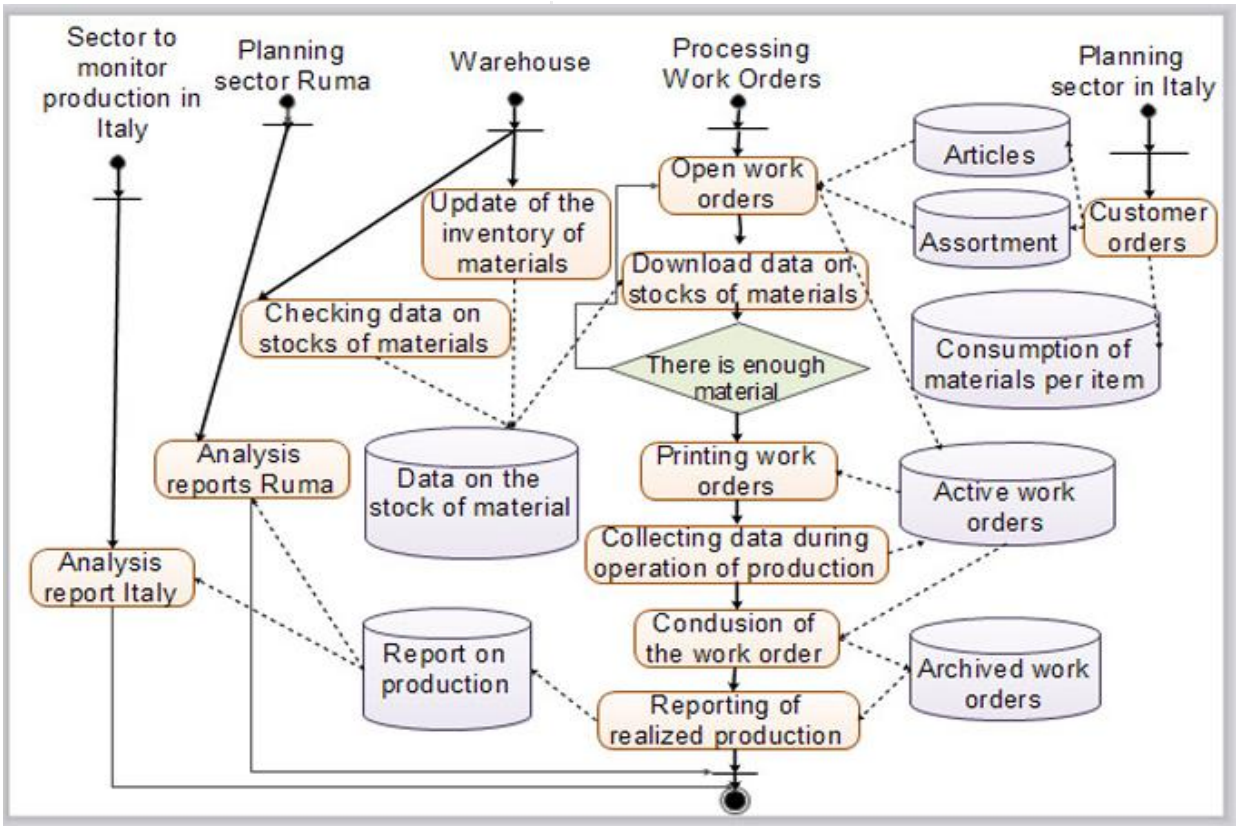

Figure 1: E-business model of Falc East

Footwear industry Falc East uses e-business application that enables management of working orders, code lists, and data protection. Management of working orders implies entry of new and update of existing working orders, archive and reports. Code lists enables updating of articles, assortment and consumption. Data protection enables user administration and password management.

In the realization of all processes Falc East uses two software tools. Software tool AS400 is used for managing orders from all production facilities and complete accounting in Italy and the second one is deployed in Serbia and adjusted for managing the production process and the details about clients, production and materials. Customers make orders through authorized agents which they forwards, over Internet, to planning sector. All orders are stored in AS400 database in Italy. Planning sector in Serbia has approach to these data and uses them in their software. Software in Serbia is adjust to production process and is used for data analysis, issuing work orders, analysis of material on stocks and tracking production process. Sector in Italy can track production process trough the same software.

3. MODEL FOR SUPPLY CHAIN MANAGEMENT IN E-BUSINESS OF FOOTWEAR INDUSTRY

Model for supply chain management in e-business of footwear industry is developed in scope of Falc East industry and it is shown in figure 2. Planning sector in Italy sends customers' orders which contain products, assortment and consumption of materials per item. After opening new working order and taking data about materials on stocks, the planning sector in Serbia creates and processing working orders. Information system of Falc East enables analysis of these materials on stocks. Upon confirmation that there are enough materials, a working order can be sent to press and given into production. Working order and analysis is made on the basis of the date of delivery to customers. Collecting data about the finished production and closed working orders is on daily basis. Creation of reports about finished production is important for analysis in planning sector in Ruma and for sector for monitoring production in Italy. Warehouse checking and updates data about material on stocks.

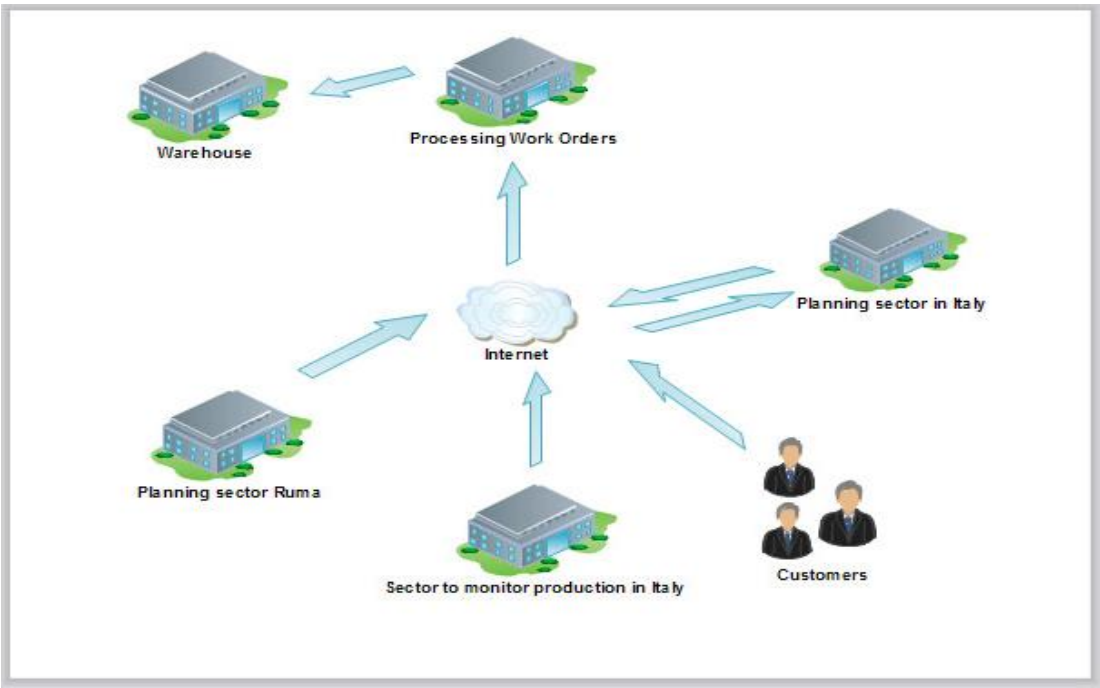

Figure 2: Model for supply chain management in e-business of footwear industry

In aim to enhance existing supply chain management system in footwear industry Falc East, model also proposes introduction of new technologies and adding new functionalities in existing software that for referent should enable tracking and monitoring of production process according to customers' orders and materials on stocks. These procedure should be conducted by referent by following steps:

- making a purchase invoice with all materials and quantities in a software system
- openning a new working order (automatic assignment of new working order number)
- selecting the item from the active items and entering the number of bolle
- entering assortment by bolla on the order
- the total number of pairs per item and the total number of pairs per order is assigning automatically
- the date of the opening of the working order should be automatically
- analysing the stock material
- referent printing order for production for bolle for wich have materials on stocks and gives further to manager, merchants and production workers
- printing of materials that are missing and sends order for them in Italy.

Received materials are chacked by a warehouse clerk and if they are matched with invoice, referent is making a report. After the end of the working day a manager is delivering referent daily report in which defines the number bollas that are finished and:

- calls the number of bolla and enters what was done by updating working orders
- concludes the working orders.

Model for supply chain management in e-business of footwear industry also proposes applying RFID technology for sorting and tracking materials in production and warehousing processes. Material are marks with appropriate RFID taggs. With the implementation of RFID technology in the industry, the production and wearhouse processes can be faster and more precisely conducted. Application of RFID in the production process can be described with following procedure:

1. In production factory hall, materials are passing through a fixed portal with the RFID reader which can read unique EPC number and other details about the delivery;
2. Received materials must pass control and then distributed to the warehouse, production or return if not fulfill the requirements;
3. Materials for returning are RFID marked and returned to the supplier;
4. Listing materials is done by reader located on the forklift which then sends data of the exact place of storage in the system;
5. Materials in the production are read at a specified levels from where the system sends information about the necessary materials for production;
6. How grouped products are moving through the production line, the data about them are loaded into the system by using a fixed reader along the production line;
7. When product is finished, the worker puts product label with a RFID chip;

8. EPC number and product data are stored in the database in every workplace. This provides the relevant documentation on the quality before the product enters further into the chain of commerce;
9. The product then goes to the packaging. A label with the chip is created to contain new information about the product.

In production process RFID technologies bring following advantages (Michael and McCathie, 2005; Ferrer, Dew and Apte, 2010):

- Automatic collection of data in real time
- Time reduction
- A large amount of various types of data
- Insight in materials and products on stocks
- High accuracy of data collection.

Automatic collection of data in real time provides current information about the state of stocks, the execution of the production process and the real demand. In this way, RFID technology provides continuity in production process and eliminates possibility of excess inventory.

4. APPLICATION FOR SUPPLY CHAIN MANAGEMENT IN FOOTWEAR INDUSTRY

For the production process footwear industry Falc East uses an application for supply chain management. The application is based on supply chain management process described in section three of this paper.

Italy sends order of customers and bolle for printing. Bolle includes all fabrics (materials) which are required for the production.

Beside of the customer's order, bolle are printed too, and given into production. At first, they are placed in warehouse, in order to prepare materials. Warehouse manager prepare only that bolle which referent of planning and monitoring gave him through working order but based on previously performed analysis. Then he gives printed bolle in the tailor who designs the shoes. They forward those parts at the preparation sector, where the parts be numbered and prepare for sew and from that place it send to sewing workshops. When the upper parts are finished, products were packaged and sent to Italy. There, in Italy, the footwear will be compiled and send to the final customer.

Referent of production monitoring from the database in Italy AS400 takes orders and bolle with delivery dates and sends itself to mail (shown in figure 3).

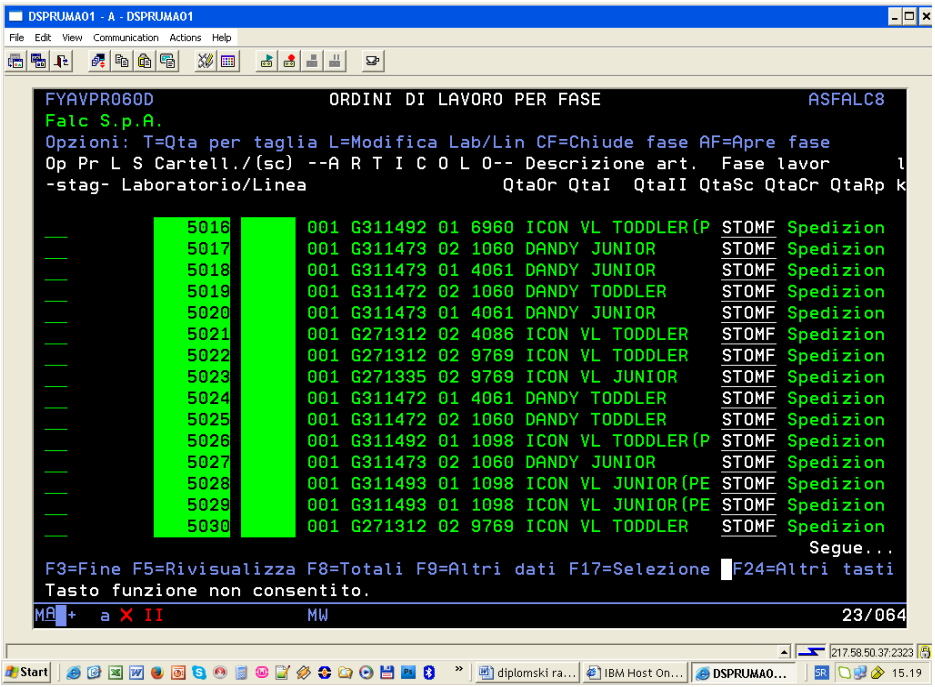

Figure 3: Bolle

Based on these, referent of production monitoring enters data into program and begins with the analysis. When finished the analysis, announcing working order for production and gives it to the manager, the warehouse clerks and the tailors. First, input invoice inserts with fabrics which sent by Italy to work. Then, after that, they create a new work order in which put in items, color, number and selection of bolle. Afterwards, they do analysis in order to organize work according to fabrics stocks, while the lack of fabrics will be ordered from Italy.

Monitoring of production is based on daily reports written by each of tailors in their workshop. Every day they must to put in the program what they from products were designed, were prepared, sewn and delivered. Each phase enters separately. These Web interface called Ambari is shown in figure 5.

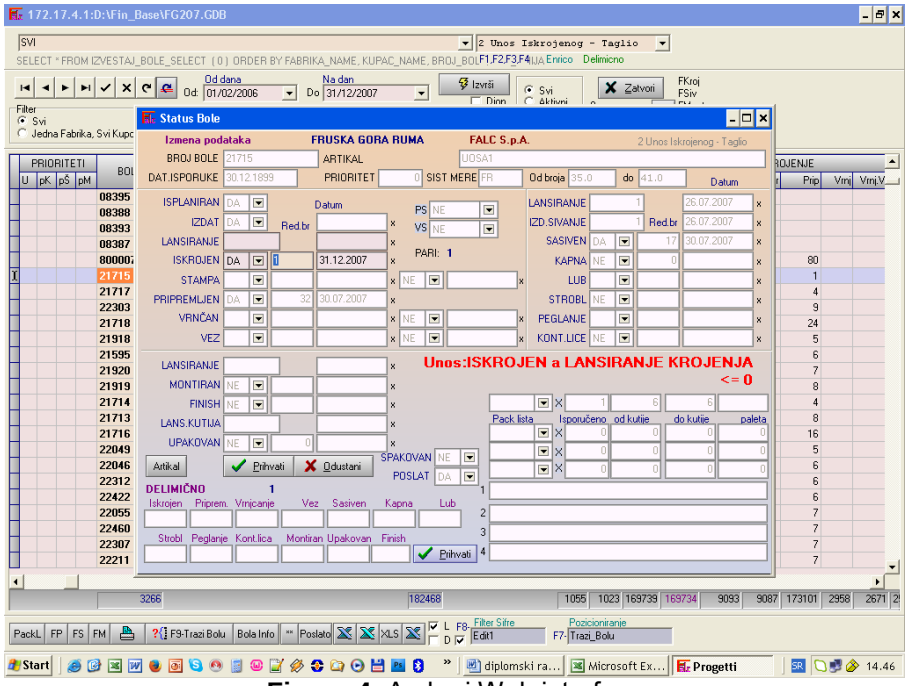

Figure 4: Ambari Web interface

The program gives the possibility of different overviews, where can be ask various parameters and may to print reports. Each review can be printed or to be export to excel.

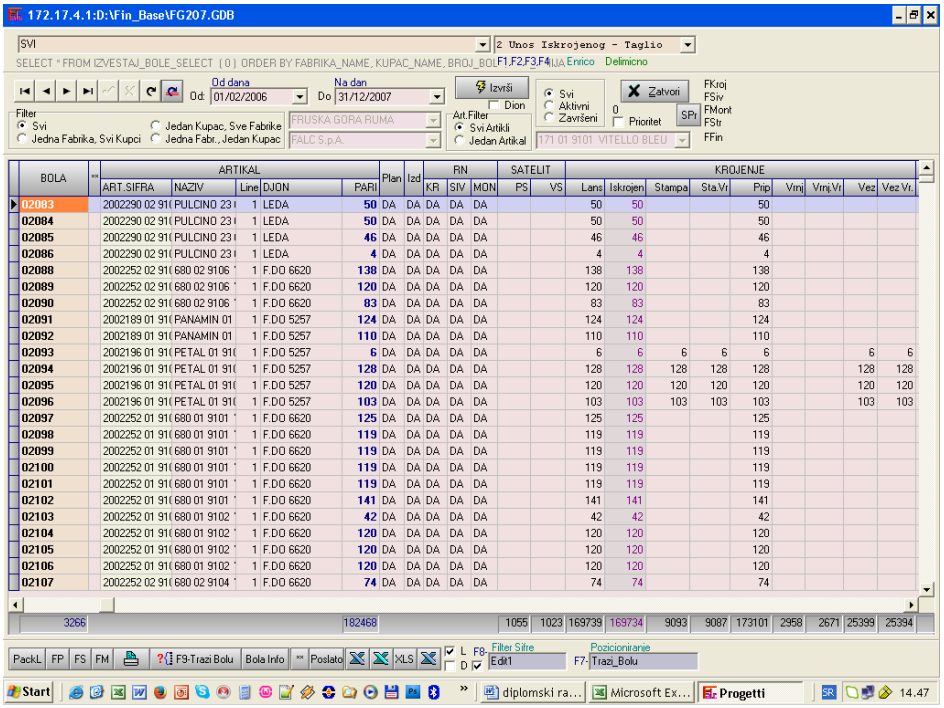

Figure 5: Complete overview

Application, also enables searching by different criteria (figure 6).

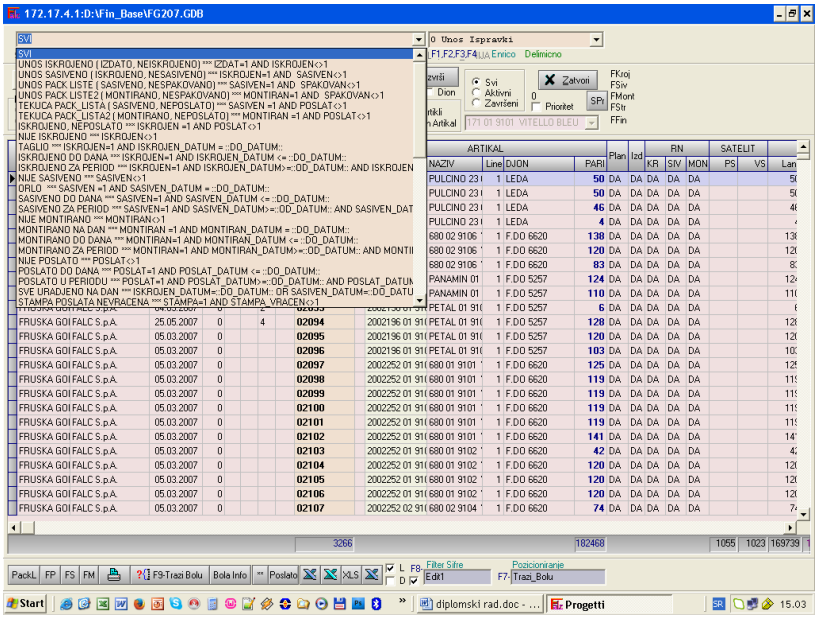

Figure 6: Searching by different criteria

When the process of production is finished, the pack list is sending to import / export service which makes documents for clearance of goods and send it to Italy.

For different users approach to this application is limited. Manager has access to:

- archived working orders
- printing and searching working orders.

Referent every week has possibility to:

- open and close the working orders
- update articles
- view consumption
- delete working orders.

Director of organizational unit is an administrator of the system and can create system users with different rolles and level powers.

At the beginning of the season Falc East receives from Italy catalog of all articles that should be produced, as well as drawing of items with the instructions. According to this instructions, Falc East makes prepration and realization of production process, as well as the delivery. Example is shown is figure 7.

SCHEDA TECNICA

	Articolo		BASE				STAGIONE	
2003318	falcotto 936		18		falcotto california		P/E 2009	
	4			ANNOTAZIONI				
		Pa 2						
COD.COLORE	9131	9132	9133					
fascia	Nabuk	Nabuk	Nabuk	taccola salpa mm.1adesiv.x california				
	BLEU	SABBIA	T.MORO					
tomaia	Nabuk	Nabuk	Nabuk	marchio falcotto f.409 oro				
	BLEU	SABBIA	T.MORO					
				forte california sagom+mastice mis 1				
				puntale 2077 laser 101				
	BELGIO + OLANDA							
				laccio 16p5 mis 45				
fodera tomaia	bianca	bianca	bianca	GOMMA PIUMA DA 4 DENS 75 X CUSC.				
incrociato				kriptom bxtaat antistrapp rinf sottocch				
Fod.Sottop.	bianco	bianco	bianco	guper 758/58 tag special rinf punta				
incrociato								
				fortex h 15 rinf.travetta				
Fondo	blu sat	osso	osso					
5152	celeste	s.ambra	s.ambra					
occhielli	nikel	nikel	nikel					
100/30s								
laccio		436	1043					
16p5	BLEU	BEIGE	T.MORO					
Filo	grezzo	grezzo	grezzo					
30 x tomaia								
				FOTO				
Marchio F	a caldo	a caldo	a caldo					
ART.335								
Etichetta tessuto	no	no	no					
FALC8 art.68/69								

Figure 7: Searching by different criteria

5. CONCLUSION

The paper presents an application of supply chain management in footwear industry based on model for supply chain management in e-business of footwear industry. Model is developed and applied in scope of the footwear industry Falc East d.o.o, Ruma. Model also suggests application of RFID technology in aim of improving existing e-business and production process. RFID in production process brings many advantages such as time and cost reduction, simpler manipulation with various type and amount of data. This can be very important for Just in time decision making related to the production process in footwear industry. Existing supply chain performance can be also improved in the future with point-of-sale scanners that allow industry to capture the customer's voice. In this way electronic data interchange can enable hearing that voice in supply chain and faster reaction by using flexible manufacturing, automated warehousing and rapid logistics (Fisher, 1997).

REFERENCES

Handfield, R.B., & Nichols, E.L. (1999). Introduction to supply chain management. New Jersey: Prentice-Hall.

Seuring, S., & Mueller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. Journal of Cleaner Production, 16(15), 1699-1710. DOI: 10.1016/j.jclepro.2008.04.020

Bertolini, M., Bottani, E., Rizzi, A. & Bevilacqua, M. (2007). Lead time reduction through ICT application in the footwear industry: A case study. International Journal of Production Economics 110, 198-212.

Lee, H.L., Padmanabhan, V., & Whang, S.J. (1997). Information distortion in a supply chain: The bullwhip effect. Management Science, 43(4), 546-558. DOI: 10.1287/mnsc.43.4.546

Milinović, S. (2009). Model informacionog sistema za preduzeće u industriji obuće. Graduate thesis, Tehnički fakultet “Mihajlo Pupin” u Zrenjaninu, Univerzitet u Novom Sadu.

Michael, K., & McCathie, L. (2005). The pros and cons of RFID in supply chain management. In Proceedings of the international conference on mobile, business (pp. 623-629).

Ferrer, G., Dew, N., & Apte, U. (2010). When is RFID right for your service? International Journal of Production Economics, 124(2), 414-425.

Fisher, M.L. (1997). What is the right supply chain for your product? Harvard Business Review, 75(2), 105-116.

APPLICATION OF VIRTUAL LOGISTIC CONCEPT IN SERBIAN ARMED FORCES

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Abstract: *The article provides an overview of the possibilities of application virtual logistic concept in supply management and storage of materials field in Serbian Armed Forces. The development of modern information and telecommunication technology increases the importance of the concept of virtual logistics. The appearance of virtual logistics has brought great benefits, by changing the borders of efficiency and effectiveness and setting up the new criteria that organization need to satisfy and adopt, if they want to remain competitive and profitable in the local as well as in the global market.*

Keywords*: logistics, virtual logistics, trends, concept, virtual supply management, virtual material storage.*

1. INTRODUCTION

As well as in the business world in which tends to meet customer requirements while reducing costs, the armed forces all over the world are faced with necessity to establish the optimal balance between the needs for the greater availability of military equipment and better support for maneuver forces, and reducing costs and decreasing logistical resources.

The traditional form of military forces support, based on collecting large amount of resources in the zone of operation, is being abandoned. That is affected by unacceptable costs and lack of ability to support dynamic changes in the zone of operations.

The new concept of force projection requires the rapid deployment of combat forces, accepting the initial combat action and at the same time autonomous support, which is directly reflected at the establishment of new logistics processes and procedures that have to be effective, flexible, and appropriate, according to specific combat forces requests that have to be supported.

In order to ensure desirable characteristics of combat forces, such as agility, mobility and flexibility or speed of response, it is necessary to provide adequate logistical support, which also has to be fast, accurate and in proper time.

For that reason, logistics management tends during planning, creating, developing, launching, maintenance, and ongoing support of efficient and effective fighting forces "provide maneuver, precision effects (fire), comprehensive protection, and rational and focused support to defense forces. That provide based on model "top-down", when, where is that necessary and in required manners , as close to the place of issuing logistics requirements, but all that in accordance with an appropriate price "(Andrejić and Milenkov, 2012).

None of combat forces will not maintain own speed if run out of fuel, ammunition, food, spare parts, medicines or other needs which are provided by the logistic units. Those are the reasons why the organization and management of logistic support are very important for performing tasks of logistic support, as well as well planned and organized use of logistic resources and units, and finally, for rational consumption of logistic resources. On the other hand, the introduction of automated information systems gives strong influence on decreasing cost in system of logistic support. Rapid information transmission, efficient processing of customer requirements and continuous availability of reserves data is affected on significantly lower levels of inventories, and in same time on increasing the level of operational availability of weapon system and military equipment. That is the reason why information is so important and why the progress in information technology provides numerous opportunities for the logisticians, in support issues forces in the zone of operations, like never before. In the era of information technology victory applies a force that has the right information at the right time. The right information gives to decision makers, knowledge of the situation on the battlefield, which they need to make right decisions to achieve the goal. However, the information and the real situation on the battlefield is not complete without proper logistic information. (Pavlović, 2006)

Proper and timely logistics information, provides timely logistic support and making the right decisions that lead to raising the quality of logistic services, shortening the response time of the logistic system, increasing the efficiency and effectiveness of logistic support, as well as increased confidence of combat forces in their logistics units.

Applying modern IT tools in the logistics support, it is possible to achieve development, processing and exchange of relevant data, information and knowledge, based on real-time and global connections between maintenance systems, supply and transportation with logistic support of units to their peacetime location as well as in the area of operations. If information system is integrated and if it provide the collection, processing, exchange and display of all the necessary information, in each logistic element vertically and horizontally, logistics management can timely and accurately to meet the requirements of users of logistics services.

Such logistical support today has accomplished by information system based on Web technology, an environment that contains a virtual data warehouse and logistics management support tools.

Sophisticated information management and dynamics of development of software applications provides sharing and information management in nearly real-time. The system allows access from each level to all data as well as supplements of the information directly from the individual locations, at low cost.

2. LOGISTIC AND MODERN TRENDS

Logistics is a key factor in the development of the armed forces, successful companies, national and international associations. Logistic is present in all areas of human endeavor encompassing all the systems and processes that allow the movement of material and immaterial flows in the physical, information and organizational terms. In the last thirty years, logistics has developed and established itself more than in the previous three centuries Logistics has become a system of skills and disciplines that are grounded in fundamental and applied scientific knowledge of each system. It is an interdisciplinary and multidisciplinary branch of science related to the operation of a variety of support systems, where operations can be in the domain of the armed forces, production, customer service, etc.

In economically developed countries, logistics and logistic processes are subject to continuous improvement, as more and more manifest the problem of using time and space to achieve effectiveness and efficiency in achieving various goals. Logistics, now days, addressing the problems of providing all the conditions, necessary for the successful operation of the business, military or technical systems and organizations, and to study all the elements of integrated logistics support necessary to keep the system carrying out their functions properly, and the way you want. This means that integrated logistic support includes elements of a technical character (development, production, transportation, supply, maintenance, etc.), and the elements of general or of the social (availability of personnel, training, environmental conditions, consumer services, etc...) and economic character (costs, working capital, profitability, profit, etc.) (Andrejić and Milenkov, 2012).

Intensive development of logistics is characterized by new concepts and technology in all areas of logistics. Some trends that were present in the past will continue with some modifications, but they appear and a new vision of technical, organizational and educational components of logistics. Identifying the need and trying to meet user requirements are the new approaches to logistics. The aim of all logistic activities is: meeting the needs of users with different products and different services in different places of origin, reducing the cost of logistics processes; improving the quality of logistic processes and services (speed, reliability, and offer to service users), protection of the environment (air, water, humanization of logistics operations, packaging material for recycling, etc…). Developed business systems increasingly used different approaches to solving the problem of logistics on various decision-making levels that allow increasing business efficiency and improve the quality of logistic services. On the one hand, users of logistic services are increasing demands for better quality products and services, on the other hand, operating systems increasing tendency to reduce logistics costs and reducing harmful impact on the environment, leading to permanent changes in all components of the logistics system, as well as the implementation of new logistics strategies and concepts.

Today's stage of development of logistic is characterized by the following trends (Zečevic and Gojković, 2010):

- introduction of new logistics strategies and concepts;
- unification and integration of smaller and more frequent logistic flows in order to reduce inventory;
- the creation of a logistics system of profit through the process of outsourcing, specialization and extension services;
- design of new logistics centers, networks and supply chain networks with a wider set of activities and participants;

- development and implementation of automation and advanced information technology;
- establishment of logistics companies and associations;
- the creating of alliances by geographic principles, principles of technology, interest and other preferences;
- the creation of supply chains with strong performance flexibility, visibility, security, economy and sustainable development;
- training new profile experts and the general specific knowledge of the multidisciplinary, interdisciplinary field.

The armed forces of the developed countries great attention is paid to the development of automated information systems to enable timely delivery of information at various levels of command. As a special type of information system within the armed forces, there is a logistics information system Adequate logistics information system provides automatic data processing, distribution and presentation of relevant information in real time, according to user requirements logistic support, logistic units (command, administrative and executive), commanders and other units, resulting in timely fulfillment logistics requires supported units. In such an information system, there are standardized relationships and information flow between elements within the logistical support system and between the system of logistical support system and its environment, which is the purpose of existing. In addition, emphasis is placed on a modular approach in projecting, which has to allow its robustness and the ability of continuous development and improvement (Dronjak and Milenkov 2012).

In modern armed forces, approaches and concepts of logistics aim to achieve:

- full integration of logistic support to make the system capable of quickly distributing goods, people and information, thus increasing the response speed of logistics;
- a general overview of logistic resources allowing decision makers quick connection of operational requirements and available logistic capabilities;
- timely supply in order to reduce the need for storage and to increase the speed of funds flow in the supply system;
- reduce cost and increase efficiency.

Changes in logistics, which have recently become noticeable, caused profound changes in the operation of the new (virtual) economy. The main driver of these changes is the development of information and telecommunication technologies that are at same time drivers of globalization at the world market. Logistic play a key role in the development of this new view of the functioning of business systems, which include the logistics system of the armed forces. Classic logistics systems, which are strictly limited flexibility and resource utilization, are beyond the development of virtual logistics where logistics facilities treat by availability, not by identity or physical form. This allows greater flexibility in the construction of the logistics system, the availability, and utilization of all resources.

Great progress in information and communication technology has allowed information to replace inventory. As information becomes cheap and stocks more expensive, the trend will surely continue, with the goal of optimizing inventory. Electronic data interchange allows optimization of compromise between stocks and information across the entire supply chain. The appearance of expert systems and artificial intelligence, suggests that the logistics optimization become increasingly sophisticated and will cover the wider area of business.

3. VIRTUAL LOGISTIC

Virtualization of logistics business comes as a result of the use of new information and telecommunication technologies knowledge. This mode of operation allows the creation of an effective logistics network increases the efficiency of logistics resource through flexible allocation of the resources and reduces logistical support time, which improves efficiency and effectiveness of logistic support.

Virtualization of business generally brings fundamental changes that Skyrme (1998) manifests most through three business dimensions: space, time and structure. The general perception of logistics resources in virtual logistics system is that it does not matter where they are or which they are forming, than availability of the specific logistical resources in sufficient time. On that way, the location of the materials and capacity of logistic units are the secondary importance. Their availability at the time when they are needed is priority.

Virtual Logistics treat logistical resources as a means of exchange. If the logistical resources treated strictly physical, it would limit their flexibility and limited the efficiency of their. Viewed in the past, in practice it is not possible to treat the logistic resources in this way because of the tendency to be accurate location spaced. Information about them was available locally, and their capacity utilization only locally available. With the

development of information and communication systems, in particular the Internet, the local barrier is overcome and opens the possibility of obtaining information on the availability of logistical resources, and then the degree of availability and efficiency regardless of their location (Protrka, 2009). Virtual logistic handle the physical and logical aspects of information activities. Management and control of resources is done via the internet (intranet) applications. This kind of management allows efficient construction logistics systems. The great advantage of virtual logistics is achieved by increasing the availability of operational information that can be used when setting deadlines, traffic monitoring, accounting, material management, and so on. Concepts of virtual logistics are: logistics virtual organizations, virtual storage, virtual inventory management, virtual supply chain, the virtual control of the goods, virtual trading, virtual delivery, virtual manufacturing, virtual logistics services, virtual markets, virtual development, and so on. (Protrka, 2009).

From the above concepts, practical applications in the Serbian Armed Forces may have virtual storage concepts and virtual inventory management.

4. VIRTUAL WAREHOUSE CONCEPT AND VIRTUAL INVENTORY MANAGEMENT

Supply system in the Serbian Armed Forces, as designed, has staff structure. The system is clearly identified:

- material flows are expressed with material flow through the warehouse - linear structure,
- collection and processing of information and system management through desk officers - staff structure.

Basic features of this organizational structure of the system are low vertical level of decentralization, although it exists, on the other hand, a very high level of horizontal decentralization. The tack of horizontal linkages affects that any cooperation between adjacent elements of the same level can be organized only by the superior level, which causes time loss and the apparent lack of occurrence of certain assets, although the system has.

Time losses and the apparent lack of resources prevent the timely achievement of logistic objectives, which represents an imperative of every logistics system that wants to be competitive in the market.

The problem could be overcome by applying the concept of virtual inventory management and concept of a virtual warehouse of the Serbian Army.

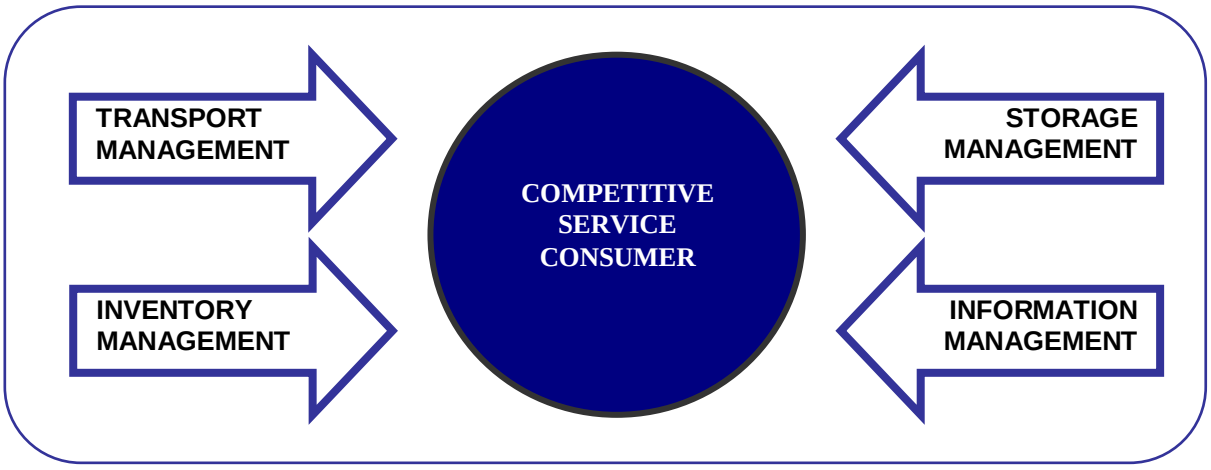

Figure 1: The four subsystems of logistics management and the ultimate goal (Božić and Aćimović, 2010)

4.1. Virtual warehouse concept in the Serbian Army

In the Serbian Armed Forces, material is stored at the logistic unit's warehouses that are not mutually linked. The advantage of introducing the concept of a virtual warehouse in SAF has simplified access to information about the materials that are stored in the warehouses and storages of logistics units, which would be easier to manage and control inventory levels.

Information about warehouses, storages and materials stored in them, would be accessed on local level and the Serbian Army catalog of material would provide organized access to remote information about the materials in a virtual warehouse of the Army of Serbia.

The physical location of stored materials would be in multiple places. The advantages of keeping the material in this way are:

- Greater flexibility and increased storage utilization and storage.
- Storage capacity become a potential which not only locally available.
- The geographical spread storage of materials contributes to finding stores and warehouses that most closely meets our requirements.
- It reduces the risk of keeping the material in one place.

The catalog of virtual Army storage would look the same as the catalog of conventional storage. The only difference would be in a physical location of material. The materials in virtual storage can be in different locations (Figure 2). Virtual stores and warehouses can therefore abolish spatial constraints, the size of the catalog and sort of materials, so it leads an increase in the efficiency of storage.

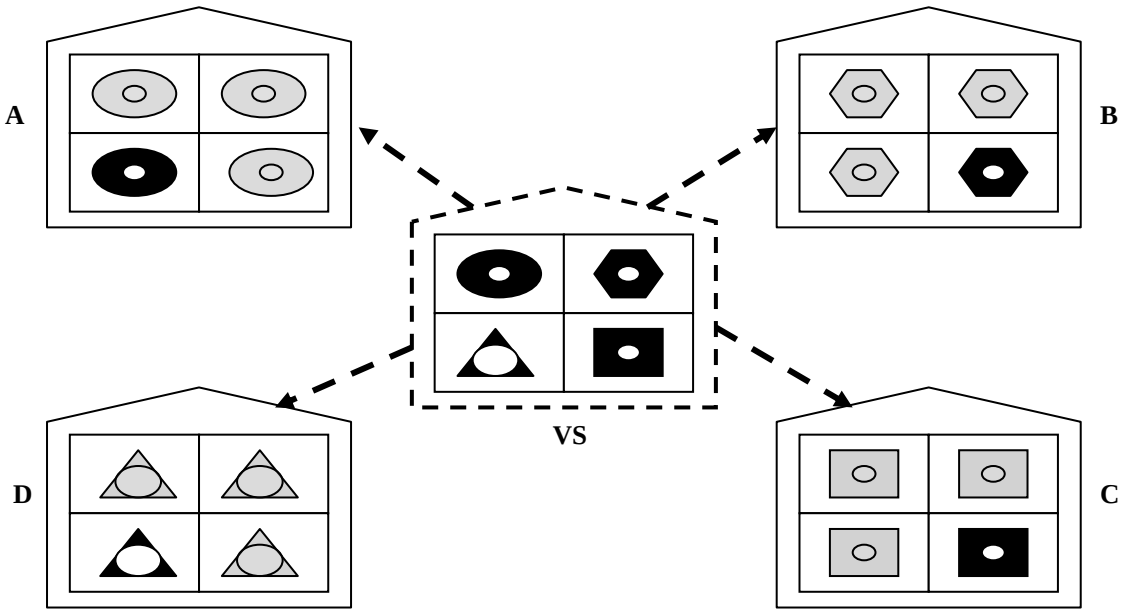

Figure 2: Virtual storage (Clarke, 1998)

Facilitated communication, application of information technology and creation a virtual warehouse would create a good basis for the introduction of the internal market of the material within the Serbian Army as an innovative business concept. Internal market within an organization can help her to realize significant benefits in: efficiency, freedom, flexibility and motivation (Malone, 2004).

4.2. Virtual inventory concept

Inventory management represents finding the optimal balance between requests for material and the amount of stock material (material management costs). The analysis of the previous problems, we see that, in addition to being on its own technical (material requirements), and economic in nature (material obtained in the optimal time to avoid delays logistic support which relates to hold the material). Its effective resolution requires respect for both aspects, as well as the application of modern methods for management of technical systems and materials.

By virtual management can be stored and utilized materials such as spare parts, fuel, lubricants, and food items, reproductive and other materials. In some cases, it would greatly change the purpose of storage. The material in them would not be such a far spent, but also developed. It is possible to owe more than you own. It is still enough material to fulfill short-term demand.

Conventional logistic considered that material is available if it is on stock (Figure 3 a). It is kept for a certain period, a critical reserve materials are used only in special cases. There are visible gaps of this storage method. It is obvious that some critical reserves will not be used, and the cost of storage of such inventory can be very large. The alternative of keeping reserves of critical materials is keeping the virtual stock. Virtual stock may physically exist in another location and material can be assured through a virtual supply chain (Figure 3 b). In this way, the cost of storage could be reduced.

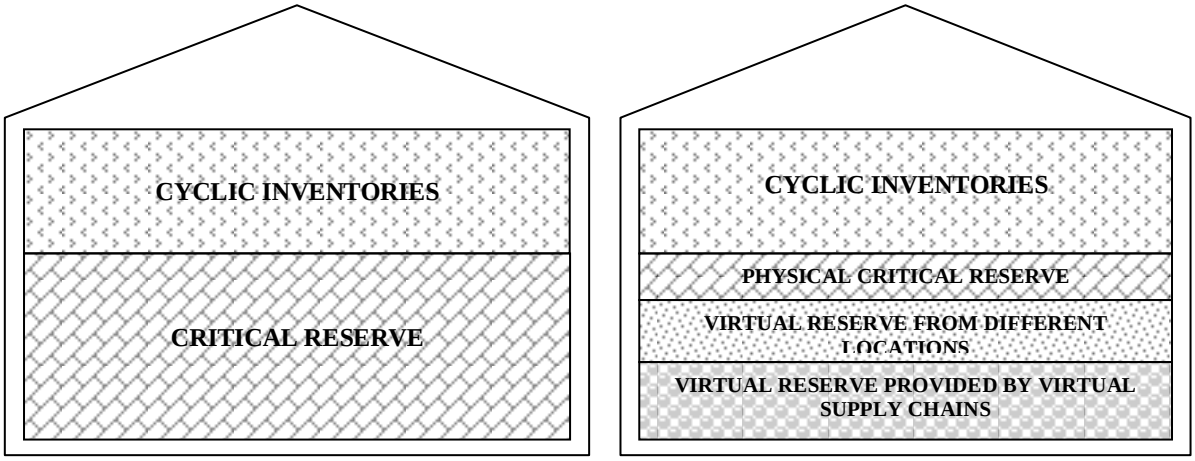

Figure 3: Comparative review of conventional storage and virtual storage (Clarke, 1998)

They ideally, the savings gained control in this way would result in reduced total cost of storage material. Virtual inventory management brings storage to a new level.

5. CONCLUSION

The development of information and communication technologies, as well as the globalization of business, makes strong influence on change in the perception on the models of organization logistic systems.

The endeavors to keep up with the high quality standards required to change the way of business thinking at all levels of logistic system in the Serbian Armed forces. As it is necessary to change the interaction with the environment, it is necessary to change the relationships within the logistics system. In addition, it is necessary the implementation of modern technologies and software models that allow precise monitoring logistic units capacities and faster and more sophisticated planning processes and logistic support in SAF.

Timely logistic information provides timely logistic support, which leads to raising the quality of logistics services, shortening the response time of the logistics system, increasing the efficiency and effectiveness of logistics support. Now, virtual logistics change the role of logisticians. Instead, to manage the physical resources, now they manage the information.

In the long run, the implementation of the concept of virtual logistics in the Army of Serbia would allow increased efficiency of logistics operations, minimize response time, and the operation would eventually become more equivalent with user needs. As a result, it is possible to get more sophisticated, less expensive products and services.

The ultimate effects of the application of the proposed system are getting in time, money and quality of the information.

REFERENCES

Andrejić, M., Milenkov, M., (2012), Osnovi logistike, Medija centar “Odbrana”, Beograd.
Božić, V, Aćimović, S., (2010), Marketing Logistika, Centar za izdavačku delatnost Ekonomskog Fakulteta, Beograd.
Clark P.M., (1998), Virtual logistic, An introduction and overview of the concepts. Centre for Logistic and Transportation, Cranfild School of Managemant. Granfild Universiti, Bedfordshire, UK.
Skyrme, D. J. (1998). Virtual Teaming and Virtual Organizations: 25 Principles of Proven Practice. Web Weaving, Butterworth-Heinemmann, New York
Malone W.T. (2004). Bringig the Market Inside. Harvard Business Review, 107 – 114.
Zečević, S., Gojković, P., (2010), Logistički trendovi, Zbornik radova, I Međunarodna naučno-stručna konferencija, Logistika 2010, Doboj.
Dronjak, M., Milenkov, M., (2012), Pravci razvoja logističkih informacionih sistema, Vojnotehnički glasnik, broj 4, Beograd.
Protrka, R. (2009), Virtualana logistika, Tehnički glasnik, Vol. 3 No. 1-2, Veleučilište u Varaždinu, Varaždin.
Pavlović, V., (Studeni 2006). Logistika u suvremeni tokovi. www.hrvatski-vojnik.hr – internet izdanje br.110.

DOMAIN EXPERTISE OF THE SERBIAN ONLINE MARKET

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Abstract: *The number of computer and Internet users in Serbia, as well as the number of companies that use computers and electronic communications in their daily operations is certain from the surveying point of view and there are also time series accessible that represent the grounds for drawing conclusions on the degree of growth and the user structure over time. Even the 2012 Census included questions on computer ownership by households as a core demographic factor for the age in which we live. During the Internet expansion in Serbia, an online population was created and it reaches the level of approximately 60% of the total population (aged between 16 and 74) and includes almost all companies. It is to be expected that the online market segment will have a powerful impact on the overall socio-economic trends in the country. The main goal of this study is the determination of the percentage share of economic entities on the Internet in Serbia by sectors and regions and explore communication channels, primarily e-mail and web, in order to determine their status. The research was conducted by CATI (Computer Assisted Telephone Interviewing) method using a representative sample of 3197 companies.*

Keywords*: Analysis, communications, domain, e-mail, research, website.*

1. INTRODUCTION

Internet domains represent one of the strategically important issues, both for the functioning of the systems within the online sphere and for the homogenization of the national online community – individuals, companies and institutions. There are no records or reliable estimations for Serbia on the prevalence of the Internet domains, so that this paper is dedicated to a statistical survey on the Internet domains used by companies and institutions.

The information and communications technologies (hereinafter: ICT) have been recognized within the European Union (hereinafter: EU) as the main factor influencing economic growth and innovations, and among seven leading initiatives of the Europe 2020 economic strategy there is “Digital Agenda for Europe,” highlighting the significance of ICT in the modern economy. The goal of the strategy is to focus the development of the information society on the utilization of the ICT potentials for the benefits of increasing work efficiency, fostering economic growth, higher employment and improvement of life quality of all citizens of the Republic of Serbia. Moreover, it is expected that by the year 2020 the Republic of Serbia reaches the EU average by the information society development indicators.

The STRATEGY FOR THE DEVELOPMENT OF THE INFORMATION SOCIETY IN THE REPUBLIC OF SERBIA BY 2020 was adopted in 2010 (“The Official Gazette of the RS,” no. 51/2010). The implementation of the Strategy is monitored by the Ministry in charge of the information society affairs. Together with the strategy in the sphere of telecommunications, this strategy compiles the Digital Agenda for the Republic of Serbia.

One of the basic preconditions for the functioning of the Internet, in terms of the assigning of domains in Serbia, was met by founding of the Register of the National Internet Domains of Serbia (hereinafter: the RNIDS) through the enactment of the decision ICANN (hereinafter: international organization Internet Corporation for Assigned Names and Numbers) no 07.76 of 11.09.2007 which gave consent to the RNIDS to manage the register of the national internet domains for the Republic of Serbia (Document of the Ministry of Science and Environmental Protection no. 451-01-01600/2007-01 of 10/05/2007). In the same year, there was an exchange of the Letters of Intention between the RNIDS and the ICANN managing the global system of textual and numeric Internet addresses and prescribing the rules for the introduction of the national Internet domains, which the Serbian delegation signed in October 2007.

The Ministry of Foreign and Internal Trade and Telecommunications was founded as of the date when the new Law on Ministries (“The Official Gazette of the RS,” no. 72/12 and 76/2013) entered into force on

26.07.2012. Under the Article 36 of this law, in addition to other affairs, it also took over from the Ministry of Culture, Information and Information society, as the legal successor of the Ministry for Telecommunications and Information Society, the execution of the competencies in the sphere of information society and the managing of the Directorate for Digital Agenda which is in charge of the information society affairs. In this way the legal continuity of the agreements signed by the RNIDS with the authorized Ministry of the Republic of Serbia (hereinafter: the Ministry) has been preserved both in the material and formal sense.
With regards to the regional backdrop, the RNIDS has a more favourable position as an autonomous and independent organization in comparison to the registers in the region. Namely, most of the regional registers are parts of an organization originating in state universities, such as the case with Bosnia and Herzegovina (link: http://www.nic.ba/); Slovenia (link: http://www.arnes.si/en/about-arnes.html) where the academic network is the administrator of the national domains, somewhat independent but under the control of the state university; Croatia (link: http://www.dns.hr/ and http://www.carnet.hr/) where the work of the national register is regulated by a special rulebook within the public organization of the university; Macedonia (link: http://marnet.mk/); with individual cases of Montenegro (link: http://domen.me/) that ceded the administration of the national internet domain to the international company „Godady" and Bulgaria (link: https://www.register.bg/user/index_en.html) where the management of the national Internet domain is owned by a private company.

2. METHODOLOGICAL FRAMEWORK

In Serbia, there are no reliable estimates regarding the prevalence of Internet domains. The authorized Internet providers have records on their users, but not only do these records not have complete coverage, they are also not joined together and cannot be generalized to the population at large. In other words, they cannot be used as the grounds for drawing any conclusions. This chapter shows the basic methodological references of the survey using a representative sample that is a basis for making statistically reliable assessments on the degree of prevalence of the Internet domains used by companies and institutions.
The survey was conducted in the period 10 – 28 March 2014 using the telephone survey method that takes approximately 15 minutes. The collocutors were the owners and general managers of companies or IT managers. The survey was conducted using a representative sample of 3197 companies. The SORS also applied the post-stratification by the size of company, industries and regional distribution.

3. MAIN RESEARCH RESULTS

All statistical series and assessments go to confirm that in Serbia today computers and Internet are used in almost all companies. At the same time, the data show that there are rare companies where computers and e-operations have completely replaced the classic ways of handling administrative operations. In those terms, the subject of this survey is primarily the prevalence of e-mail and web communication in the daily operations of companies.

As regards the question on whether they use e-mail communication with clients and business partners, in 79.9% of the companies the response was affirmative. There are significant differences in the prevalence of e-mail use depending on the size of the company, the size of the municipality in which the company is located and region. The prevalence of e-mail business communication increases with the size of the company, so that it is least used by the companies with one to two employees (69%), a little more by the companies with three to five employees (73%), and mostly used by the companies with more than six (80%) and more than 30 employees (83%). Moreover, there are significant differences in the use of e-mail communication depending on whether the settlement in which the company headquarters is located is urban or not.

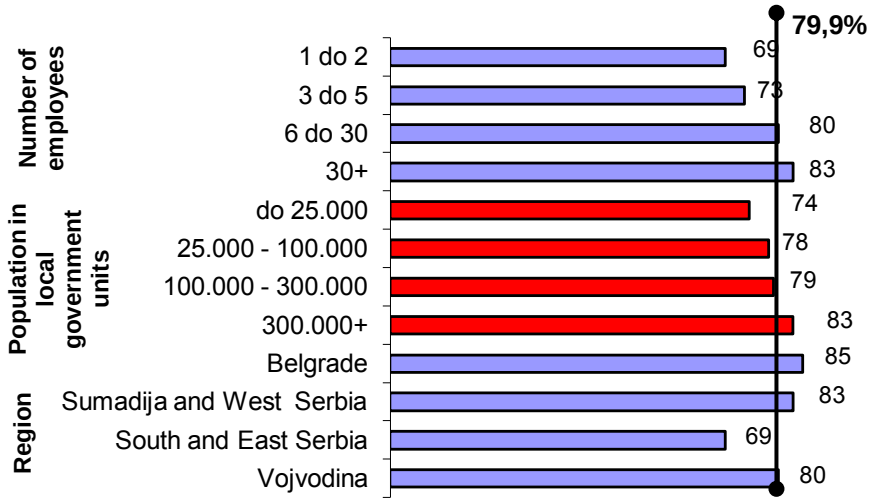

Figure 1: Prevalence of e-mail business communication use by companies

The prevalence of e-mail communication is directly proportionate to the size of the town/municipality by the number of residents. Thus, in smaller settlements (up to 25,000 residents), there is a significantly smaller number of companies (74%) that use e-mail in comparison to bigger towns of up to 100,000 residents (78%), up to 300,000 residents (79%) and over 300,000 residents (83%). Regionally observed, e-mail is most prevalent in companies based in Belgrade (85%), followed by Sumadija and West Serbia (83%), Vojvodina (80%), and South and East Serbia (69%).

It is common practice for Serbian business people and companies to use informally registered (with foreign or domestic providers) e-mail addresses for business communication, which is frequently not in line with the corporate e-identity of the company. One of the objectives of this survey was also the assessment of the degree of prevalence of Internet domains for e-mail communication in our companies.

Most frequent are the companies where the e-mail addresses of the employees are a part of the company"s e-identity (45%). Figure 2. This approach is particularly common for companies with more than 30 employees (62%), significantly less common for the companies with 6 to 30 employees (39%) and least prevalent in the companies with up to 5 employees (31%). 28.5% of the companies use the e-mail for business communications that is registered with some of the domestic providers, such as EuNet, Sbb, Ptt, SezamPro, etc., while approximately every fourth company (26.5%) uses e-mail registered with some of the global providers, such as Gmail, Hotmail, yahoo, etc. These types of e-mail addresses are most frequently used by small companies with up to five employees (39%), significantly less by larger companies with six and more employees (28%) and least by companies with 30 and more employees (16%). Also, the prevalence of the companies using these e-mail addresses is almost twice as high in smaller settlements with up to 25,000 residents (38%) than in bigger towns with over 300,000 residents (20%). If observed regionally, they are least prevalent in Belgrade (20%) and Vojvodina (25%), and significantly more in Sumadija and West Serbia (29%) and in South and East Serbia (36%) where almost every third company uses for their business communications e-mail addresses registered with global providers, such as Gmail, Hotmail, yahoo, etc.

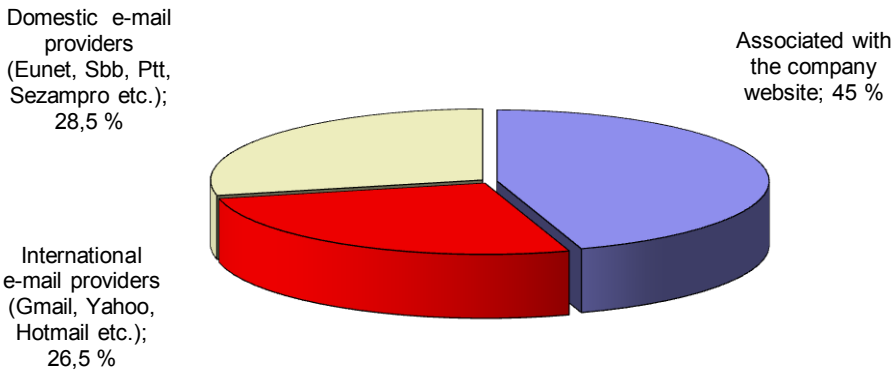

Figure 2: Internet domains companies use for e-mail business communication

According to the results of this survey, a little over half the companies (54.9%) in Serbia have a website (Figure 3). There is a statistically significant difference (Sig. 0.000) by the number of employees =27) a website. Thus, the average number of employees in the companies that have a website is approximately three times as high in comparison to the companies that do not have a website. Also, there is a statistically significant difference (Sig. 0.000) by the number of residents in the municipality/town – headquarters =378436) a website. Thus, the average number of residents in the municipality/town –headquarters of the company is approximately 58% higher for the group of companies that have a website in comparison to the group of companies that do not have one. If regionally observed, most of the companies that have a website are located in Belgrade (65%), significantly less in Vojvodina (56%), Sumadija and West Serbia (51%), and South and East Serbia (44%).

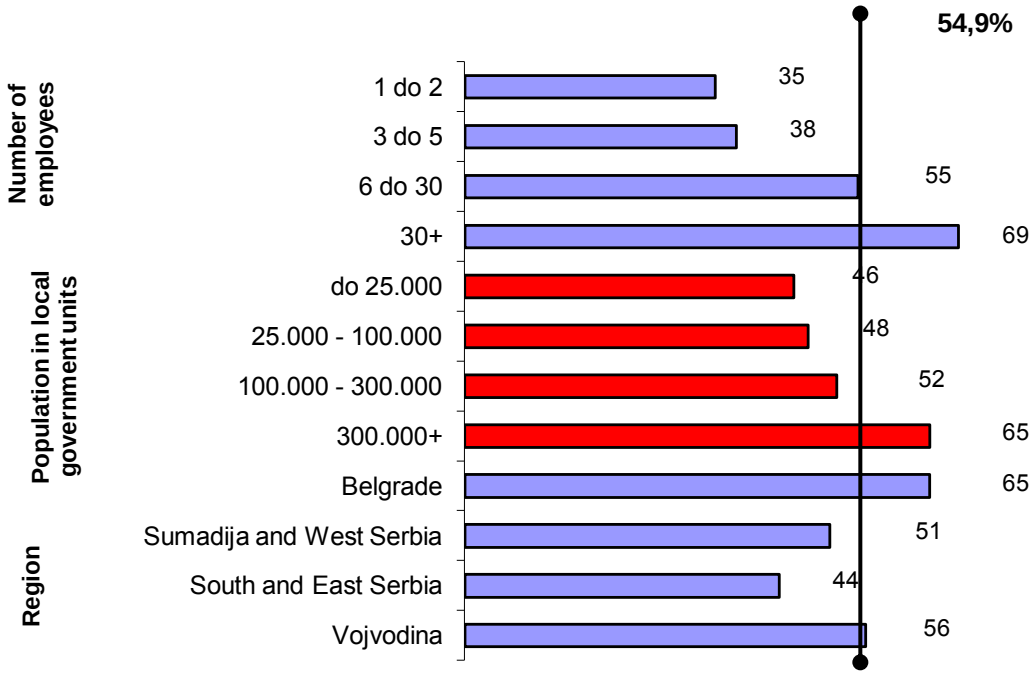

Figure 3: Prevalence of websites in companies

Out of the total number of companies that have a website (54.9%), a little over two thirds (67.9%) use national domains .rs and .co.rs. The .com domain is significantly less prevalent and it is used in 27.9% of the companies. All other domains (including .org and .net) are present in only 4.2% of the companies (Figure 4). Regionally speaking, the national domains .rs and .co.rs are most prevalent in the Belgrade companies (73%), followed by the region of Sumadija and West Serbia (66%), South and East Serbia (65%) and Vojvodina (65%).

There are no statistically significant differences in the prevalence of the national Internet domains when it comes to the websites of our companies with respect to the number of employees and number of residents in the municipality/town – headquarters of the company.

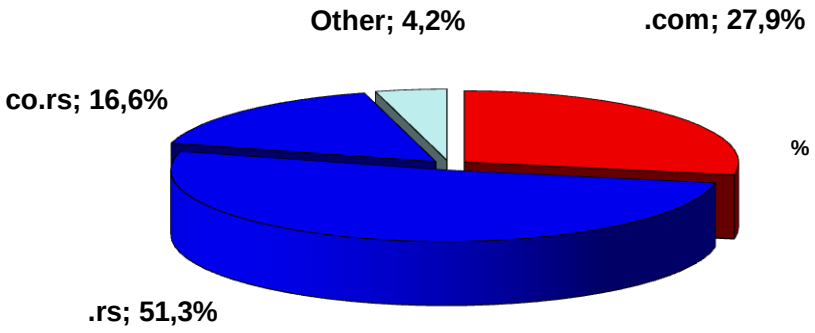

Figure 4: Prevalence of web domains

Through the analysis of the prevalence of the .com domain, it is possible to observe regional differences and thus the .com domain is most prevalent in Vojvodina (31%), a little less in the region of South and East Serbia (30%), and Sumadija and West Serbia (29%), and it is least prevalent when it comes to the sites of the Belgrade companies (23%).

4. CONCLUSION

The topic of this paper is an analysis of the role and importance of the Internet (e-mail and web) services with a special view at the Internet domains used by Serbian companies.
According to the data of the Statistical Office of the Republic of Serbia from 2013, 59.9% of the households in Serbia own a computer, while 55.8% of the households have an Internet access. 63.4% of the observed population (16 – 74) use a computer and 58.5% use internet. There is a continuous growth of the on-line population, with the annual growth rates of 7.5% (2012/2013), 4.6% (2011/2012), 1.1% (2010/2011) and 2.9% (2009/2010), which on average amounts to ~4% annually for the period from 2009 to 2013. Statistical data show that the growth of the on-line community in a demographic sense has reached a certain level of "saturation." Since population ageing and low level of education are the factors that to the greatest degree limit the growth of the number of Internet users, it is not to be expected that the number and structure of the on-line community will significantly change in the following period. Out of the Internet activities, the most prevalent are still e-mail (70.4%), surfing – browsing and downloading of web contents (69.5%), although the on-line user habits have significantly changed over the past few years with a larger share now being taken by the "social networks."

Out of the total number of Internet users, 68% are active on social networks, and as much as 93.4% of the online population between 16 and 24 years of age have a Facebook and/or a Twitter profile. The survey shows that 44.2% of the total Internet population use Internet for access to public institutions and administration. When it comes to e-commerce, during 2013 more than 900,000 people bought/paid something using Internet (increase by 300,000 in comparison to 2012). The results of this survey show that today in Serbia almost all companies and institutions use computers and Internet.

The survey has revealed the results shown in this study that can, in the briefest form, be brought down to the following:
Out of the total number of companies that have a website (54.9%), a little over two thirds (67.9%) use national domains .rs and .co.rs.
Out of the companies that have a company"s website, only in 45% of the cases the e-mail addresses of the employees are a part of the company"s e-identity.
For their business communications, 28.5% of the companies use e-mail that is registered with some of the domestic providers, such as EuNet, Sbb, Ptt, SezamPro, etc., while approximately every fourth company (26.5%) uses e-mail registered with some of the global providers, such as gmail, hotmail, yahoo, etc. This phenomenon is directly correlated with the size of the company measured by the number of employees and inversely correlated with the degree of urbanization. This demonstrates insufficient marketing literacy.
All of this goes to show that there is ample space in Serbia for further development of ICT, primarily in the sphere of education.
The global trends show a dominant impact of information technologies, Internet in particular, on contemporary business operations and it can be expected to see an even faster growth of this sector in the future.

The field of ICT has been recognized as the key factor for the economic development of Serbia and particularly for strengthening exports.

The (national) Internet domain is an important factor in the market approach of the businesses.
The national Internet domains provide a higher degree of reliability and security, thus ensuring a higher degree of clients" trust, since the domains cannot be registered by unidentified companies or individuals, which are very important in preventing misuses of domains (fraudulent misinterpretation, cyber crime...). For instance, the .com domain can be registered by anyone, without any real identification, even with completely fabricated data. Contrary to this, the users of the national .rs and .срб domains must provide accurate, complete and valid data when registering the domain, and these data are checked from time to time. This brings the possibility of frauds during on-line purchases, E-banking and other transactions on the Internet to the least possible degree.

The growing trend in Serbia of buying via Internet and the growing trend of using e-administration services

The growing use of computer applications: applications in large companies (airline companies, insurance, internet banking); applications in public organizations (e-voting, tax return); applications in health care sector (patient data, diagnostic tools and instruments, special surgical equipment); applications in education (learning through computer – CBT, distance learning, homework through Internet): adaptable learning time, adaptable place of learning, experience in multimedia learning, and reduced costs. Positive trends of applying distance working (teleworking):

The growing awareness among the citizens of Serbia of the need for environmental protection: use of electronic documents reduced the need for printed materials; recycling of printed materials; use of monitors with reduced energy consumption; recycling of used or broken computer components – all of this together leads to the broadening of the scope of electronic business operations.

REFERENCES

Strategy of Serbian Information Society until 2020. (2010). Off. Gazette of the Republic of Serbia, no. 51. Belgrade.

Vukmirović, D., Pavlović, K. & Šutić, V. (2012). The use of ICT in the Republic of Serbia. Statistical Office of the Republic of Serbia. Belgrade.

Statistical Yearbook of the Republic of Serbia (2013). Statistical Office of the Republic of Serbia. Belgrade.

19. Strategy for the eGovernment Development in Serbia for period of 2009-2013. (2009). retrieved from: http://www.srbija.gov.rs/vesti/dokumenti_sekcija.php?id=45678.

Chaffey, D. (2002). E-business and E-Commerce Management. Pearson Education, Inc.

Jobber, D. & Fahy, J. (2006). Principles of Marketing. Data Status.

David, M. & D. Sutton, C. (2011). Social Research. SAGE Publications, Ltd.

Turban, R. (2009). Introduction to Information Systems. Support and Business Transformation. Data Status.

Bayne, K.: The Internet Marketing Plan. John Wiley & Sons, Inc. 2000.

Rainie, L., Horrigan, J., Wellman, B. & Boase, J. (2010). The Strength of Internet Ties. Pew Internet and American Life Project.

Vukmirović, A., Živanović, M., Vukmirović, J. & Zdravković, J. (2013). Potential of social networks in the implementation of marketing campaigns in Serbia. E-trgovina 2013 - eBusiness Conference.

Jara, A., Concepción Parra, M. & Skarmeta, A.(2013). Participative marketing: extending social media marketing through the identification and interaction capabilities from the Internet of things. Personal and Ubiquitous Computing.

Foreman, J. (2013). Data Smart: Using Data Science to Transform Information into Insight. Wiley Publishing Inc.

Electronic communications act (2010). Off. Gazette of the Republic of Serbia, no. 44/2010 and 60/2013 - decision US. Belgrade.

INVESTIGATING WEB-BASED DECISION SUPPORT SYSTEMS SUCCESS IN ONLINE SHOPPING CONTEXT

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Abstract: *The web-based DSS success in online shopping field lead to increase the purchase level and attracting new customers. The objective behind various online shopping systems initiatives has shifted in recent years towards establishing services and demands that cater more to citizens' needs and offer greater accessibility. As a result, it is necessary to develop a theoretical framework to measure the success of web-based DSS in online shopping context. The purpose of this study is to identify the success factors influencing web-based DSS in online shopping field from the internet users' viewpoint. A theoretical framework was developed to evaluate online shopping systems success. Initially, DeLone and McLean's IS success model (1992; 2003) was used as the base model for this research. Additional variable was incorporated into the model from web-based DSS literature, and re-specifications and extensions were made to develop a proposed success model for web-based DSS in online shopping context. Consumer decision making satisfaction and perceived net benefit was proposed as a measure of web-based DSS success in online shopping field, and its relationships were hypothesized with online shopping system quality, data quality, and knowledge management. Five hypotheses were formulated to test the proposed research model.*

Keywords**:***Success factors;Web-based DSS Success; Decision making satisfaction; Perceived net benefit; Online shopping; Knowledge management.*

1. INTRODUCTION

The usage of Internet has grown rapidly over the past years and it has become a common means for delivering and trading information, services and goods (Delafrooz, 2009). The web in particular and the Internet as a mother network, vital area to manage and develop the technical capabilities of decision support systems. There are different types of decision support systems that are based on the Web (Web-Based DSS) are directed to support management and decision-making and decision support systems geared to the customer. Also, online shopping has become very popular in the last few years. There are many of online shops available all around the Internet, where customers can purchase any commodity that they want as cars, books, electronics, jewellery, clothing and many other products while sitting comfortably at their home (Janik, 2007). Recently, the web has now become the platform of choice for building consumer Decision Support Systems (DSS). According to Bharati & Chaudhury, (2004) DSS on the web has precipitated three major changes to the environment where DSS is being employed: a change in the user community, a change in problem domains, and a change in the underlying technology architecture. In the past, DSS applications have generally been implemented in commercial environments where users are employees of the firm. With the advent of web-based DSS, the user community is no longer limited to the managers and experts working on business-related problems, but beyond that to the ordinary users and customers. These changes in DSS have made it incumbent on the DSS researchers to reexamine the factors that influence efficacy and success of DSS in this new environment. An example of a web-based DSS for customers is found at www.amazon.com, www.dell.com, www.overstock.com, www.myidaman.com, www.shopping.com, and www.tabo.ps and others, as online shopping systems, where customers can choose the kind of Commodity or service. These and other self-service information technologies that aid in decision-making are becoming quite prevalent. These web-based DSS are being used, but there is little research that has evaluated these systems from the perspective of users. Thus, more studies are needed that focuses on evaluating web-based DSS in online shopping context and exploring the success factors influencing web-based DSS success in this field.

This study investigated the factors that affect consumer decision making satisfaction and in turn, perceived net benefit, that is to say measuring the success of web-based DSS through decision making satisfaction and perceived net benefit, where the research model developed based on the Delone & McLean, (1992; 2033)IS success models.

2. BACKGROUND

Web-based DSS in Online shopping context is relatively a new phenomenon but expanding very rapidly worldwide. In comparison to in-store shopping, online shopping is far too much efficient in reaching the targeted customers that can provide substantial time and cost saving (Anwaar, 2008). During the last 30 years the access of personal computers has increased all over the world. Along with the development of new technology and computers, the ability to connect computers all over the world emerged in the 1970s. This worldwide computer network was called the Internet. Along with the Internet an opportunity has emerged; the possibility to make purchases online which is called Electronic commerce (E-commerce) (Eliasson, et al., 2009). As said by Brown & Jayakody (2008), the e-commerce is more narrowly defined in terms of the purchasing and selling products or services through the medium of the Internet, and Companies are making large investments in e-commerce applications but are hard pressed to evaluate the success of their e-commerce systems (DeLone & McLean, 2003). This growth in e-commerce is the reason behind recent attempts to measure the success of online shopping systems. The advent of E-Commerce, from the Business to Consumer (B2C) perspective, has opened new opportunities for sales, as well as new issues to address in the design of web-based DSS in online shopping field. In online shopping systems, buyers benefit from convenient access to information and commerce while sellers benefit from selling to consumers anytime and anywhere with low bricks-and-mortar and intermediary costs. Despite these benefits for both buyers and sellers, the current conversion rates are still very low (2%-6%) (Eisenberg, 2004).Furthermore, the proliferation of online products provides a wide variety of choices for the consumer in selecting a product that meets his/her preferences. However, the large number of choices available on the web, Difficult to use, and inadequate information and non-obvious and perhaps other reasons, consumers often find it difficult to make a final choice of a product. Therefore, one crucial task for online shopping systems is to help buyers select products with a minimal amount of effort and time, to attract consumer to choose his demand (Pu, & Kumar, 2004). Since online shopping sites are accessed by diverse types of consumers with different backgrounds, preferences and expertise, their usability should satisfy different consumer needs and preferences in the process of product search and choice. As a result, it is an essential task to provide decision assistance for the end user to determine the target product both accurately and efficiently. Understanding the factors influencing consumer decision-making satisfaction could guide designers and researchers to build more effective online shopping systems that provide the necessary support for consumers. So, many researchers have argued that consumers with DSS will perceive better information quality, faster decision, more satisfaction and higher intention to use the system in the future than without such support. To summarize, several researchers have studied the effect of consumer decision support systems on the online shopping environment and its importance in providing an effective support to in raising the level of sales and then the success of online shopping systems. As result, purchase decision-making process and the availability of such DSS in online environments will enhance the ability of individuals to identify the products that best match their preferences.

2.1. Decision Support System (DSS)

As known, the DSS technology has been rising and flourishing since 1970s. By the 1980s, dramatic improvements in technology resulted in information systems that were less expensive but more powerful than earlier systems. People at all levels of organizations began using personal computers to do variety of tasks; they were no longer solely dependent on the IS department for all their information needs. So, people quickly recognized that computer systems could support additional decision-making activities. A DSS is an organized collection of people, procedures, software, databases, and devices used to support problem-specific decision making. The focus of a DSS is on decision-making effectiveness. Where a management information system helps an organization" do thing right," a DSS helps a manager "do the right thing" (Ralph & George, 2006). DSS's components are: base models and database management systems models MBMS, and database management systems and databases DBMS, with an interface provides ease of use, and flexibility to deal with the system software (Al-Takreety, 2004). In short, the Essential idea based decision support systems is to build systems give the ultimate beneficiary useful tools for data analysis using models and databases, and provide possible solutions to the problems presented. Recently, DSS have become a significant domain of Information Systems research. According to Newman et al., (2000), Decision support systems are computer systems assist the user in complex problem solving or decision-making. Cited in Holley, (2011) Burstein & Holsapple (2008) define the term of DSS as systems which represent and process information for the purpose of improving decision making. In turn, Holley, (2011) said that DSS can range in

level of sophistication from a simple spreadsheet to sophisticated data warehousing and mining applications, knowledge management systems, or modeling systems. According to Kwakkel, (2006) the field has evolved from two research areas: the study of organizational decision making and technical studies into applications for computers. According to Keen, (1980); Huber, (1983) & Schroff, (1998), it is impossible to give a definition of DSS that covers all the aspects. Holsapple (2008) presents Figure (1) as the framework most commonly cited in literature to illustrate a typical DSS architecture.

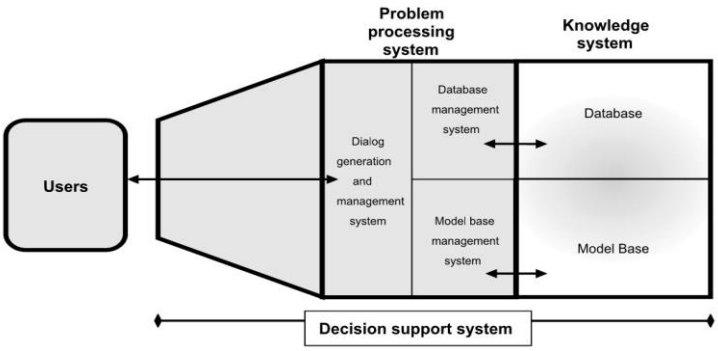

Figure 1: Popular DSS architecture framework. Holsapple (2008) p.183

To summarize, based on previous definitions of DSS and through a comprehensive survey of many of the definitions of DSS in the literature, the researcher concluded that there is no one single definition, Full, inclusive, generalizable, and agreed on by all researchers of DSS, but it is clear that there is consensus about the fact that DSS are computer-based systems that support management decision making. This broad definition can encompass many systems as web-based DSS. Pattern offers a way to characterize these systems and differentiate between them. The current research focusing on web-based DSS directed to consumer in online shopping context.

2.2. Web-Based Decision Support Systems

With the enormous development in the techniques of the Internet and the vast amount of information, data, and alternatives of various goods and services provided by Web sites, the concept of decision support systems In the development of a permanent, so, became one of the most important types of decision support systems is web-based DSS, therefore, the web-based DSS is chosen as the DSS architecture. And as mentioned by Aldhmour & Eleyan, (2012) that many types of Computer-Based Information Systems have been developed to support decision making. According to Wang & Yeh, (2009) a web-based DSS refers to a computerized system that delivers decision support information through a web browser to someone who needs it. According to Friedman, (2005) the importance of using web based DSS originates from the growing amount of available information that should be identified, controlled and accessed remotely using web based tools to support reusability of integrated decision modules. According to Gasmelseid, (2006) web-based systems are regarded as "platforms of choice" for delivering decision support while taking into account many technical, economic and social considerations. With the advent of web-based DSS, the user community expands to include, in addition to the managers and experts working on business-related problems, customers, suppliers and financers who shape the firm's policies and decisions (Gasmelseid, 2006). According to Velmurugan & Narayanasamy, (2008), the term is usually used to describe a computer based system designed to help decision makers use data, knowledge and communications technology to identify problems and make decisions to solve those problems.

2.3. Online Shopping Decision Making

Online shopping are interactions between individual recipients and consumers rather than being directed from marketing to masses of consumers (budi, 2010).The most common types of information systems used in business organizations are electronic and mobile commerce systems, transaction processing systems, management information systems, and decision support systems. In addition, some organizations employ special-purpose systems such as artificial intelligence systems, expert systems, and virtual reality systems. Together, these systems help employees in organizations accomplish both routine and special task-rom recording sales, to processing payrolls, to supporting decisions in various departments, to providing alternatives for large-scale projects and opportunities (Ralph & George, 2006).E-commerce involves any business transaction executed electronically between parties such as companies (business to business, B2B), companies and consumers (business to consumer, B2C), consumers and other consumers (consumer

to consumer, C2C), business and the public sector (administration), and consumers and the public sector. As known, web shopping is a part of the e-commerce picture. Figure (2) shows the different sectors of E-Commerce, as Merz describes them (Sebastian, 2008).

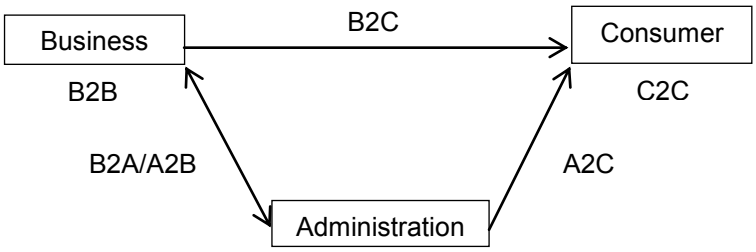

Figure 2: E-Commerce Sectors

E-commerce offers opportunities for small businesses, too, by enabling them to market and sell at a low cost worldwide, thus allowing them to center the global market right from start-up.Consumers who have tried online shopping appreciate the case of e-commerce. They can avoid fighting crowds in the malls, shop online at any time from the comfort of their home, and have goods delivered to them directly.The online Shopping Decision Making is act of purchasing products or services over the Internet, Where online shopping has grown in popularity over the years, mainly because people find it convenient and easy to bargain shop from the comfort of their home or office. Since the Internet provides quick and easy comparison of many different types ofProducts, searching for product information and buying goods online are becoming increasingly popular activities. According to Park, (2007) online shopping is an activity in which consumers make a transaction to purchase products or services offered by online stores.According to Zhang, (2011) consumer decision making process consists five stages: problem recognition, search, alternatives evaluation, choice and outcome.

According to Sharkey et al., (2009) selecting a product alternative is a multi-attribute decision process. Based on Waterfall diagram of decision process, the super-set, which contains all existing product alternatives, is the Universal Set, of course, the consumer may not be interested in all the alternatives in the set that sub-set of alternatives of which the consumer is aware, is the Awareness Set. All of the alternatives which the consumer proceeds to collect information about is called the Evoked Set and the set which the consumer evaluates further from the Evoked Set is called the Consideration Set, in turn, the choice is made from this final Consideration Set, see figure (4)

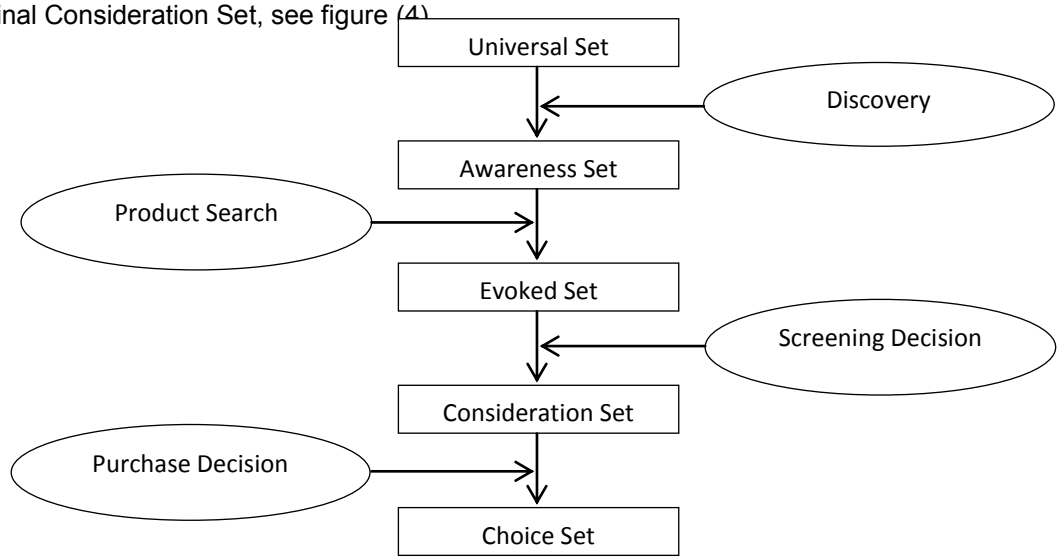

Figure 4: Waterfall diagram of decision process (Sharkey et al., 2009)

3. PROBLEM DEFINITION

A lot of active online stores do not provide enough motivations to the customers to get attracted to online shopping. Also, many of companies in the world rushing to open their online shopping systems which led to fail to support consumer's decision making, and loss of sale and the customer's repeat business.

The current study attempts to investigate and explore the success factors that influence consumer decision making satisfaction in online shopping context. Also, this research will use existing models that explain and predict information systems (IS) success as Delone & McLean, (1992; 2003). However, these success models need to be updated to recurrent industry developments. Where the researcher believes that the E-commerce environment and specifically the online shopping field is a unique setting to study and develop the DeLone and McLean's model of IS Success. Where the online shopping system is different from other types of systems implemented because its use is volitional instead of mandatory. Also, the system is not internal to the organization; in its primary use, it faces the customer, not organizational employees (Perez-Mira, 2010).

4. THEORETICAL ADVANCEMENT

IS researchers within the field of DSS have been attempting to identify more up-to-date and modern factors that affect web-based DSS success in field of online shopping. Based on this, we set out to find the opportunity factors that could suit the suggested research model by complementing it, where it today lack coverage (Johansson & Gustafsson, 2009).

Previous research on DSS has been mainly focused on factors for successful implementations of DSS for different scopes. Park (2007) identified aspects such as project factors, organizational factors and infrastructure factors have had significant impact on successful implementation. Further, he also found indications of that the external environment and prototyping were critical for successful implementation. Hence, the factors that were suitable and relevant for this investigation were accordingly those that relate to the web-based DSS success part of the previous models and concentrates on what factors affects the consumer decision making satisfaction, in turn perceived net benefit within an end-user perspective in online shopping context (Johansson & Gustafsson, 2009).

4.1.Perceived Net Benefit

According to Marafie, (2008) the perceived net benefits of online shopping in relation to traditional store shopping are one of the driving forces in the adoption. Convenience factors such as ease in purchase and time saving could be considered as perceive benefits of online shopping.

As known, Net benefits added as new construct to the updated DeLone & McLean (2003) model. The construct includes and replaces two variables previously found in the DeLone & McLean (1992) model: individual impact and organizational impact. These are defined as the system impact on an individual (user) and organizational performance, respectively. According to Holley, (2011) Critics of the model point out the Restriction of these two variables, arguing that the impacts of a system can span a wide range of stakeholders - consumers, work groups (e.g. Ishman (1998)), industries (e.g. Clemons et al. (1993)), even society (e.g. Seddon (1997)). Accordingly, the DeLone & McLean (2003) replace the two "impact constructs" with the more generic construct net benefits.

According to Delone & McLean, (2003) the impacts of IS have evolved beyond the immediate user, where some of researchers have suggested additional IS impact measures, such as work group impacts, Inter-organizational and industry impacts, consumer impacts, and societal impacts. Clearly, there is a continuum of ever-increasing entities, from individuals to national economic accounts, which could be affected by IS activity. The choice of where the impacts should be measured will depend on the system or systems being evaluated and their purposes. Rather than complicate the model with more success measures, Delone & McLean Preferred to move in the opposite direction and group all the "impact" measures into a single impact or benefit category called "net benefits." We can study net benefits at the individual level, where the customer can benefit from the system in terms of increased information, lower prices, ease of purchase, etc. Accordingly, in present research, we will adopt the net benefits as measurement Factor for web-based DSS success in online shopping context (dependent variable).

4.2.Consumer Decision Making Satisfaction

User Satisfaction is the most general perceptual measure of information systems success (Seddon, 1997). In the e-commerce environment it is an important means of measuring customers' opinions of the e-commerce system (DeLone & McLean, 2003). Customers in this study refer to only those who are familiarity with online shopping systems.Many of studies that emphasized decision performance typically downplayed or ignored the level satisfaction of the Web-based DSS users. With the growth of competitive Web retailing, however, understanding how to satisfy customers who obtain their information or services from web sites will be critical for establishing long-term client relationships, which consequently increases profitability. Therefore, understanding how online shopping users formulate satisfaction when obtaining information and services is

of great importance to Internet business. However, based on literature review, there are very few studies that systematically examined antecedents variables to satisfaction of users obtaining their information and services from Web-based DSS in online shopping context (Gudigantala, et al., 2011).
According to Saha, (2008) User satisfaction is the most common measure of success determination, and many researchers have developed and tested several standardized instruments to measure satisfaction as (DeLone & McLean, 1992, 2004).Although several authors have defined satisfaction, there is no single universally accepted definition. DeLone & McLean (1992) defined satisfaction as "Recipient Response to the Use of the Output of an Information System." A researcher must define the concept according to the context when multiple definitions exist for the construct; and also define the measurement criteria for the construct according to the chosen definition and the scope of research. In the present study, satisfaction was considered as a citizen's evaluative judgment of overall use of the online shopping service.According to Saha, (2008) in information system success and e-commerce success, different scholars developed antecedents of satisfaction, such as system quality, information quality, service quality, perceived usefulness, perceived ease of use, and trust (DeLone & McLean, 1992, 2004; Seddon & Kiew, 1996; Seddon, 1997).
In this current research we explore critical success factors influencing decision making satisfaction with web-based DSS which refers to the contentment of the consumer with the particular DSS application used.
It is noted that decision making satisfaction significantly correlated with perceived net benefit where the most important reasons for decision making satisfaction are to achieve some or all of the benefits that expected from the decision making. Also, Achievement of benefits and satisfy the desires will have the effect on decision making satisfaction. In other words, there is a mutual effect between decision making satisfaction and perceived net benefit. Accordingly, we will adopt decision making satisfaction as other measuring factor for web-based DSS success in online shopping context (dependent variable).

4.3.Online shopping System quality

There are different types of e-Commerce websites that focus on different areas of business activities. The most common type of e-Commerce website is business web portal (Wei, 2012).A great number of new websites have been launched every day. Ones with similar content will not have the same degree of quality. If the quality is poor, the user will simply leave the website and go elsewhere. Generally, there is no second chance to get a user back to the website especially in online shopping context. Therefore, in order to improve the quality of a website. The quality of a website makes a website profitable, user friendly and accessible, and it also offers useful and reliable information, providing good design and visual appearance to meet the users' needs and expectations (Zhou, 2009). In the Internet environment, System Quality measures the desire characteristics of an e-commerce system (DeLone & McLean, 2003, 2004). It is important to evaluate Web site functionality that focuses on the online service functions it provides.In the context of the present study, we changed system quality by online shopping system quality and defined it as follows: "online shopping system quality measures the desired functionality and performance characteristics of online shopping system".According to Stevens, (2008) many studies reported, a company's website is the key tool for the user's communication and it is the primary interface when searching forInformation and/or products online. If an organization's website is difficult to use, it will project a poor image on the Internet and will weaken the organizations position.Therefore, it is important that an online shopping system possesses a qualitative good website.

Online systems are measured in many studies. Measuring goes from online system interface up to the entire purchase experience. In this study, online shopping system quality will be approached from a more technical view and the objective is to know what consumers expect of the online shopping system they use and their experience; which attributes are important if a consumer makes his judgment about the quality? For measuring online shopping system quality many academic researches exist, but the outcomes are mostly fragmented and only discussing the meaning of some aspects of online system quality, but no scales to measure users' perceived online shopping system quality are available.

In summary, the dimensions of the researchers are quite wide. These differences arise mostly because they all did a survey with a somewhat different focus and their methodological approaches are varied. In this research, online shopping system quality is defined as the users' evaluation of the online shopping system features meeting users' needs. This definition is important to detain the domain of online shopping system quality.Therefore not all the existing literature is mentioned, but only the relevant literature from which sample items for the web quality construct can be taken.

4.4. Data Quality

Information Quality is concerned with issues such as the relevance, timeliness, and accuracy of the information generated by an information system (DeLone & McLean, 2003; 2004). In the e-commerce

context, as we mentioned earlier, we replaced information by data, and data delivery is an important role of online shopping systems, and quality is considered a critical issue. In addition, Cowie & Burstei, (2007) also addressed the issue of quality of data that was considered as an important factor influencing the quality of the decision by implement of the DSS.
Several quality evaluation aspects are essential, including the correctness of the output information or data, the availability of the output information at a time suitable for its use, and the comprehensiveness of the output information content.
In the context of the present study, we defined Data quality as follows: Data quality measures the characteristics of Data provided by a online shopping system. (Saha, 2008).

4.5.Knowledge Management

As known, today the usage of information and knowledge has increased in all types of organizations in order to simplify all the activities and enhance the decisions making process. Knowledge Management (KM) is an organization strategic effort that used to capture information and experience of employees and customers which is stored in database, paper or in peoples' intellect then distributes this knowledge to gain more benefit. KM is a value-added technique that aims to maximize profits, innovation, and decision making by share better information and knowledge between every member working within the organization (Mohsen et al., 2011).
On the other hand, one factor influencing customer purchasing habits is customer knowledge. Some people are not interested in online shopping because they lack knowledge of the Internet, computers and modern technology. They also do not want to take the time to learn about those areas. They would like to go to retail shops to ask staff for the information that they want and to choose products by physically seeing and touching the products. different groups of people with different knowledge backgrounds regarding any product may choose different ways to buy the products: for example, many customers may prefer shopping online for products because they have more prior knowledge of products on which to base their research, while older people may choose to buy products in the retail shops because they require more information and assistance from a salesperson and they may not be comfortable with online shopping forms" (Li, 2010).
The emergence of the Internet has also created a dynamic, electronic marketplace, where a new species of e-commerce organization is being established (Singh & Kundu, 2002). At the heart of the e-commerce organization is the website through which all the transactions take place. Besides supporting online transactions, a website can also give customers a means to obtain information about products and services (Kohavi, 2001) and companies the means to obtain information about their customers.
With the growing importance of knowledge in e-commerce, one of the main purposes of a website is the ability to acquire knowledge by the both the customers and the organizations (Fang & Holsapple 2003).

5. CONCEPTUAL RESEARCH MODEL

Based on the discussion above, the factors that are important in the context of online shopping systems include the core IS success measures of system quality (referred to Online Shopping System Quality), information quality (also referred as data quality in Online Shopping environments), Knowledge Management (referred as knowledge in Online Shopping systems)user satisfaction (also referred as Consumer Decision Making Satisfaction in Online Shopping field)and Perceived Net Benefit in the same field.
Based on the theoretical perspectives, the following conceptual model is proposed, which incorporates concepts from earlier models to be applied to testing in the area of online shopping and other fields. This model is conceptually based on the DeLone & McLean(1992; 2003) IS success model which explains the impact of IS at the individual and organizational levels.
From previous studies and from the discussions concluded so far, it becomes evident that the dependent constructs in the model are "consumer decision making satisfaction and Perceived Net Benefit" and the independent constructs are: online shopping system quality, data quality, and Knowledge Management, as shown in Figure (5).
The researcher Expect that online shopping system quality, data quality and knowledge management have an impact on consumer decision making satisfaction. Consumer decision making satisfaction have an impact on perceived net benefit, and perceived net benefit have an impact on consumer decision making satisfaction. This means there is mutual effect between consumer decision making satisfaction and perceived net benefit.

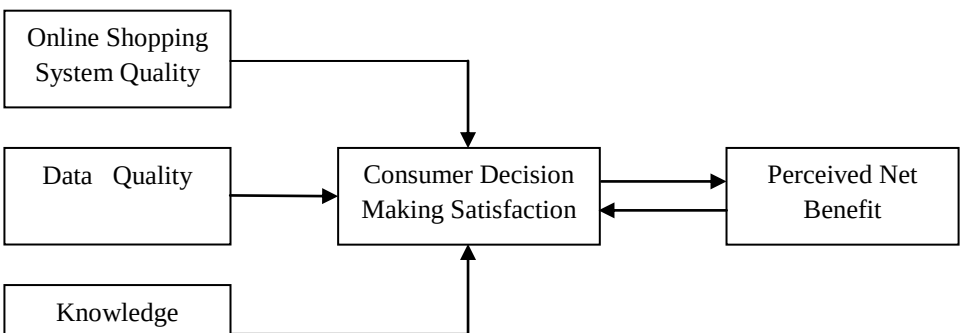

Figure 5: Proposed model for web-based DSS Success in online shopping context

In this study, Web-based DSS success in online shopping field is defined through consumer decision-making satisfaction and perceived net benefit. Consumer decision-making satisfaction is proposed to be determined by online shopping system quality, data quality, and knowledge management, in turn, consumer decision-making satisfaction and perceived net benefit have mutual effect. Therefore, the hypotheses can be generated as follows:

H1: Online Shopping System Quality positively affects Consumer Decision Making Satisfaction.
H2: Data Quality positively affects Consumer Decision Making Satisfaction.
H3: Knowledge Management positively affects Consumer Decision Making Satisfaction.
H4: A high level of Consumer Decision Making Satisfaction is associated with a high level of Perceived Net Benefit.
H5: A high level of Perceived Net Benefit is associated with a high level of Consumer Decision Making Satisfaction.

6. CONCLUSIONS AND FUTURE RESEARCH

The propositions presented in this paper an opportunity for further investigation in the web-based DSS evaluation with focus on success factors influencing Web-Based DSS in Online Shopping Context.

The proposed model should be of interest to IS practitioners in general and DSS practitioners in particular and academic community. For the practitioner community, the model will enhance their understanding on the factors that contribute of DSS success and enlighten DSS-vendors about what parts of the post-implementation phase they should concentrate on to increase the success of the system and end users decision making satisfaction. For the academic community, the proposed model provides ample research opportunity to validate in order to support or refute the proposed propositions.

We recommend other researchers for the work of empirical study on the proposed model in communities that have a weakness in the field of online shopping to measure the success of web-based DSS in the field of online shopping. Also, to know and anticipate the factors that affect the acceptance of online shopping idea by citizen's especially in countries that in initiative stage of construction and implementation of online shopping systems.

REFERENCES

Aldhmour, F. M. & Eleyan, M. B., (2012) Factors Influencing the Successful Adoption of Decision Support Systems: The Context of Aqaba Special Economic Zone Authority. International Journal of Business and Management, Vol. 7, No. 2.

Anwaar H. M., (2008) the impact of Demographics, Shopping Orientations, and Risk Perception on Kuwaiti Consumers, Master of Business Administration, Kuwait-Maastricht Business School.

Brown, I. & Jayakody R., (2008) B2C e-Commerce Success: a Test and Validation of a Revised Conceptual Model. The Electronic Journal Information Systems Evaluation Volume 11 Issue 3 2008, pp. 167 - 184, available online at www.ejise.com.

Budi, k. (2010) Factors affecting customer satisfaction in purchase decision on ticket online: a case study in air Asia. Master thesis, State Islamic University Syarif Hidayatullah.

Clemons, E. Reddi, S. & Row, M., (1993) the impact of information technology on the organization of economic activity: The "move to the middle" hypothesis. Journal of Management Information Systems Vol 10 No 2 pp 9-35

Cowie, J., & Burstein, F. (2007). Quality of data model for supporting mobile decision making. Decision Support Systems, Vol.43, N.4, pp.1675-1683. http://dx.doi.org/10.1016/j.dss.2006.09.010

Delafrooz, N., (2009) factors affecting students' online shopping attitude and purchase intention, university putra Malaysia

DeLone, W. H. & McLean, E. R., (1992) Information system Success: The quest for dependent variable, Information system research 3:1

DeLone, W. H. & McLean, E. R., (2003) The DeLone & McLean Model of information system success: A Ten- Year Update, Journal of Management Information System, 19(4), 9-30.

DeLone, W H. & McLean, E. R., (2004) Measuring e-Commerce Success: Applying the DeLone & McLean Information Systems Success Model, International Journal of Electronic Commerce, 9 (1), 31–47.

Eliasson, M.; Holkko, L. J.; Smajovic, S. (2009) Thesis within Business Administration, E-commerce: A study of women's online purchasing behavior.

Eisenberg, B., (2004) Benchmarking an Average Conversion Rate, ClickZ Experts.

Friedman, T. L, (2005) the World Is Flat: A Brief History of the Twenty-First Century, Farrar, Straus and Giroux.

Fang, S. & Holsapple, C. W., (2003) the usability of websites for knowledge acquisition: a taxonomy of influences, Inter-national Journal of Electronic Business, Vol. 1, No. 2, pp 211-224

Gudigantala N. Song J. & Jones D. (2011) User satisfaction with Web-based DSS: The role of cognitive antecedents, International Journal of Information Management.

Gasmelseid, T. M., (2006) Multiagent Web based Decision Support Systems for Global Enterprises: An Architectural Blueprint, Department of Information Systems,College of Computer Sciences and IT, King Faisal University

Huber, G.P. (1983). Effects of DSS on governmental organizations and policy making. Proceedings of the 17th ICA conferences, Copenhagen.

Holley, M. R., (2011) Decision Support Systems and Financial Risk Assessment: An evaluative study, Lund University

Holsapple, C. W., (2008) DSS Architecture and Types. In Burstein, F. & Holsapple, C.W. eds (2008): Handbook on Decision Support Systems 1. Springer, Berlin.

Ishman, M. (1998) Measuring information system success at the individual level in cross-cultural environments. In Garrity, E.; Sanders, L. eds (1998): Information Systems Success Measurement. Idea Group, Hershey, PA

Janik, M., (2007) Online Shop Web Tier in Java EE, masaryk university, faculty of informatics.

Johansson, J. & Gustafsson, B., (2009) Critical Success Factors affecting Decision Support System Success, from an end-user perspective. Master thesis, Department of Informatics, Lund University.

Kwakkel, J. H., (2006) DSS failure studied from an adaptive design perspective, Delft University of Technology

Kohavi, R., (2001) Mining E-Commerce Data: The Good, the Bad and the Ugly, Proceedings of the 7th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, San Francisco, USA, pp. 8-13

Keen P. G. W. (1980). Decision support systems: A research perspective. Data Base, 12 (1/2), 15-25.

Li, P., (2010) Factors that affect students' decision making on buying computers: online or in retail shops. Master of Computing, Unitec New Zealand, Department of Computing.

Marafie, A. H., (2008) the impact of Demographics, Shopping Orientations, and Risk Perception onKuwaiti Consumers. Master of Business Administration, the Maastricht School ofManagement (MSM), Maastricht, the Netherlands.

Mohsen, Z. A., Ali, M., Jalal, A., (2011) The Significance of Knowledge Management Systems at Financial Decision Making Process. International Journal of Business and Management, Vol. 6, No. 8.

Newman, S. Lynch, T. & Plummer, A. A., (2000) Success and failure of decision support systems: Learning as we go, Central Queensland University, North Rockhampton, Queensland 4702 Australia

Park, Y. A., (2007) Investigating Online Decision-Making Styles, Texas A&M University

Perez-Mira B. (2010) Validity of Delone and Mclean's model of information systems success at the web site level of analysis, Doctor of Philosophy in The E.J. Ourso College of Business Information Systems and Decision Sciences

Pu, P. and P. Kumar. (2004) Evaluating Example-based Search Tools. in Proceedings of the 5th ACM conference on Electronic commerce. New York, NY, USA: ACM Press.

Schroff, A. (1998). An approach to User Oriented Decisioin Support Systems, Inaugural-Dissertation, Druckerie Horn Buchsal.

Saha, P., (2008) Government e-Service Delivery: Identification of Success Factors from Citizens' Perspective. Doctoral thesis, Lulea University of Technology.

Singh, N. & Kundu, S., (2002) Explaining the growth of E-commerce corporations (ECCs): An extension and application of the eclectic paradigm, Journal of International Business Studies, Vol. 33, Iss. 4, pp 679- 697

Seddon, P., (1997) A Specification and extension of the DeLone and McLean Model of IS Success. Information Systems Research Vol 8 No 3 pp 240-253
Seddon, P. B. & Kiew, M. Y. (1996), A partial test and development of delone and mclean's model of is success, Australian Journal of Information system (AJIS) Vol. 4 No. 2, may.
Sharkey, U. Acton, T. Conboy, K., (2009) Modeling the Effects of Decision Tools in Online Shopping, 22nd Bled e-Conference, e-Enablement: Facilitating an Open, Effective and Representative e-Society June 14 - 17, 2009; Bled, Slovenia
Sebastian, B. (2008) Analysis of Online Shop Systems. Diploma thesis, University of applied Sciences.
Stevens, J., (2008) Website quality versus social capital as determinants ofeWOM in social online community settings. Master Thesis, VrijeUniversiteit Amsterdam.
Velmurugan, M. S. & Narayanasamy, K., (2008) Application of Decision Support System in E-commerce, Multimedia University, Melaka, Malaysia.
Wei, L., (2012) Success Factors for Transactional e-Commerce Websites: an Investigation Focusing on Technical and Business contexts. Master of Computing
Wang, T. Y. & Yeh, D. H., (2009) A Web-Based DSS Architecture and its Forecasting Core in Supply Chain Management, International Journal of Electronic Business Management, Vol. 7, No. 2, pp. 98-111, Taiwan
Zhang, J. L., (2011) an Empirical Analysis of Online Shopping Adoption in China, Lincoln University, Canterbury, New Zealand.
Zhou, Z., (2009) Evaluating Websites Using a Practical Quality Model. MPhil Thesis, Software Technology Research Laboratory, De Montfort University.
Ralph M. S. & George W. R., (2006) principles of Information Systems: A Managerial Approach, Seventh Edition, Thomson, Course Technology.
Al-Takreety S. G. Y., (2004) Decision Support Systems, Second Edition, Curriculum house for Publishing andDistribution, Amman-Jordan.

USING BIG DATA FOR CUSTOMER LOYALTY IN ONLINE BUSINESS

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Abstract: *Concept of Big Data is one of the key trends in recent years which significantly affects all players in the marketplace and which will be one of key sources of competitive advantage in the future. Nowadays, many start-up companies base their entire business model on big data while established old corporations seek ways and build infrastructure to enable efficient use of big data in management processes for achieving their business objectives.*

Big data can have many applications in a company – this paper focuses on online sales and rewarding loyal customers. Paper reviews internal corporate capabilities and processes, online solutions as well as how to engage and reward customers. Upon review of theory, existing solutions and good practices from various business fields, paper provides customer loyalty program management model which aims at integrating internal capabilities and process with internet and technology necessary for big data deployment for loyalty management and customer as critical determinant of business success. Ultimate benefit of the approach is in optimal resources allocation and maximization of profit.

Keywords*: big data, loyalty program, cloud, personalization, customer satisfaction, customer management*

1. INTRODUCTION

As Bo Li (2013) states “big data is the term for data sets so large and complicated that it becomes difficult to process using traditional data management tools or processing applications” (p.2). Difficulties occur in all phases of the process: collection, sorting, storage, search, distribution, transfer, analysis and visualization. Based on data sets so huge it is possible to better observe connections and generate new insights in various fields (from business management to fighting crime or preventing diseases).

Big data brings revolutionary step forward compared to traditional data analysis and it is characterized by three main factors: variation, volume and velocity – three Vs (Minelli et al, 2013). Referring to Lee (2013) variation refers to today’s mainly unstructured data collected by social networks, online retail, search engines… Volume of data is enormous. Such amount of data cannot be processed by standard analytics tools because it flows in at great speed. That is why it becomes necessary to provide new way to access this data and have analytics output in real time.

2. BIG DATA TECHNOLOGY

Specific technology is needed to manipulate with big data. As Bo Li (2013) summarizes, this refers to (p3):

- Classic big data technologies
  Classic big data networking technologies are Hadoop, MapReduce and NoSQL. In recent years significant progress has been made in the areas of data storage and warehousing, transfer, software defined networking and analytics.
- Cloud computing technologies
  Referring to Furth (2010) (p18) cloud computing can be defined as new style of computing which provides flexible, on demand and scalable computing infrastructure. This is a new computing practice which provides virtual and dynamically scalable resources as a service via internet. Some of the big data related topics are opportunities and challenges related to big data networks in cloud, big data resource management in cloud, big data performance optimization in cloud. There are several cloud services: SaaS (software as service), IaaS (infrastructure as service), PaaS (platform as service) and dSaaS (data storage as service).
- Benchmarking

Benchmarking is relevant for big data analytics and methodologies verification. As big data systems and architectures evolve, there is a need for comparison, evaluation and measurement of these systems and architectures. In the benchmarking work by Wang, Zhan, Luo et al (2014), several aspects of this problem are stated. Class of big data can be different: search engine, social network or online retail. Software solutions can be different, with Hadoop being the most frequently used. For comparison validity, different data sets analytics should be evaluated – text, tables, charts, multimedia). Finally, analytics requirements may be online, offline or in real time. All of this combined allows valid comparison of big data architectures and systems and comparison of their performance metrics, energy efficiency and cost.

- Mobile networking technologies
  Mobile technologies are becoming more and more relevant with fast expansion of smart phones and tablets – device is constantly connected to the internet and that connection needs to be reliable and fast. In 2013 for the first time sales of smart phones exceeded the sales of regular mobile phones, as tracked by Gartner. Mobile technologies can be considered for the role they have in data collection, management, analytics and application.

3. BIG DATA IN BUSINESS

Big data is a concept relevant for any company and is not exclusively linked with new online businesses (Google, Amazon, Facebook and others that base their business on big data) nor only for big companies (which have been having and using huge amounts of data due to their size and scope). In today's world enabled by today's technology and cloud computing big data becomes accessible to all and at the same time necessary to create and maintain competitive advantage. Devenport and Dyche (2013) argue that big companies for years have had lots of data from various sources but it is not the bigness of data that is impressive, but the lack of structure, opportunities that arise and low cost of technology.

Objectives of big data application in a company can be different: cost reduction, processing time reduction, offering new products and services or decision making system support. Using big data must result in financial gain – management should invest in big data capabilities with the purpose of creating long term sustainable competitive advantage.

Large companies have had some systems how to organize, store and manipulate the data. Applying big data requires significant changes and investments: abandoning existing proprietary systems and adopting open source solutions (like Apache Hadoop, for example); replacing expensive hardware with cheaper solutions; replacing proprietary and customized applications with packaged solutions; replacing decades old business intelligence tools with data visualization (Devenport and Dyche, 2013).

In terms of organization, big companies need to evolve their organization structure and people's skills and capabilities as well as to consider integration with existing solutions before introducing completely new systems. It has been most effective if there is close relationship between big data users and IT sector. In terms of skills, it is necessary to balance the scientific knowledge required for big data with understanding of business needs – having mixed teams has been proven to be the most efficient solution.

With big data there is the evolution of new analytics, so called analytics 3.0 (Devenport and Dyche 2013), when big companies combine traditional analytics with big data to generate insights fast and at scale. Such approach allows any company, regardless of its size, to be part of the data based economy. New models based on prediction and prescription are generated.

4. APPLYING BIG DATA FOR CUSTOMER LOYALTY IN ONLINE BUSINESS

4.1 Customer loyalty

As stated by Paharia (2013) purpose of loyalty is "to give customers a compelling reason to continue to patronize the business and to resist competitive offers". Loyalty exists when people decide to use one particular store (real or virtual) or to buy one particular product rather than to use different stores and products and when such behaviour is consistent over time.

In business, term loyalty can be used to describe the readiness of a customer to patronize a firm, preferably as exclusive choice and to recommend products of that firm to friends and acquaintances, referring to Lovelock and Wirtz (2011).

Loyalty can be behavioural or attitudinal, referring to Richard in FT article. Behavioural loyalty can be measured by share-of-wallet or how much of the total spend goes for a specific product/service/store. Attitudinal loyalty refers to emotional connection to the brand and is measured as share-of-heart. One is not prerequisite for the other. Here big data helps to establish whether it is financially viable and how to convert emotional loyalty into desired behaviour of regular purchase.

As customers nowadays on average participate in 6-8 different loyalty programs, it is crucial to understand what loyalty really means. Paharia (2013) provides interesting concept of Loyalty 3.0. According to Paharia Loyalty 1.0 is transactional level relationship: application to the program and reward redemption can create some engagement but there is no interaction in the meantime. Loyalty 2.0 starts using data for segmentation and personalization (direct mail, email). Loyalty 3.0 combines understanding of motivations, big data analytics and gamification i.e. applying elements of games to create engagement, excitement, satisfaction, accomplishment. And only at this level true loyalty is created.

4.2 Loyalty programs

With such high level of proliferation and multiple participation in loyalty programs, using data and big data analytics helps to identify which 30% of customers generate 70% of total turnover, as well as to reduce activities and wasting resources on those who are in the program for discount only. In their 14 year study on retail loyalty in Great Britain Werner, Reinartz and V Kumar have identified 4 customer segments based on level of loyalty: real friends (long term loyal and highly profitable), butterflies (changing behaviour but still profitable), strangers (lowest profit generating potential) and barnacles (only create hassle and should be got rid of). In retail most customers are butterflies, as the result of continuous competitive struggle and discounting of retailers. Referring to Kantar Worldpanel Hill (2013) states that largest retailer in GB Tesco has highest share of real friends and it is just under 30%. Next retailer in size Sainsbury has only 16% share of this segment. Objective of efficient customer loyalty program management is maintaining and developing profitable relationship with customers. Advantages of using data and targeting offer appropriately are following:

- Reducing investment in unnecessary mass promotions,
- Defining most valuable customer segment,
- Segmenting and targeted approach,
- Tracking efficiency and pay back of activities.

There are two basic loyalty models in retail, by Cox (2012): deal loyalty (discounts and other offers created using big data algorithms) and relationship loyalty (connecting the customer to the brand, building relationship via exclusive offers like trying new products before they reach the stores for example). Working on both at the same time is the approach that enables long term sustainable business result.

Loyalty programs are expensive and it is important to have right metrics to determine their efficacy. One aspect of loyalty program measurement is related to (Isson and Harriotti, 2013):

- Customer acquisition (getting customers to join the program),
- Customer retention (keeping customers in the program and engaging them),
- Share of customer's wallet (influencing behaviour in terms of order size, frequency and value).

Also, loyalty program can be measured by following key performance indicators (PWC, 2013):

- Participation rate,
- Activity rate,
- Tenure,
- Attrition rate,
- Cost per redeemed point,
- Total revenue,
- Revenue per transaction,
- Loyalty program percentage cost etc.

Summary metric is customer lifetime value (CLTV) – projecting net profit generated during entire relationship a customer has with a firm. This is the present value of future revenue of one customer during his/her entire relationship with the firm, as defined by Farris, Bendle, Pfeifer and David (2010). Harvard Business School has developed the formula and the model to calculate CLTV as a useful tool that helps marketing managers determine the value of customer relationship considering the cost of attaining and servicing the customer.

4.3 Role of Big Data in loyalty programs

Introducing a loyalty program which would generate valuable data from huge number of interactions with customers and then use the program only to allow discounts to all members under same conditions is almost equally inefficient as running standard mass promotions (this is still the situation with most of loyalty programs in the country today). Contemporary possibilities for manipulating the data in large databases should enable running the business more efficiently and providing better customer service.

One of probably most important applications of big data analytics is customer segmentation by specific characteristics. Segmentation is the first step towards personalization – having focused and relevant communication even towards groups of users (before one to one stage) is a precondition for targeted offers, content and services to users. Of course, that assumes appropriate infrastructure and process that would enable real time response in line with predefined criteria.

Customer satisfaction is critical for keeping users in the program as well as to drive desired behaviour. Big data framework for customer relationship management assumes possibilities for creating the feeling of satisfaction. In online environment, people expect immediate response as well as that this response would meet their expectations. Without big data as base, right infrastructure and management process it becomes more difficult to have the real time contact and give impression of good customer service. Research results from Maritz-Loyalty Marketing in US show that communication within loyalty program increases overall program satisfaction by factor of 3. This further drives desired customer behaviour.

Combining data from different sources and their interpretation while the user is online is a precondition to allow appropriate reaction along the path to purchase: before, during and post shop. Figure 1 is one of the illustrations of a path to purchase model (used by Metro in Canada) and in online environment big data allows appropriate communication and interaction at every stage.

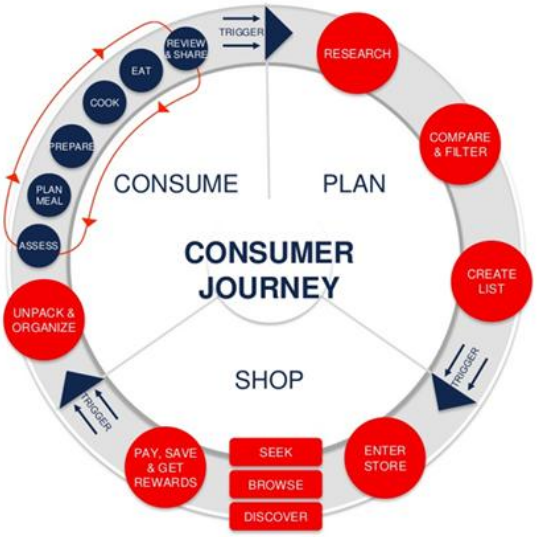

Figure 1: Metro's (Canadian retailer) path to purchase model

Another way to look at this is illustrated in Figure 2 – how to develop efficient marketing strategy and offer according to users' needs or possibilities, how to efficiently track and mix media contact points and maximize the use of owned and earned channels (mainly possible because of big data analytics and real time reaction) and finally customize the offer either as discounts, cross purchases, additional information or services – all with the objective to minimize wasting resources on non-differentiated initiatives.

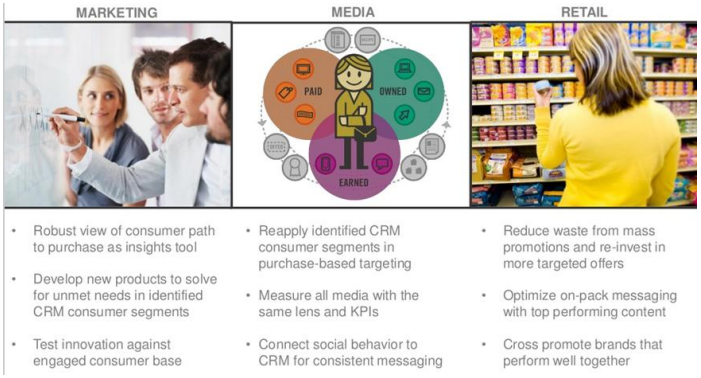

Figure 2: How to influence the customer along the path to purchase by dunnhumby

Personalization should ultimately lead to increased transaction value, providing relevant service, additional offers, solving customer's problem, all but giving only the lowest price.

Big data availability and right implementation in reporting, management and control should result in more efficient resources deployment and maximizing business result.

4.3 Customer loyalty program management

Running a loyalty program is a complex and expensive initiative. In order to ensure it achieves desired financial result it needs to be carefully thought through, planned and managed. Some of the questions that should be answered before launching a loyalty program are:

- Level of profitability,
- Cost efficiency level,
- Sustainability,
- Exit strategy,
- Speed and level of benefits redemption,
- Communication and building awareness with potential users,
- Success criteria and time frame to reach success.

Considering everything reviewed until now, customer loyalty management model which summarizes relevant aspects of setting up and managing a loyalty program has been proposed and illustrated in Figure 3.

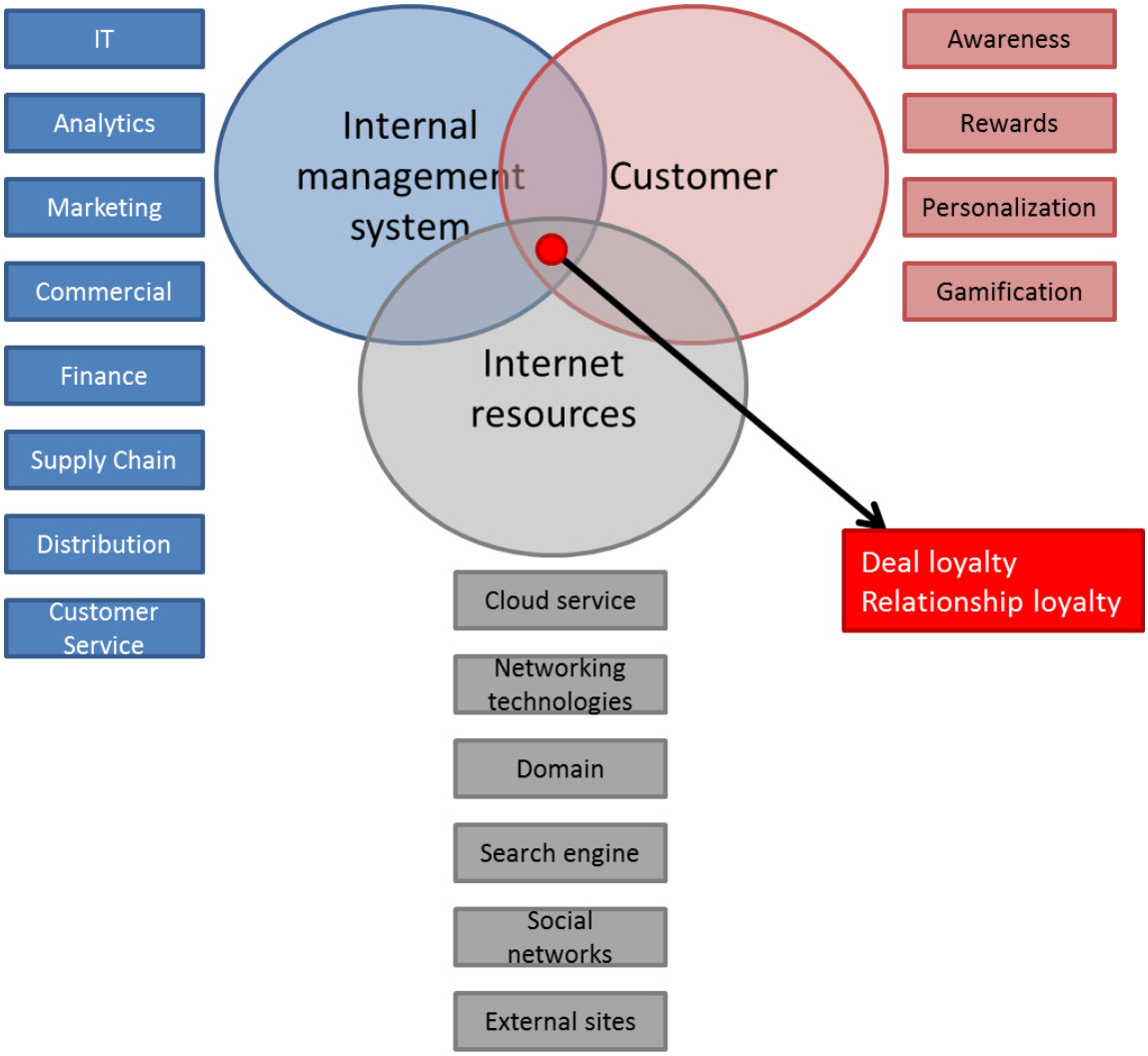

Figure 3: Customer loyalty management model

The program should lead to deal loyalty – loyalty to what the program offers to the user in terms of special offers, solutions, personalization i.e. purchase according to program scheme; and relationship loyalty – long term commitment to the brand or firm, establishing positive attitude and behaviour that would favour the brand or firm.

4.3.1 Internal management system

Internal management system deals with organizational solution that will allow for decision making and management process and running the program efficiently. Loyalty program by its nature, importance and scope assumes multifunctional approach. In the context of big data as key success factor for the program, big focus is on IT sector and analytics. Appropriate technology solutions and skills and knowledge of analytics teams are at the base. In some cases it makes sense to outsource the analytics to highly specialized suppliers in this field.

Next important topic is reporting and communication between sectors to secure that: there are sufficient stocks, delivery is made within committed timeframe, payment is easy and accurate, offers are provided timely, communication with users is relevant and timely.

An excellent example of big data analytics application for efficient functioning and cooperation of multiple sectors (analytics, distribution, logistics, finance) is the recent Amazon example with “anticipatory shipping”. This innovation is based on an algorithm which forecasts future orders and according to those forecasts products are shipped to distribution centres even before customers place the orders. Ultimate goal is to achieve same day delivery. Data quality is key in this case to enable more efficient stocks management and to avoid increased cost to the business due to higher costs for managing unsold stocks and returns. Another reference is Walmart which is fully integrating big data into management processes between functions, to

avoid “analysis-paralysis” i.e. enable fast and fact based decision making. Recently they have changed their shipping policy based on big data analytics, lowering order size and expanding product offering.

Customer service is something that can be critical for success and longevity of the loyalty program. Jao (2014) stated that 68% of users leave the site because of bad customer service. Utilizing big data can help coordinate communication with the user via different channels (mobile, email, chat) as well as to recognize which service is the most frequently requested in order to optimize own resources accordingly and reduce customer conflict resolution to minimum time needed.

4.3.1 Internet resources

In online business, internet is naturally key part of the system. Some of the tasks that need to be solved in setting up the loyalty program are: enable easy and fast purchase, be accessible always and everywhere, maximize users’ data and track their behaviour within own domain as well as outside to direct them more efficiently to our program and offer them solutions which stand the highest probability for purchase.

Advantages of cloud based solutions, primarily for data storage dSaaS, can help to set up and utilize the system. Classic networking technology solutions like Hadoop, MapReduce or NoSQL are standard for big data access. Loyalty program needs to be based in a domain. How to get to the site and what is the communication flow with other content and platforms needs to be optimized. According to recent research by Shopify, Facebook is the number one social platform from which 85% of buyers come from. Big data analytics is key to select external links and communication with the loyalty program users in order to customize the offers, communication and call to action i.e. purchase.

4.3.1 Customer

Final element of the system – the customer. All is created for the customer and customer’s action is the end goal.

First step that needs to be completed is to build awareness with potential customers about the loyalty program and its benefits. Classic advertising in offline media, online advertising as well as big data analytics can be used to effectively target most promising customer segments according to their profile and behaviour.

Probably most important area for big data analytics application is reward system and personalization. Dynamic pricing and promotions i.e. optimizing the price and additional features and service offer to secure desired transaction without giving too big of a discount or giving it to the wrong recipient is where big data plays key role. Combining loyalty program database, internet search and previous behaviour enables creation of customized optimal offer for each customer which should be supported with personalized communication. Personalization drives loyalty which leads to repeated purchase.

Recent trend and opportunity for better interaction with the customer and driving relationship loyalty is application of concepts and principles that successful games apply – i.e. gamification.

In terms of its scope, this model can be relevant both for companies that directly or via third party engage in online commerce and for retailers either those purely based in online or those combining multiple online and offline channels. Functions may be differently called but the responsibilities and work flows are equally relevant. Level of interaction and connection between online and offline business may be different, but the functions and process still apply.

5. CONCLUSION

Concept of big data and firm’s capability to master it is one of the key factors of creating and maintaining competitive advantage. Big data analytics enable customer communication which can lead to purchase in shortest, most efficient and cheapest way while creating long term customer loyalty in terms of both deal and relationship loyalty. Big data management in the context of loyalty programs should enable optimal resources allocation and revenue and profit maximization.

Further builds to the model should deal with integration of mobility – in developed markets already today more than 50% of shoppers use mobile devices to plan and make their purchases.

REFERENCES

5 Noteworthy Ways to Use Big Data for E-commerce, By Jerry Jao, Published January 24, 2014, http://www.business2community.com/big-data/5-noteworthy-ways-use-big-data-e-commerce-0756487

Amazon Patents "Anticipatory Shipping", Source: The Star, Monday, Jan 20, 2014 http://techcrunch.com/2014/01/18/amazon-pre-ships/

Big Data in Big Companies, Date: May 2013, Authored by: Thomas H. Davenport, Jill Dyché http://swqlab.fov.uni-mb.si/moodle/pluginfile.php/9774/course/section/534/Big-Data-in-Big-Companies.pdf

Big Data Prioritized by Walmart in Moving Business Forward, Avoiding “Analysis-Paralysis”, Source: Wall Street Journal, Monday, Nov 25, 2013

Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, by Michael Minelli, Michele Chambers and Ambiga Dhiraj, ISBN:9781118147603, John Wiley & Sons © 2013

BigDataBench: A Big Data Benchmark Suite from Internet Services, Lei Wang, Jianfeng Zhan, Chunjie Luo, Yuqing Zhu, Qiang Yang, Yongqiang He, Wanling Gao, Zhen Jia, Yingjie Shi, Shujie Zhang, Cheng Zhen, Gang Lu, Kent Zhan, Xiaona Li, and Bizhu Qiu, The 20th IEEE International Symposium On High Performance Computer Architecture (HPCA-2014), February 15-19, 2014, Orlando, Florida, USA. http://prof.ict.ac.cn/BigDataBench/

Dunnhumby and Metro Canada http://www.slideshare.net/dunnhumby/dunnhumby-and-metro-canada-digital-personalization

Dunnhumby – Achieving personalization at scale, http://www.slideshare.net/dunnhumby/achieving-personalization-at-scale-dunnhumby-sia-conference

Facebook Is No. 1 for Social Commerce, published on March 31, 2014. http://www.emarketer.com/Article/Facebook-No-1-Social-Commerce/1010721/2

Gartner: Smartphone Sales Finally Beat Out Dumb Phone Sales Globally In 2013, With 968M Units Sold, Feb 13, 2014, http://techcrunch.com/2014/02/13/smartphones-outsell-dumb-phones-globally/http://hbsp.harvard.edu/multimedia/flashtools/cltv/

Handbook of Cloud Computing, Furht B. Escalante A. (Eds), Springer publishing company, 2010

http://lexicon.ft.com/Term?term=customer-loyalty

Loyalty 3.0 – How Big Data and Gamification are Revolutionizing Customer and Employee Engagement, By Rajat Paharia, McGraw-Hill 2013

Loyalty analytics exposed: What every program manager needs to know; PWC (PricewaterhouseCoopers LLP), 2013

Maritz-Loyalty-Marketing_US-Loyalty-Report-Infographic.ashx

Marketing Metrics: The Definitive Guide to Measuring Marketing Performance; Farris, Paul W.; Neil T. Bendle; Phillip E. Pfeifer; David J. Reibstein (2010), Upper Saddle River, New Jersey: Pearson Education, Inc.

Retail Analytics – The Secret Weapon, By Emmet Cox, John Wiley and Sons 2012

Services Marketing: People, Techology, Strategy, Christopher Lovelock and Jochen Wirtz, Prentice Hall, 2011https://bschool.nus.edu/Departments/Marketing/Jochen%20papers/sm7_cover_table%20of%20contents_samplechaptersandcase_2010_lgt.pdf

Survey of Recent Research Progress and Issues in Big Data, Bo Li, boli@seas.wustl.edu (A paper written under the guidance of Prof. Raj Jain) http://www.cse.wustl.edu/~jain/cse570-13/ftp/bigdata2/index.html

The serial adultery of the modern customer, andrew.hill@ft.com,http://www.ft.com/intl/cms/s/0/d1c98e1c-89c3-11e3-8829-00144feab7de.html#axzz2tP7d3jZK

What is Big Data? The definition by Philip Lee, February 23rd, 2013 Trends Crux http://techrux.net/big-data-definition/

Win with advanced business analytics: creating business value from your data, By Jean Paul Isson and Jesse Harriott, John Wiley & Sons © 2013

POST PLATFORM AND CAPABILITIES OF SERBIAN POST*

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Abstract: *This paper will show the status of the postal services and the reasons for the introduction of services that are based on IT technologies. The Internet and the digital revolution are changing the world of communications, and postal sector must adapt to the digital age. Postal digital platform was created with the aim of integrating three dimensions - physical, electronic and financial. This creates a postal network dedicated to electronic services. In order to led this project in the right direction, at the 25th Congress of the Universal Postal Union in the Doha the strategy oriented towards electronic services was set forth. In line with this strategy, actual state of the postal system in Serbia will be analysed and given suggestions of new services which could be provided to users as well as the future of the postal sector in a smart city.*

Keywords*: IT, digital revolution, postal digital platform, smart city,*

1. INTRODUCTION

Postal sector has to adapt to modern business conditions, continuously improve and develop its range of services. Postal operators shouldn‟t rely on conventional transfer of letters and packages and have to indroduce new services that are based on information technologies.

The second chapter will give more details about the reforms in the postal services and the need to develop new services based on ICT.

The third part of the paper shows the connection between the postal service and the digital space .

The fourth section will give some more information about the electronic future of the postal sector , postal digital platform and the Italian post. For an example Italian post is taken as one of the most advanced in this area and their web portal with post domain is given.

The fifth chapter deals with the implementation of e-services in Serbia . It also describes which goals from defined strategy and the Doha Proposals has Serbia fulfilled and new services that could be provided in the future by the existing infrastructure and would fit into the concept of a smart city.

In conclusion the results of our research and suggestions for further research in this area are presented.

2. POSTAL REFORM

The Internet and the digital revolution are fundamentally changing the worlds of communications and commerce. The digital economy continues to grow at a rapid rate. Electronic substitution of traditional mail is accelerating as both consumers and businesses adopt electronic processes across multiple domains. Mail users are shifting from traditional hard copy distribution models to a variety of new ways to digitally communicate, advertise, or transact. They are attracted by greater convenience, faster service, and lower cost. The digital revolution has become the “disruptive innovation” to the traditional business of the Postal Service. With several different communications channels competing for consumers, the Postal Service needs to modernize its role to accommodate for the digital age.

The transition to a new digital landscape is already under way. The Postal Service should consider new products and services that reflect the evolving mandate to “bind the nation together” in a new world where people are increasingly communicating digitally. Using a foundation that links a physical address to an

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electronic mail box for every citizen and business, the Postal Service can build a digital platform that facilitates communications and commerce for postal, governmental, and commercial applications that are available to all (U.S Postal Sevice Office of Inspector General (2011, April)) .

3. THE POSTAL SERVICE AND DIGITAL SPACE

With more than 660,000 post offices throughout the world, the postal network is the biggest phyical network in the world . Post offices are everywhere, from capitals of bigger industrialized countries to small rural towns of least-developed countries. In outlying areas, they are often the only public service available and in many cases, they constitute vital channel to communicate and exchange goods between communities. Bilions of people visit post offices every year for a reason or another (Universal Postal Union (2010)).

Market liberalization, globalization, and the rapidly advancing digital technologies that challenge the Post today should be viewed as an excellent opportunities. At the same time, today"s advances in technology also provide the greatest opportunities for tomorrow"s Posts. By combining the traditional strengths and "reach" of postal services with the flexibility and speed of electronic media, a whole new range of products can be developed to meet emerging customer needs for value added communications products. Some of these applications, such as electronic bill presentation and payment, trusted third-party certification, electronic stamps, directory services, and secure e-mail already exist.

The synergistic merging of the Post"s unrivalled retail and delivery networks with electronic media and the Internet is still in its very earliest stages. Vast possibilities in areas such as financial services, eBusiness applications, and the conversion of post offices into "Communications Centers" which provide universal Internet access are only now being researched and implemented. Postal services are also continually seeking out ways of incorporating modern information technologies into their operations to raise productivity and lower costs. In order to maximize its contribution to economic development, the postal service of the future will need to provide hard copy communications and hybrid digital/mail products while simultaneously providing general access to the Internet and eCommerce.

The Digital Age has arrived and is the motor for a New Economy based on instant communications and universally accessible information. Each day, the "e-World" spawns a new e-concept or e-technological advance based on making the interfaces between people, businesses, and information faster, cheaper, and more reliable. One side effect of this growing wave of technological progress has been to forget, or at the very least diminish, how much these advances depend on sound physical distribution systems for their success. The information available through cyberspace can be digitized, compressed, and transmitted instantly, but the goods and merchandise this information describes must travel through physical transportation systems and be delivered to actual, not virtual addresses. Furthermore, the future growth of the New Economy will be directly related to the capacity of physical distribution networks to efficiently process the increased traffic being generated by new technologies (Universal Postal Uninon and World Bank, joint publication (2001, April)).

The Postal Service can develop and maintain a secure digital postal platform, accessible to all citizens through a website. Private industry would be invited to provide commercial solutions and work with the Postal Service on developing effective postal and governmental applications on the platform to serve all. The Postal Service can fill its established role of providing a trusted communications infrastructure. This represents a modern manifestation and a natural extension of its traditional mandate in the physical space to meet the new requirements of the digital age. Apple"s strategy of encouraging independent development of applications or "apps" for its iPhone® and iPad® platforms would serve as a relevant model for independent development of digital products on the postal platform. Apple invites all developers to bring their applications to its online App Store, until they meet the required technical and content standards. The Postal Service identifies the standards to allow innovation and allows market forces to determine success and failure (U.S Postal Sevice Office of Inspector General (2011, April)).

4. ELECTRONIC FUTURE OF THE POSTAL SECTOR

Post is the UPU"s sponsored top-level domain for the postal sector. The domain"s technical infrastructure became a reality in 2012, and member countries and their designated operators can now register for their domains and explore the possibilities of .post. Some Posts, for example, have plans to use .post to stimulate cross-border e-commerce and hybrid mail.

More than 70 per cent of the world's Posts say that electronic services are strategically important to their business, according to UPU research. This finding provides impetus to the goal of developing the .post (dotpost) platform, and the 2012 Universal Postal Congress decided that work should continue in this direction.

The platform‟s goal is to interconnect current and future electronic postal services and make them interoperable in a secure and trusted environment. It will authenticate postal service providers and strengthen the postal brand globally. post intends to link the physical and digital worlds, creating a secure platform that enables postal e-services to be delivered to all citizens and businesses.

Applications, such as identity management, e-shops, e-payments, e-forms, secure postal mailboxes, address management, hybrid mail and advertising mail, would have a home on this future platform.
In 2009, the Universal Postal Union became the first United Nations agency to be granted a sponsored top-level domain for the postal sector.

What the UPU is trying to achieve through .post is not different to what happened when the organization was created in 1874. At that time, 22 countries with their own postal infrastructure, services and bilateral agreements came together to create the UPU and a single physical postal territory that interconnected them.
Poste Italiane has already set up its .post site (www.posteitaliane.post-figure 2) and has plans for future services branded with the .post suffix. The Italian operator is teaming up with the Netherlands‟ PostNL to look at developing cross-border e-commerce on the platform. Poste Italiane is also trialing a postal registered electronic mail service with China and Macau Posts. The .post platform extends the physical postal network into cyberspace, enabling the community to offer trusted and secure postal e-services.

In order to show the possibilities of .post, the Postal Technology Centre (PTC), the UPU‟s technical arm, has created a global track and trace application which, eventually will enable customers to track the items they have ordered until final delivery. Using the electronic data that the world‟s Posts exchange on the UPU‟s Post*Net network and other interconnected networks managed by external partners, participating Posts could benefit from a comprehensive end-to-end track and trace system.
Malaysia has also pledged 100,000 USD to the project. Earlier this year, Poste Italiane has donated 500,000 EUR to get .post off the ground.

A post user-group is expected to be set up at the next Postal Operations Council in April 2013 to oversee the future development and management of the top-level domain. Member countries will be able to join the group for a fee and help to shape the future of .post. This will bring the funding of .post in line with other user-funded groups, such as the EMS and Telematics Cooperatives. In the interim, a committee headed by Italy is ensuring work continues. In 2009, the UPU became the first United Nations agency to be granted a sponsored top-level domain (www.upu.com).

Figure 1 shown trusted communication and services space .POST (Donhoe, P. (2009, May)).

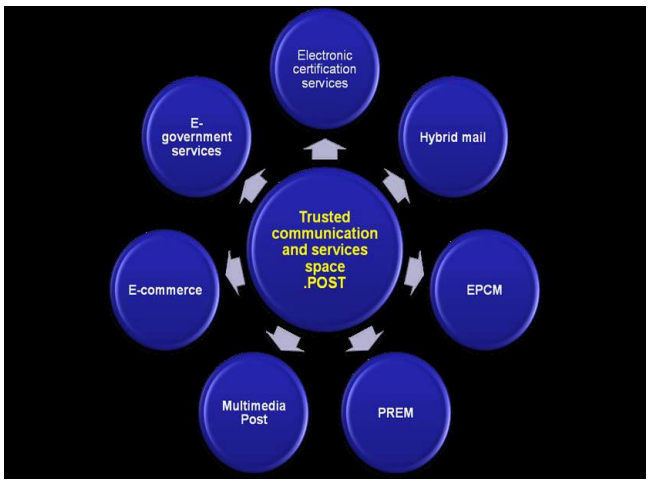

Figure 1: Trusted communication and services space .POST

Figure 2 shown web portal of Italian post with post domain (www.posteitaliane.com).

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Figure 2: Web portal of Poste Italiane

5. THE IMPLEMENTATION OF E-SERVICES IN SERBIAN POST

Universal Postal Union has conducted a study related to the determination of the level of development of e-services offered by the postal administrations around the world (Abdallah, F., Shakurova, Y. (2012)). Services are divided into four groups: e-post services, e-financial services, e-commerce services and e-government services. Total has identified 55 e-services. This paper will describe the services offered by Serbian post.

Traditionally, postal services have been used to facilitate communication between citizens and businesses via physical means, such as letters. E-post services are communication services delivered to customers via ICT means. Serbian post offers following e-post services:

- Public Internet access point in post offices (Customers can access Internet services in post offices)
- Hybrid mail (Enables customers to send an original message, which is then processed electronically and converted into a letter-post item for physical delivery to the addressee)
- Post office location lookup (Enables customers to search for the address of a post office online by entering information such as the street, the city or the postcode. Customers can also obtain additional information about the different products and services provided at the post office as well as its business hours)
- Track and trace (Enables customers to electronically track and trace a postal item)
- Electronic notification to an addressee that letter is to be delivered to (The Post notifies an addressee electronically (e.g. by SMS or e-mail) about a letter item to be delivered to a specific address)
- Electronic notification to a sender that letter has been delivered (The Post notifies a sender electronically (e.g. by SMS or e-mail) that a letter item has been delivered to a specific address)
- Web-based customer service and contact (Allow customers to contact the Post electronically for a service or information, via a website, e-mail or telephone)

E-finance services are financial services provided by postal operators to end customers using ICTs. The UPU has developed regulations for postal payment services provided among Posts. Serbian post offers following e-financial services:

- Electronic money transfer (A service allowing account-to-account fund transfers from a sender to a payee through the Posts)

E-commerce services consist of buying and selling products and services using ICTs. It involves processing and delivering purchased items physically or electronically. Serbian post offers following e-commerce services:

- SSL web certificates (The Post issues SSL certificates for securing websites)

E-government services are driven by government and provided through ICT means, using Posts as a trusted third party. Serbian post offers following e-government services:

- Digital identity (The Post issues a digital identity legally identifying its customers. The digital identity can be secured with a simple electronic authentication using a password or with more secure authentication technologies using cryptography and public key infrastructure)

Doha strategy (Universal Postal Union (2012, September)) defines regional development for countries with four goals: 1. Improve the interoperability of the international postal network, 2. Provide technical knowledge and expertise related to the postal sector, 3. Promote innovative products and services (develop the 3-D network), 4. Foster sustainable development of the postal sector. Serbia must adhere to this strategy. Improvement of quality of the service and efficiency of the postal network and development of e-commerce are the top goals. Serbian post improves quality of the service and efficiency of the postal network, but e-commerce must be improved in accordance with the development of e-commerce in leading postal administrations. Serbian post does not join global monitoring system, but there is tendency to modernize and reform postal sector, and provide staff training in the application of new technologies to master operational, technical innovation in key areas of postal activity. 3 D network involves the integration of physical and financial dimensions of post. Serbian post must orient its development in this direction. Improvement of marketing activities is evident in the Serbian post, which has the status of trusted third parties and recognizable brand.

Table 1: Strategy for regional development-Europe

Improve the interoperability of the international postal networks	**Provide technical knowledge and expertise related to the postal sector**	**Promote innovative products and services (develop the 3-D network)_**	**Foster sustainable development of the postal sector**
Improve quality of service and efficiency of the postal network	Modernize and reform the postal sector	Develop e-commerce	Carry out marketing and advertising activities to promote electronic, financial, business and e-government services
Join the Global Monitoring System	Provide staff training in application of new technologies to master operational, technical and technological innovations in key areas of postal activity	Further develop and improve electronic payment services	Improve marketing and sales potential

Information and communications technology (ICT) is a key enabler for cities to address challenges in a „smart" manner. Smart City is one with at least one initiative addressing one or more of the following six characteristics: Smart Governance, Smart People, Smart Living, Smart Mobility, Smart Economy and Smart Environment. ICT links and strengthens networks of people, businesses, infrastructures, resources, energy and spaces (Manville, C., Cochrane, G., Cave, G., Millard, J., Kevin, J., Thaarup, R., Liebe, A., Wiesner, M., Massink, R. (2014, January)).

The convergence of information and communication technologies is producing urban environments that are quite different from anything that we have experienced hitherto. Cities are becoming smart not only in terms of the way we can automate routine functions serving individual persons, buildings, traffic systems but in ways that enable us to monitor, understand, analyse and plan the city to improve the efficiency, equity and quality of life for its citizens in real time.

Having this in mind, the postal sector needs to focus its development towards smart cities

Post has a strong telecommunication infrastructure and brand, and can provide good and reliable services in the field of security and teleservices. Post is faced with the failling of profits from classic delivery of items and health services could bring a new profit. This primarily relies to the delivery of various health"s reports. Services in the field of education could be further strengthen the brand, and they should be offered free of charge as well as services that are related to entertaintment. Post could use for delivery electrical vehicles and that electrical vehicles could be rented for tourism purposes and could offer to citizens delivery of formal documents through its infrastructure.

Based on the experience of foreign countries, taking into account the existing capacities of Serbian post, we can expect the appearance of the different services. These services are given below and are divided by areas.

Security:

- Integrated traffic control management
- Telesurveillance

Health:

- Online diagnostic reports
- Drugs home delivery
- Health information management
- Individual Health Record
- Online management prescriptions and recipes for drugs

Education:

- Circuit discounts for students
- Parents Online: access system to pupil data

Entertainment :

- E-ticketing
- Multimedia tourist guide

Sustainability:

- Use of electric vehicles

Citizenship:

- Dematerialization of administrative document
- E-democracy (televoting)
- Improvement of administrative process

6. CONCLUSION

The postal digital platform is created with the aim of integrating postal administrations, in order to overcome many limitations and obstacles, by facilitating the international exchange of information and goods. Post platform presents new special space on Internet that interconnects current and future electronic postal services and make them interoperable in a secure and trusted environment.

In some countries, a post office provides valuable social services, and they are poised to become an even more important business centers. Postal sector in Serbia also plays a role in the interconnection of other public utilities, administrative and social networks, which is necessary for the development of the country and a better life for the population. For development of e- services in Serbian post there is a lot of space. The most common e- services is e-post services, but must be developed and other e-services, especially e-commerce and e-government services. Integration of public administration and post will provide a new opportunity for post and place for the creation of new services.

Post Serbia can follow model of the Italian post, which is very good or to apply the strategy as implemented by Apple. Postal sector, with its physical, electronic and financial capabilities can provide many opportunities for e-commerce. Italian postal e-commerce services meet all online business needs, offering important facilities, such as websites realisation, catalogue configuration and the integration of dispaches and payments.

Future research in this area should be directed towards the development of new services based on IT technologies, increasing profit and in meeting the rapidly changing needs of users.

REFERENCES

Abdallah, F., Shakurova, Y. (2012). Measuring postal e-services development.

Batty,M., Axhausen, K.W.,Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G., Portugali, Y.(2012). Smart cities of the Future, The European psyhical journal special topics.

Donhoe, P. (2009, May). E-service strategy and action plan.

Manville, C., Cochrane, G., Cave, G., Millard, J., Kevin, J., Thaarup, R., Liebe, A., Wiesner, M., Massink, R. (2014, January). Mapping smart cities in EU.

U.S Postal Sevice Office of Inspector General (2011, April). The postal service role in digital age part 2.

Universal Postal Union (2012, September). The global roadmap for postal services, Doha postal strategy 2013-2014.

Universal Postal Union (2010). ICTS, new services and transformation of Post.

Universal Postal Uninon and Worl Bank, joint publication (2001, April). The postal industry in an Internet age, Case studies in Postal reform.

www.posteitaliane.com

www.upu.com

USING MOBILE TECHNOLOGIES IN FOSTERING THE DEVELOPMENT POSTAL SERVICES

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Abstract:*Aside from being an everyday phenomenon when it comes to communication, mobile technologies today create a way of doing business and provide support during execution of services, selling of goods, and, of course, payment. Development of new services, as well as the already existing ones, in all areas, calls for precise predicting of possibilities and efficient placement of information, especially when it comes to a segment of a potential market. Newest trends emphasize that mobile technologies are becoming an important (if not crucial) line of communication with potential clients. Postal services, especially newly developed ones, are not an exception, so this work will present the importance of using mobile technologies as a way of generating the development of postal services.*

Keywords*:postal services, electronic services, mobile technologies, clients*

1. INTRODUCTION

Postal traffic is a very important infrastructural unity. Using this kind of service is defined as citizens' right, so that developing new, as well as already existing services represents an imperative for postal operators in the country, as well as internationally. According to the latest statistics of Universal Postal Union (UPU), over the 60 % of the market for this sector in Europe and central Asia implies financial services and transfer of regular post items (UPU, 2014).

Liberalizing the postal service market, which means the appearing of new players in the field is defined by The Strategy of Postal Service Development in Serbia 2013-2016. and it relies on the recommendations of the Universal Postal Union (UPU) and the directive of the European Union (Strategy, 2013).

Postal sector in region SI Europe represents a huge mechanism and support for development of small and medium-sized businesses. Service time, which is time required for receipt of the consignment, time required for automatizing the process of adaptation and time required for delivery can vary significantly for a certain number of items with registered acceptance number (no matter if it is recommended mail or valuable shipment), as well as for a certain number with incorrectly paid postages depending on the speed of sensing data and the way the customer choses to pay for the services. In order to do business more efficiently, it is important to reduce business charges, since they are a great part of the overall costs, even in countries far more developed than ours. (Okholm, Winiarczyk, Moller, Nielsen, 2010.).

Using mobile technologies enables faster and more efficient communication, gathering and processing important information, based on which it is possible to manage further.

The goal of this text is viewing the possibilities of using mobile technologies in processes connected to realizing postal sevice offering. The solution to integrating mobile technologies is introduced for each process: reception, processing and delivering consignments. Forming a geo-network can be used for segmenting the market while placing an accent on the physical location where a customer can receive required service (Location Based Services – LBSs). Also, social networks built based on this form and GPS technology can be used for geomarketing postal services. Mobile payment points, such as mPOS (mobile Point Of Sale) devices can be used for counting postages for consignments which are being delivered in specific circumstances, such as unexpectid increasing number of parcels. NFC (Near Field Communication) technology, combined with QR codes, can increase the speed of scanning and charging postages for consignments which would be handed over on self-service counters or other places meant for automatized receiving. In fact, given the option of creating a free QR code based on different information about dimensions, weight and sending destination, the sender could simply equip the consignment with a QR code. Informing the customer via a mobile device about the reception, manner and time of delivery, while delivering a consignment introduces great savings. Electronical platform *.post* is different when it comes to transactions

being realized by customers all around the world. Physical and electronical customer's address can be integrated within the *.post identificator* app, which means that the risk of delivery failing is minimal.

2. TRANSFORMING THE POSTAL SERVICE MARKET

Traditional limits of postal services sector are becoming broader, so its economical function is defined by the content of basic activities of this branch, which are reduced to communications, logistics and advertising (Grgurović, 2013).

Postal services market, just like most of other markets, is going through a transformation, transgressing into a virtual space. Supply, price and demand remain basic elements of this kind of market. Components of the market which stay the same as the ones of a traditional market are existence in certain time intervals, objects of exchange (product/service), participants, ways of forming prices and regulations, while space, i.e. the place of the exchange transgresses from physical to virtual. The speed of emerging (and disappearing) in this type of market, the influence on potential and old clients, the speed of reacting to changes in the items being offered, user comfort during the process of service realization… These are just some examples of the potential of the new way of doing business which could be viewed as additional values which influence the increase of availability of management as well as the efficiency of management.

The need to establish stronger connections with business partners, no matter if they are clients or collaborators, cannot be pictured without mobile technologies which no longer serve as just a line of communication or application support, but as a business platform.

2.1. Space for mobile technology: physical,virtual or hybrid?

Over the last couple of years, a tendency to merge digital information with physical space has been noticed, which introduces a brand new space dimension: hybrid space (Frith, 2012.). Digital information is becoming a part of physical space. There is almost no physical place of any type (shop, stadium, restaurant etc.) that isn't minutely filled with digital information in the virtual world (social networks, browsers, web pages). Spreading of digital media when it comes to multimedia contents certainly leads to an increase in the use of mobile devices. World statistics show that the digital media are extending to the field of mobile devices and of accessing content through mobile devices (Comscore, February 2013). Despite the existence of a vast number of electronic shops, clients still go to physical shops, browse and buy products. Certain economic areas, including postal service, cannot provide all their services through the virtual world, but they can use it to get closer to their clients.

Hybrid spaces in postal services could enable a faster and more efficient finding of closest units of postal network using an application on mobile devices. This sort of application uses the client's geographical location to find the shortest possible way to a postal unit which provides a certain service. Canadian and American postal services have a similar offer. They enable smart phone users to use a free application which can find the closest facility which administers receiving shipments and packages. An application which provides information about the location and time of submitting shipments using postal vehicles is designed for rural and less populated areas. Synchronization of the time of the physical encounter, through the digital information about the location and the time of the encounter optimizes the expenditure of the client and of the operator (provider). Changing the address of the delivery after the receipt of the shipment, in terms of redirection, in this kind of environment has minimal effect on the efficiency of the process. By the way, this is one of the crucial problems in the area of the delivery of consignments, not only because the shipment has to me set back to the delivery terminal (and often to the sender), but because of the expenses of taking up space during storage and re-sending. The efficiency of the last stage of the technological process in postal services is a constant problem, conditioned by harmonizing different parameters, among which the time of the delivery and the time when the recipient is ready to pick up the consignment are the most sensitive ones(Toime, E. 2013.)..

2.2. Location based services (LBS) and Location based social networks (LBSN)

To every physical location we can add a pile of digital information which changes and enriches the initial information. E.g. using contemporary mobile phones with GPS and internet connection we can get information about a client's location, as well as all the characteristics of the given location. Physical location is being enriched by information from virtual world. Aside from basic location information, e.g. a chain the shop belongs to, different information about management, forums with other customers' experiences, ongoing and future actions etc. can also be found there. Physical location is enriched with valid information, while the mobile device interface becomes a representative of a corporation with a goal to entertain users.

Information offered through mobile devices can easily be changed, adjusted, followed and used to establish and strengthen relationships with clients. That is, personalizing services through individual offers to every potential and old client according to their needs through mobile devices reaches full potential, which enables a long-lasting relationship with a client – from satisfaction, through loyalty to the fact that the client becomes a supporter of new services.

Offering a big number of useful information in the hybrid space through mobile devices develops a new dimension of experience, use and realization of services, at an exactly defined location.

Positioning business points depending on the density of potential clients is a particularly sensitive category. This problem can be solved by GIS (Geographical Information System) technology, which can help analyze market, rationalize charges of the distance travelled, defining optimal routes etc. (Marković, Grgurović,Štrbac, 2011.).GIS applications on mobile devices are completed by coordinates of objects, which enables viewing digital maps in order to develop a social network based on certain locations (LBSNs – Location Based Social Networks). This kind of geographical networks ensure that the information about the benefits currently offered in objects on certain locations be delivered, so that clients can stay informed about products, services, business hours, actions etc. These networks are adaptable when it comes to already existing networks such as Twitter, WhatsApp, My Space etc. which makes an available information possible to multiplex. Simple modulation, in terms of adjusting information based on statuses, interests or some other characteristics of users is a reality.

Making a list of potential clients who would have information delivered via mobile devices in postal sector is a relatively achievable task. Survey is a possibility when it comes to already existing clients. Potential clients can be informed based on information from database about PAC (Postal Address Code). Every address can be delivered a consignment with information about accessing mobile service. Free access to the mobile service is already being practiced by companies which value their clients even in our region. Location based service could offer to clients in postal units information about new or hardly known services which, based on marketing activity, at least when it comes to domestic public operators, aren't accessible enough.

Users' social networks based on location can offer information about business of resources in near-by locations, sharing experiences with other users on the network about services and products, information about possible waiting queues and business hours, as well as prolongation of business hours if the number of potential requests is higher than expected (holiday jam while paying bills or turning in consignments etc.).

3. MOBILE TECHNOLOGIES IN PROCESSING CONSIGNMENTS

3.1. An app for following consignments until the moment of delivery

The processing of consignments is a series of operations between the reception phase and the delivery phase. Since this is about manipulating physical objects, following all operations in processing is important for multiple reasons: from safety, to exactly locating consignments at any given moment, to the possibility of managing routes in case of changing delivery location. Using postal model of EPC RFID (Electronic Product Code Radio Frequency Identification) It is possible to follow consignments trough all phases with a high information safety level (Melia-Segui, Garcia-Alfaro, Herrera-Joancomarti, 2010.). Communicating with the final customer (the sender or the receiver) contributes to the faster and more efficient manner of doing business.

Big postal operators, such as UPS (United Parcel Service Inc.) have noticed that the communication with clients is of mutual interest and have decided to adjust to clients' needs using a new application through which they get information about clients' basic preferences – whether they live in a rural or an urban area, how much time do they daily spend at home, how they feel when they see a report about a shipment which had been delivered during their absence and how often they receive various consignments. Depending on their responds, clients are offered a free or a yearly paid membership as well as some other utilities. The day before the delivery, clients are being notified by a text message, e-mail or by telephone. The application enables tracing the path of a consignment, as well as a calendar of all deliveries during the past period of time, defining the approximate time of arrival of the consignment, the possibility to give permission to the operator to deliver a shipment without demanding a signature (if the consignment isn't being received personally), the possibility to define a place of delivery (front yard, a neighbor's house, in an operator's facility), the possibility of redirection or the possibility to change the date of the delivery (e.g. if the recipient is on vacation) etc. (fig. 1) (UPSP, 2014.).

Fig 1. The design of the app used for informing about the time and the location of consignment delivery

4. M-PAYING – THE INCREASINGLY PRESENT FUTURE

Minor payments via mobile phones, such as paying for parking, mobile payments to online accounts, etc. are becoming more and more common. Mistrust and fear when using new technology, especially when it comes to money transactions are being overpowered by the speed of the realization and the comfort for clients, especially in situations related to the moment out of regular business hours.

Most mobile payments currently offered are being refused by clients for solely one reason – user safety. This is because realization of money transactions required providing clients' bank card numbers.

4.1. NFC Technology and QR code as an option for more efficient mail logistics

Mobile devices have stopped being just a symbol of communication a long time ago. Aside from other devices (which we will not discuss and which are related to fashion or status accessories) it also includes an informational device (whether it uses online or offline connections), as well as recording and updating devices (photos, videos). According to the latest trends, paying via mobile devices as becoming a regular part of financial transactions. There are more and more department stores which have a serious approach to this question and offer their customers a solution in the form of buying and paying via their mobile devices. These two terms are separated by intention, because buying includes the phase of choosing a product or a form of service, while paying can be separated from it both in time and space.

Increasingly popular QR code opens new possibilities of using mobile devices. Source QR code is designed to enable additional information to mobile device users. The camera on a mobile device is supposed to scan a two-dimensional code, after which the client is redirected to a specific URL page which contains required information using a special software.

NFC (Near Field Communication) completes the story of mobile payments. After scanning information required for paying for a certain product or service, by activating NFC device, the financial transaction of a the appropriate amount of money is performed, which transfers a certain amount of money from a customer's account to the seller's account. Customers can choose products or services at any physical place, even via interactive boards, which have a certain offer for customers to choose from. These boards exist in big retail chains, such as Tesco or Casino. The question of safety of these money transactions leads us to new solutions, which offer information in form of a code, time-limited, which do not require providing any information regarding clients' accounts (card number or expiration date).

Latest UPU statistics show that over 6.5 billion packages and 346.5 billion letters have been sent during the year 2012, which points out the extremely large potential of the market, both globally and locally. Internal (domestic) traffic is especially interesting, given that, according to these statistics, it takes up around 99 per cent of this sum (UPU, 2014).

NFC technology, combined with QR codes, can increase the speed of scanning and charging postages for consignments which would be handed over on self-service counters or other places meant for automatized receiving. In fact, given the option of creating a free QR code based on different information about dimensions, weight and sending destination, the sender could simply equip the consignment with a QR code. Once the information on the consignment has been scanned, the postage would be calculated automatically,

which the client could pay using the NFC technology and a mobile device. The receipt for the transaction with details regarding the consignment would either be printed immediately if the client requires so, or it would be sent to the client's e-mail address, to be printed if needed.

4.2. Mobile selling point as a support for hybrid space

Charging postage on consignment acceptance, especially when it comes to non-standard consignments which must be brought to a counter of a postal unit, means a client would have to wait in a queue if the number of present clients is bigger than service capacity. Physical places of consignment receipt are reduced down to counters with required equipment for receiving, such as electronic scales and POS (Point of Sale) device. Increasing the number of available counters in case of queuing can be done easily by turning client queues into mobile points of reception, using a modified mPOS (mobile Point of Sale) device.

Mobile device for charging postages, mPOS, is a system of transmission equipment for scanning, postage counting and receipt (receiving confirmation) printing. This device can read franked consignments, re-print postages and count postages which the client shall pay through credit card reading, just like at any other POS terminal.

4.3. Electronic platform: .post

The spotted problem and the care for clients caused the making of a trusted international electronic platform regulated by The UPU which integrates physical, financial and electronic postal dimensions: .post. This platform integrates e-post, e-market and e-management. The idea of developing .post platform is making an innovative business model by postal operators and their partners aiming to bring a new value to buyers.

Some of the management problems which .post should solve are: How can physical postal network be converted into the digital world? As a postal service provider, how can we guarantee to our clients safety and confidence in electronic communication and ensure they can receive their consignments in every part of the world, even during holidays or short business trips? How can the problem of undelivered shipments be reduced, which would also reduce expenses?

New .post domain differs from other domains, such as .com, .int or .org, mainly by its restrictive access, which is meant only for legitimate members of postal sector.

This domain enables governments and postal operators to define the internet space which can be used for safe realization of business transactions of any kind. This opens the possibility of development of electronic postal services outside the borders of postal administration. Also, this platform brings the idea of transmitting the trust in physical network into the digital world, especially on international level, when it comes to transference of official documents or legal contracts where the distrust in digital communication is especially present.

The problem of updating data about changing the address of clients who change their place of residence often, influences the possibility of regular consignment delivery. This platform offers to connect the physical and electronic address into a unique identifier. A client can simply update .post identifier from any place and by doing so, he/she provides a new address for consignment delivery. By updating addresses, the number of undeliverable shipments is in rapid decrease. Another role of the identifier is filtering direct mail by the hand of a client, which significantly reduces the amount of unwanted mail, and senders get a chance to adjust to clients. Access to .post is available from mobile phones from any place at any time, which is of great importance when it comes to integrating continuality of business processes and time differences.

The .post platform, among other things, enables both sides which participate in a transaction to know exact customs and tax charges before the transaction is over, simply by developing a systematic customs declaration, which hasn't existed up until now. Transparent use of the platform with tracking system (track and trace) integrated in it enables users to follow the trip of their order. Following orders via mobile phones makes even more sense, especially if the shipment is expected in a non-standard regime.

E-management services are developed so as to be available anywhere and at any given moment. One of the challenges which is being set for the countries' governments is enabling a universal service for their mobile citizens according to the defined international rules. Using .post domain can reduce charges of a universal service by combining traditional and new electronic services via mobile phones through hybrid communicational service.

4. CONCLUSION

Mobile applications were initially designed to make communication easier. The development of social activities sets new requirements, new challenges for new applications and new functions. Mobile devices surely belong to not only private, but also business environment. Communicating does no longer mean only transferring information, but also a corresponding (and fast) reaction in means of verification of the value of the transferred information.

Using mobile devices in business represents a great challenge for postal sector. Developing new applications requires improving, upgrading and coming up with specially designed solutions in order to provide postal service to clients.

Various use of mobile devices is present in all areas and most commonly means locating, following, gathering information, realizing and confirming activities. All these functions can be used in the field of postal service, in order to achieve a market advantage, good relationship with clients and optimal solutions for using existing capacities.

According to NSA (National Statistics Association) statistics for the year 2013, 87 percent of population in Republic Serbia uses mobile phones, the number of internet users has risen for 6.9 per cent compared to the year before, over 900 thousand people have bought or ordered products/service via internet during that year, and 30.3 percent of the internet population have used mobile phones to access internet when outside their house or office (NSA, 2013). That said, integrating the traditional and the new, electronic service, as well as using positive experiences of big postal managements and private operators can be of help in making a good starting position in the upcoming market competition and the fight for new service users.

REFERENCES

Grgurović, B., Štrbac, S., &Milovanović-Braković,G. (2012), Uticaj tehnologije na budući razvoj poštanskog saobraćaja. (Z. Čekerevac, Ed.) FBIM Transactions, 1(1), 56-65. Retrieved from www.meste.org/fbim/FBIM_1_2013/_06.pdf

Frith,J. (2012) Splintered Space: Hybrid Spaces and Differential Mobility. (Routledge). Mobilities, Vol 7, No 1, 131-149, DOI: 10.1080/17450101.2012.631815, http://www.tandfonline.com/loi/rmob20

H. B. Okholm, M. Winiarczyk, A. Moller, C. K. Nielsen (2010), Main developments in teh postal sector (2008-2010), http://ec.europa.eu/internal_market/post/doc/studies/2010-main-developments_en.pdf

Joan Melia-Segui, Joaquin Garcia-Alfaro, Jordi Herrera-Joancomarti (2010.), RFID EPC-Gen2 for postal applications: A security and privacy survey

Marković, D., Grgurović, B., Štrbac, S. (2011), The use of spatial data for segmentation of the postal services market, Technological and Economic Development of Economy, Taylor&Francis.

Mobile future in fokus report 2013, ComScore, februar 2013

NSA report of Republic Serbia „Informacionetehnologije u RepubliciSrbiji“ http://webrzs.stat.gov.rs/WebSite/repository/documents/00/01/17/66/17_Informacione_tehnologije.pdf.

The Strategy for Postal Service Development in Serbia 2013-2016, Official gazette RS, no. 43/2013

Toime, E. (2013), Up to speed, Postal tehnologies,mart 2013, 14-15, wwwpostaltehnologies.com.

UPSP report (2014), http://www.upsp.com

UPU statistic report (2014), http://www.upu.int/en/resources/postal-statistics/2012-results.html

WARRANTY MANAGEMENT MODEL IN E- COMMERCE

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Abstract: *Virtual market is a place with a significant number of retailers offering their products or services. In addition, buyers have a wide selection of goods and services to choose from and their decision to purchase something is based on the offer and impression that sellers make on potential customers. Such conditions require traders to treat every customer with due care and not let him/her be unhappy with the purchase, even if they must complain about the purchased product. The system of automated management of warranty claim process is very important, because it allows the buyers to exercise their rights acquired by purchase, and the vendors to make a good impression without harming their reputation. Moreover, customer feedback obtained via warranty claim processes can be of great importance for improving products or services. The paper presents a system of production management, while special attention is given to one of its segments - warranty management system.*

Keywords: *Warranty, Warranty management, eBusiness, Escrows, e-commerce.*

1. INTRODUCTION

The increased availability of online products and the modern lifestyle, with average users having less and less time for shopping in retail shops, have both made the consumers turn to online shopping. This phenomenon resulted in the increased number of online purchases, even in our country.

According to the data provided by the Statistics Office of the Republic of Serbia in October 2013, over 900,000 persons have purchased or ordered goods via the Internet in the last year, which is an increase of slightly over 300,000 than in 2012. In terms of timeframe, 19.3% of users have made a purchase or ordered goods or services over the Internet in the last three months, 9.2% more than three months ago, and 7% over a year ago, from the time of the issuance of reports. A significant number of customers, 64.5% in total, have never purchased or ordered the goods online.

These data suggest that an increasing number of users have been opting to purchase or order goods and services over the Internet. With an increased number of customers, the problem of dealing with customer warranty claims and possible refunds is becoming increasingly important, especially if we take into account the fact that buying over the Internet is somewhat unreliable, because customers do not have an opportunity to take a product they intend to buy in their own hands and examine it for quality, but have to rely on the description and characteristics of the product given by the vendor. There is a possibility that the ordered product is not in conformity with its description and characteristics, or that it may be damaged during transport. Such conditions of purchase require a system that will enable warranty management, as well as the vendors, to provide a good quality post-sale support. According to Jim Ericson [Ericson, J. (2002)], "Warranty management today is about faster cycles for engineering design and redesign, better consumer response, recovering costs, improving channel relationships, and building a service business with much higher margins than traditional manufacturing. Today, the customer demands the warranty, but the manufacturer needs it as well."

The use of specialized websites that serve as intermediaries and safeguard the entire process of purchasing and delivery of goods is one of possible modes of online customer protection. These websites are called Internet Escrows and their role is mediation of payment. The user orders goods on the vendor's site and chooses an escrow website as a mode of payment. In the next step, the buyer pays the money to the escrow provider's account, after which the vendor sends the goods to the customer. When the buyer receives the product and checks its quality, he/she updates the transaction, after which the money is paid to the vendor. This method of securing purchases eliminates the possibility of fraud, because the buyers cannot get the goods until they pay for them, and the vendors cannot send the goods without previously getting paid for them, provided the goods conform to their description. While trading by using escrows reduces the possibility

of customer warranty claims, it does not reduce the possibility of complaints for goods that are non-functional or defective. Escrow network does not cover such defects and these products are returned to vendors (manufacturers). Servicing of this type of warranty claims requires background business operations that will accept and process them.

2. ANALYSIS OF THE EXISTING SYSTEMS

Companies all around the world are being faced with great costs incurred by customer warranty claims. According to the statistics, the losses comprise approximately 7% of revenue, while US companies alone spend more than 22 billion dolars each year on resolving warranty claim issues. Poor warranty management may leave a company at mercy of its competitors and can further entail:

- Increased costs
- Loss of customer-vendor trust
- Decreased revenue
- Lack of trust in the product or service reliability.

Warranty claim processes can be improved by applying the knowledge of new technologies and their integration into the business system. There is a significant number of organizations on the market that offer their platforms for warranty management, and the best include: Oracle, Tavant, Optimum-us, Entigo, Product& Service Advantage (PTC).

The analysis of the existing warranty management systems has shown that their essence lies in a constant monitoring of products and services. The analysis makes possible the prediction of unwanted consequences, as well as a timely response to them. All examined systems have some common characteristics, including:

- Centralization and automatization – involve the creation of a central database where all relevant data will be stored. When the data are organized in this way, forms and questionnaires can be created and specific conclusions reached - automatically.
- Personalization and optimization – by using automatic data processing, all warranty questionnaires can be dynamically optimized, adjusted to specific situations and customized for each individual client. This method helps remove the obstacles in terms of language, device, location or any other charatcteristic.
- Analysis and adaptation – adaptation to organizational change requires the use of tools that will help data analysis provide accurate, timely and measurable results.

The integration of the warranty management system can help reduce administrative costs, as well as time spent on warranty claim processing. It can also reduce errors, prevent their recurrence and increase productivity. The possibility of automation is one of the biggest advantages, because it can improve business operations in terms of eliminating customer dissatisfaction and providing confidence in the product.

3. WARRANTY MANAGEMENT IN E-COMMERCE

Warranty is defined as a guarantee that a product will perform as stipulated, and as a commitment to correct problems if the product fails during the warranty period. There are various levels of product warranties, as well as differing implications for buyers and manufacturers.

Electronic commerce has increased in recent years and the number of users who opt to shop online has been on the rise, which has led to an increased number of websites for this type of sales. Greater competition requires that the providers improve the quality of goods and services if they wish to retain the existing customers and attract new ones. This entails the need for an adequate warranty management which would reduce the level of dissatisfaction among customers who had to complain about the purchased products. In order to place a product on the market, the manufacturer must guarantee for its correctness, and provide a written guarantee that the product is correct and usable within a specified period. As products are mostly made up of components that manufacturers purchase from their suppliers, the warranty that the manufacturers obtain from the suppliers is further transferred onto the finished product and its warranty. The warranty does not always imply refund, but the repair of the product instead, in which case the warranty system includes service network. Warranty claims can be organized in such manner that the goods are returned to the manufacturer, or the warranty claims can be dealt with through the service network.

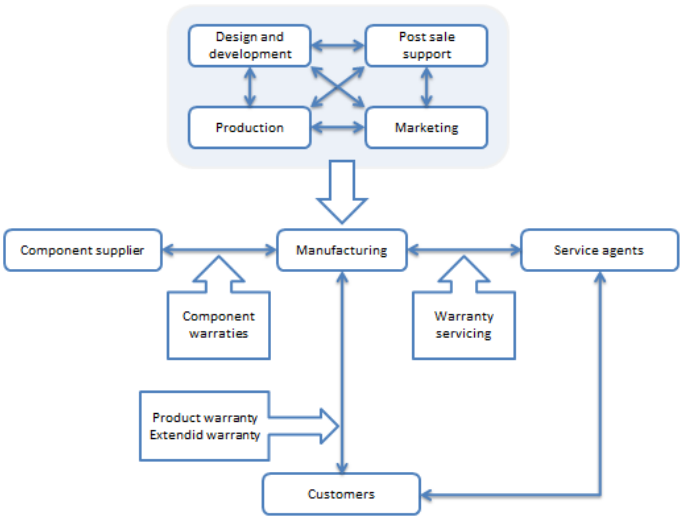

Figure 1. Key elements of warranty management [Shriti, and Meraj,2008]

Whenever an item is returned under warranty, the manufacturer incurs various costs (handling, material, labor, facilities, etc.). These costs are random (unpredictable) quantities. The following three costs are of importance to both consumers and manufacturers:

- Warranty cost per unit sale
- Life cycle cost per unit sale
- Life cycle cost over repeat purchases.

4. WARRANTY MANAGEMENT MODEL

Warranty management model can be divided into two separate segments. The first segment is the information model for production management that constitutes the internal part of the warranty management model, while the second one is external and it includes processes such as receiving warranty claims and their processing. Receiving warranty claims can be organized on the website, via the Call Centre, directly through the outlet network, or through the service network. At this point it is also important to check the agreed terms and the ones defined in the contract.

Warranty claims are a segment of the trading process both in real-time and virtual environments. The Image 2 shows their place and role in the process which includes a set of activities that must be carried out for the successful placement of products on the market.

The process of product advertising includes a number of activities which have a direct impact on other processes that occur in the production. First of all, technical service must identify and analyze the product defect or flaw, as well as its effect on the functionality of the product. Also, this service has to determine whether the error occurred in the production process or whether it was made by the subcontractor-supplier of the parts and assemblies that were built into the product. Given that the supply of parts for the majority of products involves multiple suppliers (sub-manufacturers), the analysis of the resulting error must encompass the entire process in order to determine where it was made or not and who the claim should be forwarded to. These data can be found in the part of the database where the supply side is processed (SCM). The cycle of product replacement begins with the identification of the causes of the product malfunction or failure. This means that the number of newly manufactured parts that will replace the returned products will increase. Well-established production lines know in advance the percentage of products that are usually returned, and the number of products to be released is also increased in advance for that percentage.

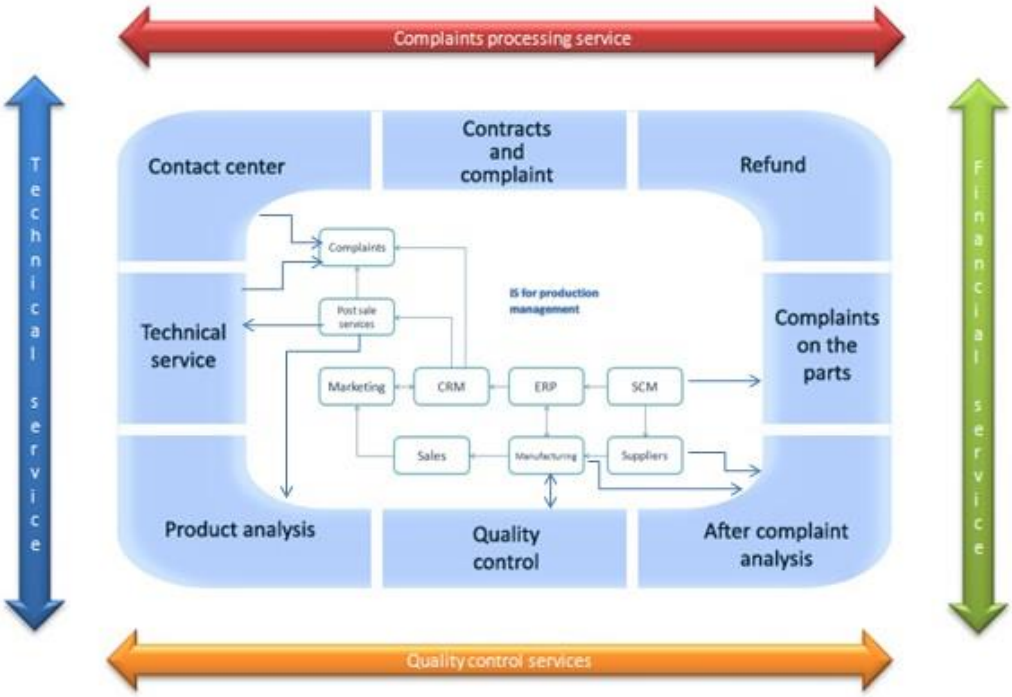

Figure *2 – Warranty management information system*

Warranty management model should encompass the entire process which includes a range of activities, from communication with customers and analyzing warranty claims, through acceptance or rejection of their request, to the analysis of the causes of errors, refunds, etc. A model of warranty claims coordination process which, apart from a standard procedure for warranty processing, includes the activities carried out by the technical service, is described in the further text. Management of the quality of products and their parts, as well as the financial aspect of the entire process, has also been covered.

Elements of the model:

- Contact center deals with customer information, receives warranty claims and determines their validity. Detection of false claims is an important segment in this phase of the process. Here the focus of warranty management is on the administration of warranty claims. It involves the following steps:
    - Receiving claims from service agents
    - Processing claims to check for the validity of claim (so as to prevent fraud)
    - Arranging for reimbursement
    - Part management (to update the part inventory of service agents).

The aim is to control warranty servicing costs through detection of fraud (by customers and/or service agents) and to ensure a certain level of customer satisfaction through efficient servicing of valid claims by service agents. The approach to warranty is reactive and warranty is viewed mainly as a cost element with an accounting emphasis [Shriti, and Meraj,2008].

- The part of the model related to contracts and warranty claims serves to analyze the conditions of the sales transaction. It registers returned products, checks for any specific terms or if the goods were sold as part of a campaign, etc. Legal department is in charge of this type of activities because the above-mentioned elements must be viewed in light of customer rights and vendor obligations.
- Reimbursement is valid if the analysis of the warranty terms shows that the customer has a right to claim refund. Reimbursement is a duty of the Finance Department. In this process there is a part of funds that cannot be reimbursed and which always represents a loss – fees to payment processors.
- Technical service is tasked with warranty claim processing and determining of the product repair or replacement costs.
- The potential error is detected in the process of product analysis**.** Parts and assemblies are checked, etc.
- Quality control involves finding possibilities for improvement of products, servicing or operations with the aim of reducing the number of warranty claims and improving the products.

- Post-warranty claim analysis and quality research involve a process where the quantity of the needed parts is estimated, based on the research and analysis of the percentage of returned or replaced products. An overall product quality analysis.
- Component warranty claims are an important segment of warranty claim process, as the manufacturer is not solely responsible for the poor quality of the product. A part of the responsibility lies with the component manufacturers, in terms of the warranty they give for the components installed in the final product and which can be returned as a part of the warranty claim.

A specific problem occurs when payment was made by credit card or by using any of the electronic forms of payment. In this case, the payment includes the sum paid by a customer, but the bank transaction fee is then deducted from this sum. This means that the reimbursed amount is smaller than the actual refund, and the customer is entitled to total refund under warranty terms. The difference must be compensated from the vendor's own assets.

5. CONCLUSION

The tendency of the customers to buy online is constantly on the rise, and so is the competition. Therefore, the need for adequate service is becoming increasingly important. Customers whose expectations are not adequately met and who had to complain about the purchased product could harm the reputation of the vendor. The warranty claim system is very important for traditional retailers, but it is even more important for those who primarily do business on the Internet, because this is the environment which customers do not trust enough and they generally seek traders with good reputation who they can trust. As the information in the virtual world is widely available and customers can easily read various comments about the vendors, it is important to pay attention to each customer, especially the ones whose expectations have not been met and who complain about it.

An adequate system of warranty management is very important. It allows traders to check the validity of claims easily and to respond appropriately. It also makes possible the collection of information important for determining the quality of the product, as well as of its components. In this way, the warranty management system is the means for getting customer feedback that can be used for product improvement.

REFERENCE

Ericson, J. (2002), "The word on warranties," Line 56, Thursday, May 23, 2002. [1]

http://download.springer.com/static/pdf/860/chp%253A10.1007%252F1-84628-258-6_7.pdf?auth66=1397933926_5b30c07a8e4a98e46db5c0b83166c360&ext=.pdf

http://optimum-us.com/optimum-warranty.asp

http://4.bp.blogspot.com/_PnGDRmMobXI/TTsFvYsC0kI/AAAAAAAABB8/M5YmzHQiIA0/s1600/warranty_management_framework.gif

http://www.warrantyweek.com/archive/ww20070619.html

http://www.entigo.com/solutions/warranty.html

Identifying and Reducing Warranty Costs in Your Organization, A Guidebook for Embarking on a Program to Cut Costs Related to Warranties, Entigo ® White Paper Series, September 2003.Printed in the United States of America. www.entigo.com

Shriti, M. Meraj, M, (2008), Warranty Management—A Neglected Source of Competitive Advantage, prtm whitepaper,.

Warranty Management Systems, whitepaper (2011).

ANALYSIS OF THE USE OF CREDIT CARDS AT ATMs AND POINTS OF SALE IN AND OUTSIDE THE REPUBLIC OF SERBIA

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Abstract: *In this paper, we applied the techniques of descriptive statistics to analyze the use of credit cards at ATMs and points of sale in the country and outside the country, issued by the commercial banks that operate within the banking system of the Republic of Serbia and issued by commercial banks outside the Republic of Serbia in the period from 2009 to 2013. Payment cards as an instrument of cashless payments are becoming an important part of our daily lives, whether we use them as an instrument of payment transactions (payment transactions made over the Internet), for the payment of goods and services, for cash withdrawals or as an instrument of identification.*

Keywords: *payment cards, electronic banking, cashless payment, ATM, POS systems.*

1. INTRODUCTION

Credit cards appeared in the United States during the 1920s, when individual firms, such as oil companies and hotel chains, began issuing them to their customers. The first card for deferred payment for privileged users was issued by Western Union Telegraph Company in 1914. These credit cards had a restricted use, ie. could only be used in the sales/service facilities of the company that issued them. The first bank card named "Charg-It" was introduced in 1946 by John Biggins, a banker from Brooklyn, which allowed bank customers to purchase consumer goods in local stores that entered into an agreement with the Bank.

The first universal credit card made of cardboard, which could be used in a variety of sales / service facilities, was issued by the Diners' Club International on 8/02/1950. By the end of 1951, 20.000 Diners Club cardboard cards were issued and a decade later they were replaced with plastic. The other significant cardboard credit card of this type was launched by American Express Company in 1958 and in early 1959, it issued a plastic credit card. The first banking system of national importance was "BankAmericard", launched by the Bank of America in California in 1959. This system was licensed in other states in the beginning of 1966 and since 1976-77 was renamed Visa. Other major bank cards are MasterCard (formerly Master Charge, 1966) and Barclay's. Discover is the American organization that launched the Discover card in 1985. In our country, the first cards appeared in 1969, issued by Diners Club, and the first national bank card is DinaCard, established in 2003 by the National Bank of Serbia and commercial banks.

2. ELECTRONIC PAYMENT CARDS

In traditional retail payment systems, electronic payments credit have been functioning for many years, and today they represent the dominant payment system in e-business. Electronic payment cards are used in most business transactions carried out over the Internet. Payment cards can be defined as the standardized (ISO 7810 standard and physical characteristics [9]) of non-cash payment instrument emitted by the banking system, commercial or specialized systems with which the cardholder may purchase goods or services (POS systems) and withdraw cash (ATM) charged to his bank account. According to the generally accepted definition, the debit card is a small piece of plastic that contains a means of identification (signature or photo), which allows the cardholder to purchase goods or services charged to his/her account.

Payment cards can be divided into several groups [2], [4], [12]:
- According to the use:

a) horizontal cards: credit cards, debit cards, prepaid cards (single-purpose/multi-purpose and specialized), corporate cards, Internet cards and loyalty cards;
b) vertical cards: platinum card, gold card, business cards, classic cards and virtual cards.
- By technological drafting:

a) standard embossed payment cards, engraved cards defined by ISO standard 7811, as follows: form, size, height and position of the bulge;

b) electronic magnetic stripe cards, today represents the most popular instrument of payment, defined by ISO 7811 (chapters 1, 2 and 3), where are specified characteristics of magnetic stripes, coding techniques and positions;
c) smart card, these are physical cards with embedded chips that allow the storage of significant amounts of data [1]. It is widely used in: financial transactions (e-banking, e-commerce, e-governance), hardware-software protection of business systems that require a higher level of security for their business data on computer networks and computer systems (authentication, authorization, privacy, integrity, inability of rejection), and in the user identity identification, defined by ISO7816 series of standards and EMV standards (global standard for smart card-based payments) [8].
Smart cards can be divided into three groups:
- smart card with the possibility of an internal microprocessor data processing, capable of remembering and protecting the data and making decisions within certain limits,
- only memory cards, the cards with direct access to memory, where static data is stored, and consist of ROM and EEPROM memory, and
- hybrid smart cards, cards with contact chip (providing logical access control – access to computer and other resources) and contactless chip (providing physical access control).
Today, for greater security, there are cards with built-in LCD display and touch keypad that allow generating One Time Passwords (OTP), as an authentication security measure.

- According to the application location:

a) domestic (national) credit cards: DinaCard and YUBA in Serbia;

b) international credit cards: VISA, MasterCard/Maestro, American Express, Diners Club Card, Discovery, JCB, are all international credit card organizations, card schemes or networks that are globally interoperable. Visa, MasterCard/Maestro, Dina and YUBA are bank payment cards, where banks appear as a credit card issuer. American Express, Diners Club Card, JCB and Discovery are non-bank cards issued by other entities, and banks may emerge as mediators in issuing cards.

2.1. The electronic cards payment process

Modern information and communication technologies have initiated many technological innovations in the financial services industry, particularly in the area of new models of electronic banking (online banking, Internet banking, SMS banking and mobile banking) as well as payment systems (electronic accounting systems of large value payment and distribution retail systems). In the further text, we will briefly explaine the traditional distribution retail payment systems, which include: Automated Teller Machine-ATM, Point of Sale/Electronic Funds Transfer at Point of Sale-POS/EFTPOS and Home Banking-HB, which use electronic payment cards and today increasingly mobile phones (Near-Field Communication - NFC) as an alternative to paper payment systems.

2.1.1. Automatic bank tellers-ATM

Automatic bank teller or ATM, according to the NBS, is "The device usually installed in a crowded area or the branch of the bank and enables the cardholder to withdraw cash from his account 24 hours a day. To withdraw cash from an ATM, the cardholder must, as identification, type a PIN number, obtained from the bank in a sealed envelope, known only to him."
The first traditional distribution retail payment system was an automatic bank teller/ATM Machine (ATM-Automated Teller Machine) that worked in the off-line mode. It was invented and installed by John Shepherd-Barron at Barclays Bank in London in 1967 and was able to pay a voucher worth 10 pounds. Vouchers were later replaced by plastic cards, kept in the ATM after the transaction. The bank would return them later by mail to clients for further use.
Automatic bank tellers (ATMs) are self-service devices placed in crowded areas (airports, railway stations, bus stations, subway stations, factories, universities, convention centers, sports facilities ...) and connected to a distributed network (ATM networks) within the electronic banking system. They are now divided into two groups according to their functionality:
1. Monofunctional automatic bank tellers-ATM (older versions) that provide 24 hours a day, 356 days a year, the bank customers and other users with: cash withdrawal and account balance inquiry;
2. Multifunctional automated teller-bank ATM, the modern ATMs that provide bank customers and others users, 24 hours a day, 356 days a year, with the following functions: cash payment and withdrawal, account balance inquiry, taking deposits, transfer funds to other accounts within the bank, payment of various bills, querying and obtaining information, a list of recent transactions, printing transactions, change of PIN, mobile impulse purchasing... [5].
The best-known manufacturers of ATM terminals are: NCR (world's number one ATM manufacturer, NCR SelfServ™ 26, NCR SelfServ™ 31…), Diebold-Incorporated (Diebold 429 Lobby, Opteva® 923 In-Lobby Teller…), Wincor Nixdorf (CINEO C2040, CINEO C2550…), Hitachi-Omron (HT-2845-SR, ATM SR7500…)… Figure 1 shows the diagram of transaction processes of an ATM.

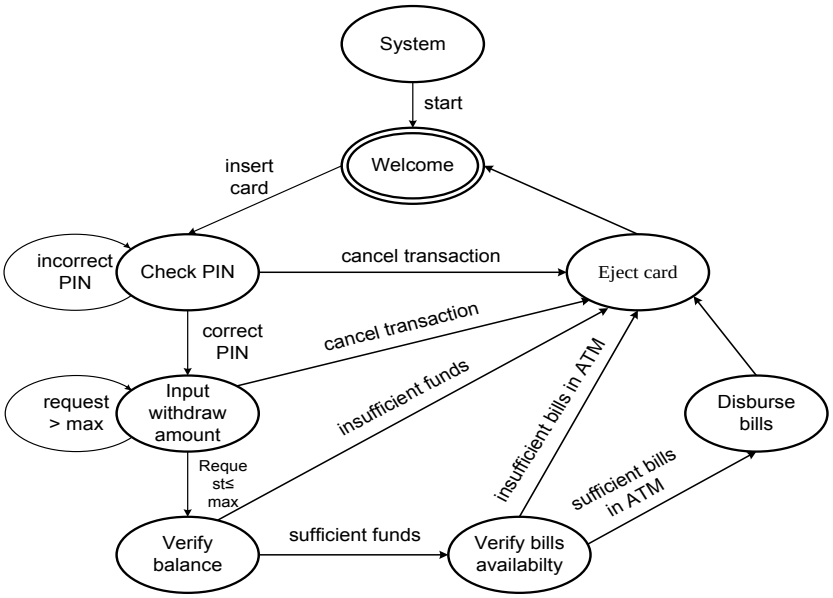

Figure 1: Diagram of the ATM transaction processes [13]

2.1.2. Point of sale devices – EFTPOS

According to the NBS, EFTPOS is the electronic terminal, placed at the point of sale, which allows payment for goods and services. It is equipped with software for processing payment card transactions (reading data from the card, forwarding to the recepient bank and the issuing bank acceptance of the response, based on which the money is withdrown for the purchase of goods). EFTPOS devices or systems work in off-line processing mode (accumulating all clients' transactions carried out during the day and later withdrawing certain amount of money from the customer's account) and on-line processing mode (processing is performed at the time of card activation through the EFTPOS terminal), which is now the dominant mode.
There are "four participants" in the process of payment for goods and services at the EFTPOS device/ terminal, as follows:

- Customer-cardholder;
- The card issuing bank;
- Merchant;
- Merchant's bank - card recipient .

Lately, in the credit cards payment transactions, there is the fifth participant (credit card networks-Visa, MasterCard), which checks the security functions, coordinates the transfer of funds and the transfer of necessary information between the card issuer bank and the card recepient bank. When paying with credit cards, there is a model where the transaction involves three actors: the customer, the merchant and the card network (American Express, Diners Club and Discover Card). This model recently also includes the bank as the card issuer. Figure 2 shows the graphical model of on-line business transactions using payment cards and EFTPOS terminals.

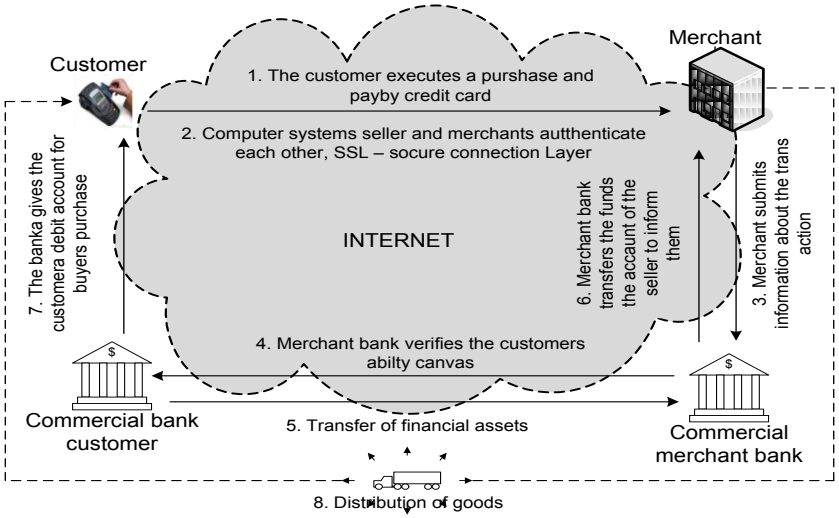

Figure 2: Business transactions using payment cards and EFTPOS terminals [4]

Introduction of EFTPOS devices decreases: circulation of cash, the use of checks by customers, the cost of treatment, time needed for financial transactions, and increases the overall safety of both payment card users and payment.

3. ANALYSIS OF THE USE OF DISTRIBUTION RETAIL PAYMENT SYSTEMS IN SERBIA IN THE PERIOD 2009-2013

In the analysis of the use of distribution retail payment systems in Serbia for the observed period, we will use the statistical analysis descriptive methods [6]. The analysis will include: Number of installed ATMs and POS terminals in Republic of Serbia; Number and value of transactions with cards issued in the Republic of Serbia at ATMs in the country; number and activity of cards issued in the Republic of Serbia.

Number of installed ATMs and POS terminals in Republic of Serbia

Table 1 and Figure 3 shows the official statistical data of the National Bank of Serbia on the total number of installed ATMs and POS terminals, the number of transactions and the total turnover in the Republic of Serbia [11].

Table 1: The number of installed ATMs and POS terminals in Republic of Serbia

Year	Number of ATMs	Index	Number of retail stores with POS t.	Index
2009.	2.723	100	59.058	100
2010.	2.857	104	57.459	97
2011.	2.830	104	58.012	98
2012.	2.785	102	62.656	106
2013.	2.613	96	59.822	101

Source: bank reports

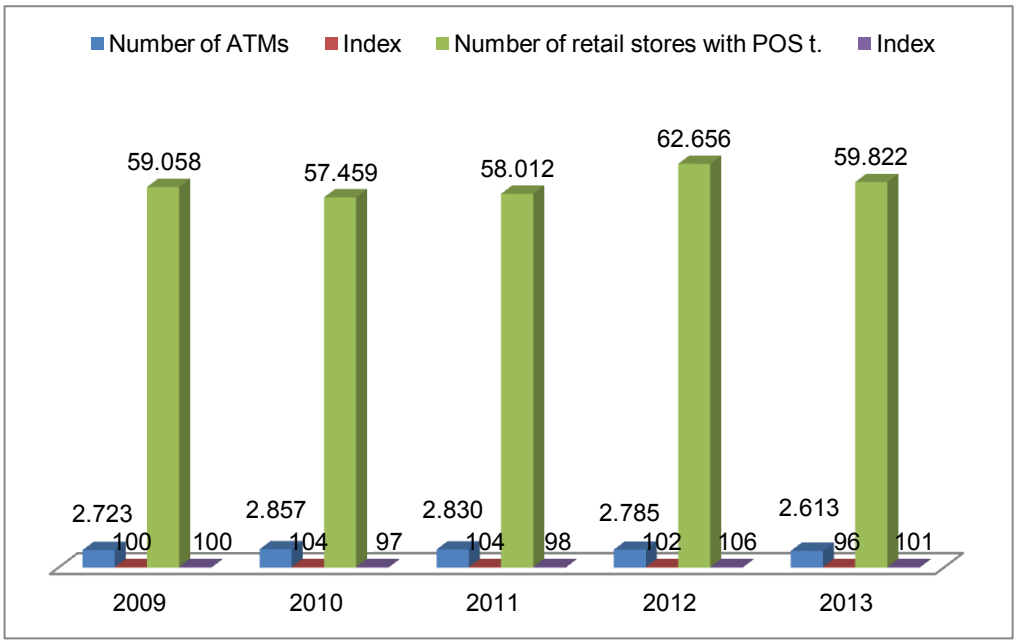

Figure 3: Number of installed ATMs and POS terminals and total turnover in the Republic of Serbia

Based on Table 1 and Figure 3, we can conclude that the number of installed ATMs in 2009 was 2.723, and 59.058 EFTPOS terminals. In the next two years, the number of ATMs increased by 241 which is 8.9% (2010: 4,9%-134 and 2011: 3,9%-107). In 2012 and 2013, there was a reduction in the number of ATMs by 217 (revoked license: Poljoprivredna banka Agrobanka a.d. Belgrade-25.05.2012, Nova Agrobanka a.d. Belgrade-27.10.2012, Development Bank of Vojvodina a.d. Novi Sad-06.04.2013. and Privredna Banka a.d. Belgrade-26.10.2013), as follows: 2012: 2,3%-62 and 2013: 4,0%-110. The number of EFTPOS terminals but in 2010 and 2011 there was a reduction in the number: 2,7% (1599) and 1,7% (1046) compared to 2009 (due to the economic crisis, many shops closed). In 2012 the number of EFTPOS terminals increased by 6,1% (3589) and 2013 by 1,3% (764) compared to 2009 year.

Number and value of transactions performed with cards issued in the Republic of Serbia at ATMs and POS terminals in the country

Table 2 and Figure 4 show number and value of transactions performed with cards issued in the Republic of Serbia at ATMs and POS terminals in the country.

Table 2: Number and value of transactions performed with cards issued in the Republic of Serbia at ATMs and POS terminals in the country

Year	Number of ATM transactions	TOTAL turnover of * ATMs	Number of retail stores with POS t.	TOTAL turnover at * POS t.
2009.	48.123.180	263.782.000	57.457.802	124.832.000
2010.	51.986.007	312.659.000	64.210.478	141.573.000
2011.	57.490.112	372.483.000	74.729.116	161.486.000
2012.	62.833.608	430.000.000	86.826.191	194.262.000
2013.	68.334.949	487.048.000	100.486.400	218.516.000

Source: bank reports
* Value of transactions performed with cards issued in Serbia at ATMs and POS terminals in RSD

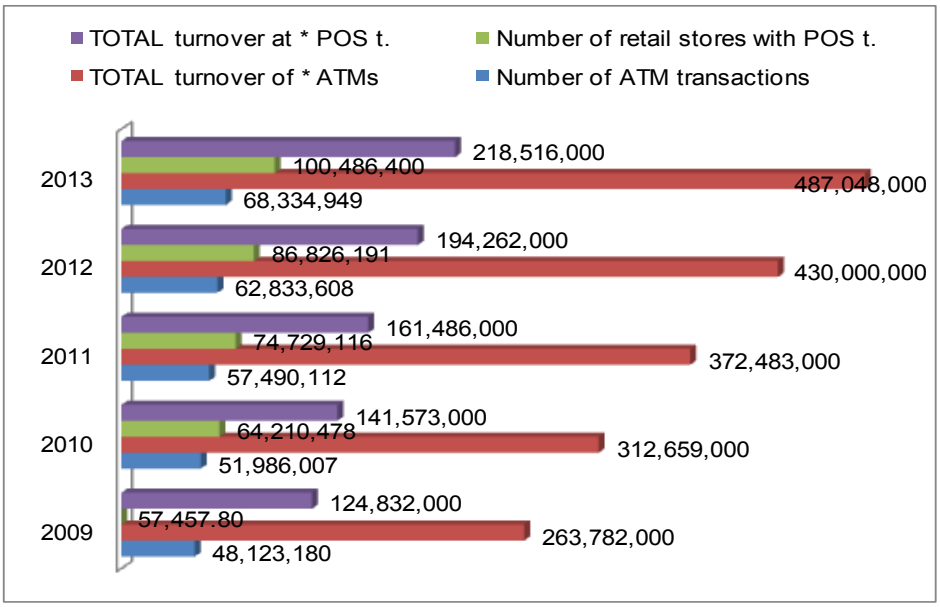

Figure 4: Number and value of transactions performed with cards issued in the Republic of Serbia at ATMs and POS terminals in the country

In the observed period, from the data in Table 2 and Figure 4, we can conclude that the number of transactions and the turnover using cards at automated banking counters-ATM and POS terminals in the country continues to increase. The number of transactions at ATMs in 2009 was 48.123.180,00 in the year 2013 was 68.334.949,00 which was an increase of 20.211.769,00 (70,4%), and in point of sale terminals in 2009 there were 57.457.802, in 2013, it was 86,826,191, which was an increase of 35,093,920 (40.4%). The total turnover at the ATMs in 2009 was 263.782.000,00 RSD, which is a decrease of 223.266.000,00 (84,6%) compared to 2013, and in point of sale terminals total turnover in the year 2009 was124.832.000,00 RSD which was a 93.684.000,00 RSD (42,8%).

Number and value of transactions performed with cards issued in the Republic of Serbia

According to the official statistics from the National Bank of Serbia, Table 3 and Figure 5 show the data on the number of transactions and turnover in the country, using the cards issued in the Republic of Serbia.

Table 3: Number and value of transactions performed with cards issued in the Republic of Serbia

Year	Number of transactions			Turnover*		
	debit	credit	business	debit	credit	business
2009.	84.658.239	12.948.369	3.441.739	300.853.196	38.546.530	15.739.154
2010.	93.760.724	12.648.839	4.083.366	354033.741	38.290.743	20.762.245
2011.	107.497.491	12.844.824	4.836.075	418.847.126	39.556.433	26.462.510
2012.	121.926.831	14.074.197	5.621.490	485.635.250	44.895.663	34.129.391
2013.	139.500.639	13.179.107	6.578.497	552.219.873	42.552.204	42.942.087

Source: NBS reports
* Value of transactions with debit, credit and business cards in RSD

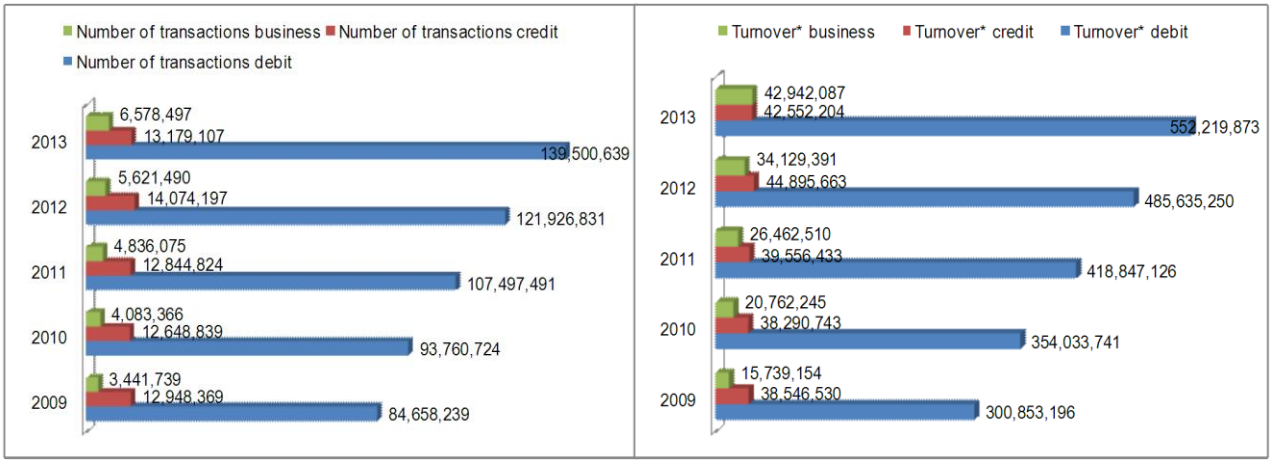

Figure 5: Number and value of transactions performed with cards issued in the Republic of Serbia

From Table 3 and Figure 5 we can conclude that the number of transactions and turnover in the country, using cards issued in the Republic of Serbia, in the observed period, continuously increases. Most transactions were achieved by debit cards in the 2013 is 139.500.639, credit cards 13.179.107, and the least transactions by using business cards 6.578.497, with the turnover of 552.219.873,00 RSD for debit cards, 42.552.204,00 RSD, credit cards and 42.942.087,00 RSD for business cards. In comparison to the year 2009 (84.658.239 transactions), the number of transactions with debit cards has increased by 64.8% (54.842.400), and turnover by 83,6% (251.366,134,00 RSD). Concerning credit cards, the number of transactions increased by 1,8% (233.738), and the turnover by 10.4% (4.005.674), business cards, the number of transactions increased by 9,9% (3.136.758), and the turnover by 172.8% (27.202.933). The economic crisis and unfavorable interest rates have influenced the decrease in the number of transactions and turnover using credit cards 2010 and 2011.

Number of transactions and turnover in the Republic of Serbia of cards issued abroad

With the increase in the number of tourists, sporting and cultural events in the country, the number of transactions and turnover using payment cards issued by banks outside of the Republic of Serbia has also increased, Table 4 and Figure 6.

Table 4: Number of transactions and turnover in the Republic of Serbia of cards issued abroad

Year	Number of transactions				Turnover*			
	ATM	POS	Counters	Total	ATM	POS	Counters	Total
2009	2.258.461	2.548.700	42.512.000	4.849.673	20.887.000	14.330.000	963.000	36.180.000
2010	2.420.087	3.553.606	39.941.000	6.013.634	24.618.000	18.246.000	1.130.000	43.995.000
2011	2.636.487	4.668.949	41.449.000	7.346.885	29.224.000	21.604.000	1.135.000	51.963.000
2012	2.943.814	5.343.233	47.957.000	8.335.004	34.042.000	27.112.000	1.178.000	62.332.000
2013	3.193.444	6.672.340	55.985.000	9.921.769	38.444.000	31.255.000	1.295.000	70.994.000

Source: bank reports

* Turnover in the country using cards issued by banks outside of the Republic of Serbia, stated in RSD

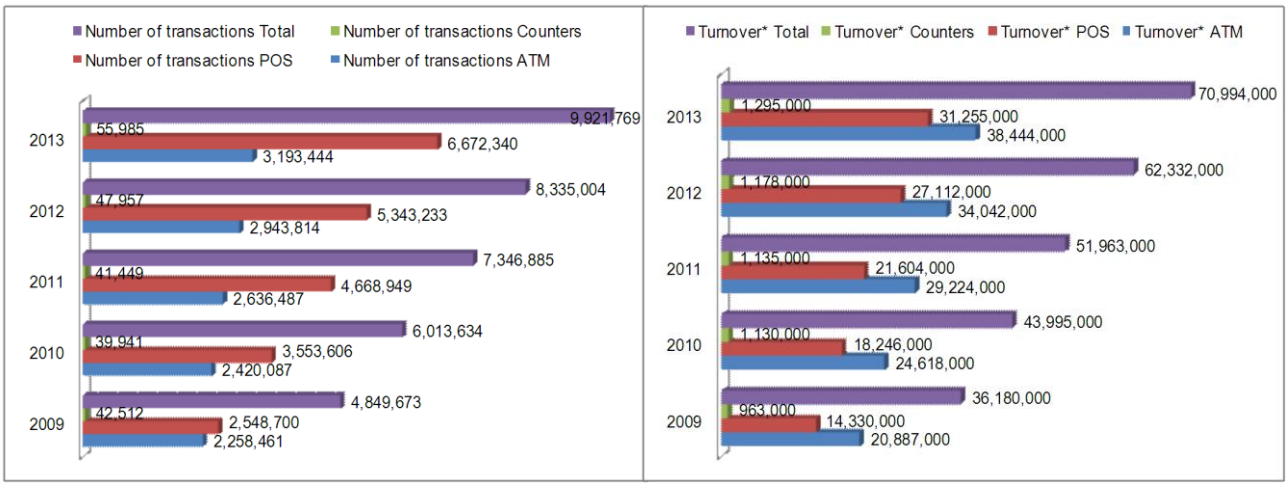

Figure 6: Number of transactions and turnover in the Republic of Serbia of cards issued abroad

In the observed period, based on the data given in Table 4 and Graph 4, we can conclude that the majority of transactions using cards issued by the banks outside of the Republic of Serbia were carried out in 2013: 3.193.444 ATM transactions and the turnover of 38.444.000,00 RSD. The lowest number of transactions took place in 2009: 2.258.461, as well as the lowest turnover 20.887.000,00 RSD. POS terminals have achieved the highest number of transactions 20.887.000 (2013), the lowest being 2,169,416 (2009). The highest recorded turnover was: 27,112,000 RSD (2013) and the lowest 14,330,000,00 RSD (2009). The traditional banking model (counters), or face-to-face interactions have made much less transactions compared to ATMs and POS terminals, the highest number of transactions 9.921.769 (2013), the lowest number of transactions 4.849.673 (2009). The highest recorded turnover was: 1.295.000,00 RSD and the lowest 1.500.000,00 RSD (2009). The total number of transactions and turnover (ATMs, POS terminals and counters) increased by 104,6% (5.072.096) and 96.2% (34.814.000,00€) in the 2013 compared to 2009.

Number and value of transactions with cards issued in Serbian foreign acceptance networks

Table 5 and Figure 7 shows number and value of transactions with cards issued in Serbian foreign acceptance networks

Table 5: Number and value of transactions with cards issued in Serbian foreign acceptance networks

Year	Number of transactions				Turnover*			
	ATM	POS	Counters	Total	ATM	POS	Counters	Total
2009.	324.088	1.547.973	7.275	1.879.366	42.900.000	115.400.000	1.500.000	159.800.000
2010.	337.958	1.967.284	7.242	2.312.484	43.900.000	142.600.000	1.600.000	188.100.000
2011.	382.162	2.479.524	7.800	2.869.486	50.500.000	182.300.000	1.500.000	234.300.000
2012.	435.776	3.086.974	9.698	3.5324.48	54.700.000	211.600.000	1.600.000	268.300.000
2013.	506.402	4.001.323	11.022	4. 518.747	61.500.000	231.600.000	1.800.000	294.900.000

Source: bank reports
* Turnover in the country using cards issued in cards issued in the country in EUR

From Table 5 and Figure 7, we can conclude that the number of transactions and the turnover in euro at the Automatic Teller Machines-ATMs, POS terminals and counters outside the Republic of Serbia using cards issued in the country in the observed period have continually increased. The largest number of ATM transactions is achieved in the year 2013 (506.402), which is by 56.3% higher compared to 2009 (324.088). The number of transactions at POS terminals was much higher compared to 2009 (1.547.973) and amounted to 158.4% in favor of the 2013 (4.001.323), and lowest number of transactions was carried out through the counter (2009: 7.275 and 2013: 11.022). The total turnover of ATM in the year 2009 was 42.900.000,00€ which was an increase of 43.2% (18.600.000,00€) compared to the 2013. In the observed period, turnover at the counter was in most cases even. The total turnover of POS terminals in the year 2009 was 115.400.000€ which was an increase of 100,6% (116.200.000,00€). The total number of transactions and turnover (ATMs, POS terminals and counters) increased by 140% (2.639.381) and 84.5% (135.100.000,00€) in the 2013 compared to 2009.

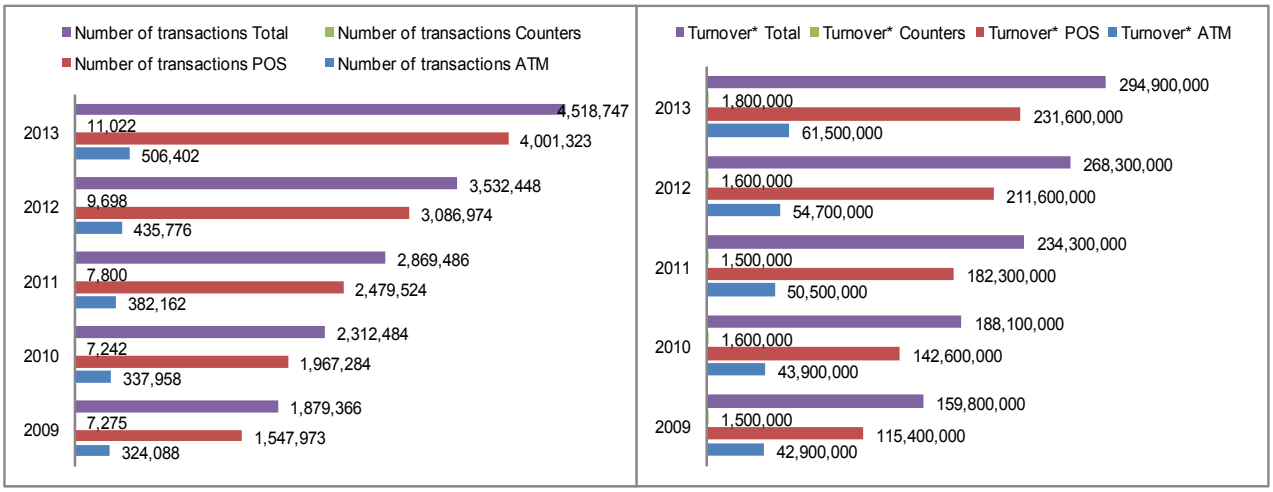

Figure 7: Number and value of transactions with cards issued in Serbian foreign acceptance networks

4. CONCLUSION

The traditional distribution retail payment systems will continue to play an important role in the future period in the financial transactions of modern banking systems. Based on the results of descriptive statistical analysis, we can conclude that the use of automatic bank tellers-ATMs, point of sale terminals-POS and

payment card system as payment instruments have an upward trend in our country. The increasing interoperability of ATMs and POS networks, the prices of payment instruments, innovations in payment instruments and the legislation have all initiated the upward trend in applying the traditional distribution retail payments systems. In spite of this upward trend in the use of payment cards as a payment instrument on POS terminals or cash withdrawal at an ATM, these transactions are far less used in our country compared to the global scale.

REFERENCES

Beynon-Davies, P. E-business, New York: Palgrave Macmillan, 154.

Vuksanović, E. (2006). Elektronsko bankarstvo, Beograd: Beogradska bankarska akademija, 44.

Deloitte Center for Banking Solutions, Available on Web site: www.deloitte.com

Drašković, M. (2010). Elektronsko poslovanje, Beograd: FSOM, 112-113.

Drašković, M., Smiljić, S., & Kukrić, M. (2013). Traditional distribution retail payment systems, Beograd: LEMiMA, 365-372.

Đedović, B., Drašković, M., & Bračika, N. (2013). Poslovna statistika, Beograd: VPŠSSČ, 27-29.

Electronic payment architecture and trends in Europe, http://www.ingenico.com/en/

EMV - Integrated Circuit Card – Specifications for Payment Systems, Book 4, Application Scpecification,

Version 4.3, Nevember 2011, www.emvco.com

ISO - International Organization for Standardization, www.iso.org

Laudon, K., & Traver, C. (2012) E-comerce, Boston: Pearson.

Narodna Banka Srbije, www.nbs.rs

O' Mahony, D., Peirce, M., & Tewari, H. (2002). Electronic Payment Systems for E-Commerce, Boston, Artech House. 12-14.

Wang, Y. (2010). The Formal Design Model of an Automatic Teller Machine, International Journal of Software Science and Computational Intelligence, 2(1), 102-131, January-March 2010, pp. 105. ISSN: 1942-9045.

PROVIDING CRM SERVICES IN B2B PORTAL OF ELECTRONIC MEDIA

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Abstract: *This paper describes an approach for providing CRM services within B2B business of electronic media. Main goal of the paper is to foster CRM processes, particularly marketing activities oriented toward business partners of a TV station. The main component of the solution proposed in the paper is based on web portal that provide plethora of services in the context of CRM. B2B web portal enable access all relevant services, resources and information related to the electronic media business. The approach is adapted to the specific conditions of business within electronic media in Serbia. The web portal is implemented within business system of Radio Television of Serbia. Further, electronic media B2B business framework is proposed. Model of CRM metrics in electronic media business is described, too.*

Keywords*: CRM services, B2B portal, Electronic media.*

1. INTRODUCTION

In modern environments success in business of an electronic media primarily depends on its ability to maximize outcome of relations with all stakeholders: audience, citizens, marketers, content providers, customers, business partners, etc. New business models are based on connected and integrated processes, collaborative decision-making, transparency of information, integrated metrics and lower barriers for expanding business partnerships. Medias are forced to develop new methods and services, to harmonize appropriate business processes and implement newest concepts in communication and collaboration with all partners.

Customer Relationship Management in electronic media is a set of methods, techniques and best practices implemented within a business system of an electronic media so as to enhance communication and cooperation with all customers, promote activities and services of electronic media and maximize business profits. In the context of e-business of media following CRM services are the most important: management of specific channels of distribution, analytics, customer services, sales, marketing, social CRM and internal CRM. Development and ubiquity of ICT enables application of advanced tools and services for customer relationship management. Nowadays, users of electronic media are increasingly oriented toward the use of mobile technologies, social networks and other modern media for transferring information. Compared to previous methods of communication with customers, which were implemented exclusively through TV or radio devices, today, media companies can easily manage customer relationships and establish a direct connection.

Main goal of the paper is to foster CRM processes, particularly marketing activities oriented toward business partners of a TV station. The main component of the solution proposed in the paper is based on web portal that provide plethora of services in the context of CRM. The approach is adapted to the specific conditions of business within electronic media in Serbia. The web portal is implemented within business system of Radio Television of Serbia.

2. LITERATURE REVIEW

In business of an electronic media it is necessary to implement modern concepts in business, especially in dealing with customers: personalized approach, adaptability, accessibility, user-generated content, use of social media, information timeliness, uniqueness, and comprehensiveness. Electronic media are forced to transform infrastructure and business model to ensure provision of facilities at any time, any place and on any device. Defining customers' profiles that include characteristics, expectations, and habits is an important task.

Complexity of the design and implementation of CRM systems increases with the number of services provided, as well as with number of users. It is necessary to define a method for modelling and development

of customer relationship management in e-business media. The model should include modern standards, concepts and services related to various business segments of an electronic media. A framework consists of set of tools and methods that enable integration of various components. Main problem in implementation of CRM strategy is a heterogenity of components and clients.

The significant role of CRM in business of electronic media has been recognized in a number of studies. In (LaRose, 2004; 2010) authors emphasize importance of analyzing certain characteristics of audience, especially their habit. TV media should analyse way of establishing and changing habits of audience in order to realize a high quality program that meets needs of the audience. Further, Adams (2000) discusses the ways and habits of watching TV by certain target groups. Impact of large quantity of information on modern world and importance of this issue in the context of electronic media business is discussed in (Diddy & LaRose, 2006; Kishi, 2008).

Importance of determining patterns of clients' behaviour in digital environment is discussed in (Webster, 2011). The authors discuss structure and ways of providing content to customers, but also point out that convergence and integration of media is best solution. Role of TV as a medium and relationship with other media types is discussed in (Cooper & Tang, 2009). In (Napoli, 2010), author discusses the modern trends in electronic media with a focus on the transformation of behaviour and expectations of those who are provided with services and media services. Connection between TV and Internet as a medium, is discussed in (Cha, 2013), with particular focus on videos.

Methods of research and audience measurement are explained in (Webster, 2008). Integration of a large number of methods is required, as well as use of modern technology such as business intelligence, semantic web etc. Applying the concept of big data and importance of electronic media is analyzed in (Mahrt & Scharkow, 2013). The role of social media in business TV stations are discussed in details in (Kishi, 2008; Baym & Boyd, 2012; Greer & Ferguson, 2011). Social media can be defined as a set of web applications, platforms and media which aim to facilitate collaboration between users and content sharing (Deandrea et al., 2012). The author points out great potential of application and integration of standard content and services on the TV with the capabilities of social networks. Particularly noteworthy is importance of information that can be collected on the social networks and used to improve customer relationships management.

Main idea of using social CRM in media is to engage customers and build loyalty and trust. Social media include: social networks (Facebook, Twitter, Google +, Pinterest, etc.), blogs, wikis, forums, etc. Medias can use social CRM in following contexts:

- Using social media tools for promoting TV media's services and products, collaboration and communication with business partners and customers.
- Tracking activities of competition and public opinion about the particular TV media
- Fostering the medias 's proactive communications via social media tools
- Mapping business partners' social profiles with internal and external CRM applications

Types of CRM applications

Most used classification of CRM applications includes four groups (Seybold, 2008):

- Customer-facing applications – in this category TV media provides customers and business partners with call centres, automated responders, field service automation, applications that help medias' employees, etc.
- Customer-touching applications – these include personalized web pages for customers, web self-service systems, FAQs, etc.
- Customer-centric applications – purpose of these applications is to analyze all data gathered within CRM process. Numerous tools and techniques are used: reporting services, business intelligence, data warehousing, etc. Based on these analyses CRM plans are created and implemented.
- Online networking and other applications – idea is to establish direct relationship with customers and partners. Main tools are: social media, web sites, advertisements, forum, blog, chat, etc.

Electronic media B2B business framework

Figure 1. presents a framework of B2B business of electronic media.

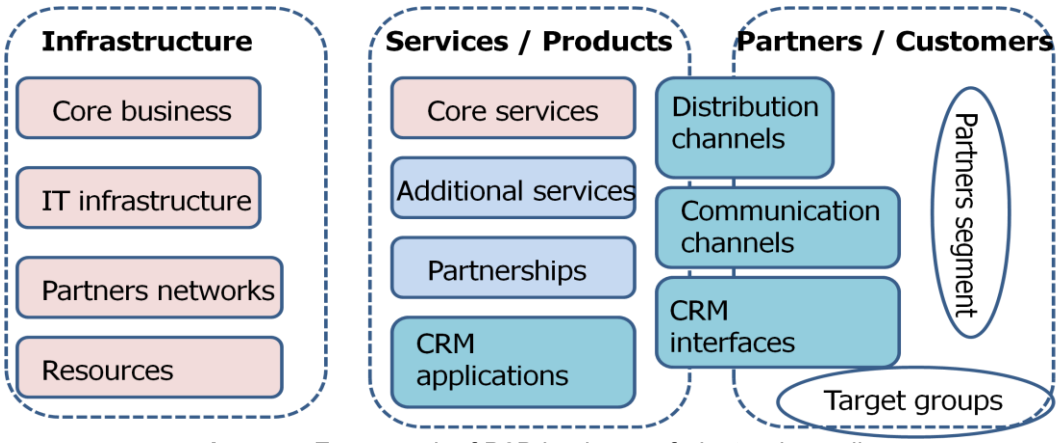

Figure 1: Framework of B2B business of electronic media

Infrastructure for B2B business includes:

- Core business processes – such as finance, HR, marketing, CRM, sales management
- IT infrastructure – hardware and software infrastructure, web portal that integrates internal processes and provide content and services to extranet. In this research, web portal is implemented and described as one of the main infrastructure component and CRM channels.
- Partner networks
- Business resources - such as buildings, equipment, studios, etc.

Core services that a TV media provide to business partners are:

- Place for advertisement
- Broadcasting
- Recording events and programs
- RSS
- Podcasting
- Web site services
- Digital TV

Model of CRM metrics in media

Metrics that are used in order to measure effects of the CRM activities and applications within a TV media are presented in table 1 (Kellen, 2014).

Table 1: CRM metrics in business of TV media

Metrics	Attrbibute
Marketing	Response rate
	RFM
	Conversion rate
	Churn
	Product category involvement
	Average order size
Sales	Customer score
	Cross-sell rate
	Number of calls
	Number of new customers
	Sales quota
Service	Call counts and duration
	Service level
Social	Business partner engagement
	Conversion rate
	Audience Growth Rate
	Total Followers

3. DEVELOPING B2B PORTAL OF TV STATION

3.1. Requirements

Main idea was to develop portal that would integrate a number of services for business partners, with particular focus on informing potential partners about possibilities to advertise on RTS. The portal is electronic point of sale for all partners of RTS, with up-to-date information about prices and availability. Business partners are provided with information about prices for advertizing on RTS's emissions, programs, broadcasts, RTS' web site and information about additional service as well. Business partners can see detailed schedules, make reservations, queries for broadcasting commercials and order a number of services. At the same time, the portal is connected with internal CRM processes and enables RTS employees to implement abovementioned CRM activities.

3.2. Architecture of the proposed solution

There are three main roles among users of the portal:

- Employees – they are enabled to perform CRM activities, for instance: create and implement email campaign, do CRM analytics, write articles, etc.
- Administrators – manage portal content and services, role management, news management
- Business partners – they posses their own profiles and can view various contents on the portal, make order, view their orders, apply for several services, ask for help, make query for collaboration, etc.

Data layer include data from various sources, such as: internal databases and files, social networks, web portal database, knowledge database, etc.

Central component is part of the web portal responsible for executing business logic. This layer communicates with different components in background and provides adequate content for users.

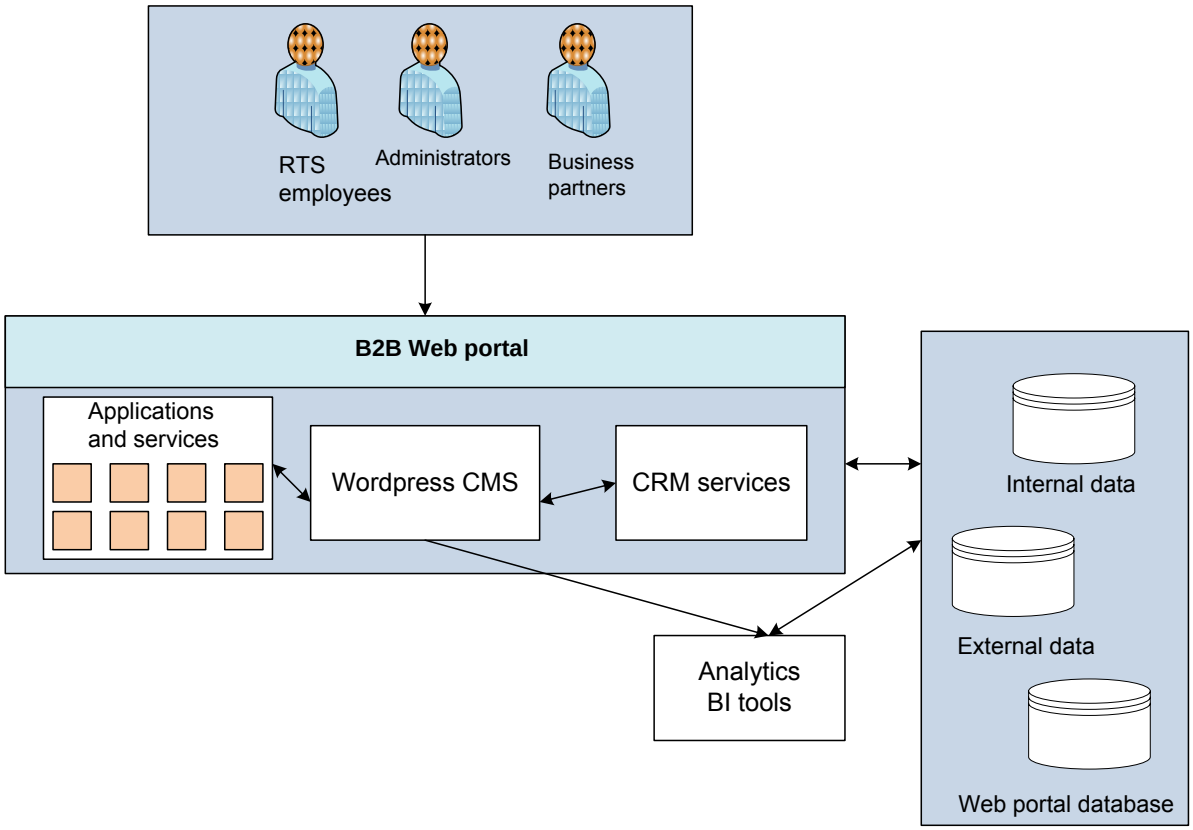

Figure 2: Architecture of the portal

3.3 Description of the implemented portal

Wordpress CMS solution was used for developing the portal. Further, several Wordpress plugins were used and developed in order to fulfill all the requirements and integrate services. Figure 3 shows the portal home page.

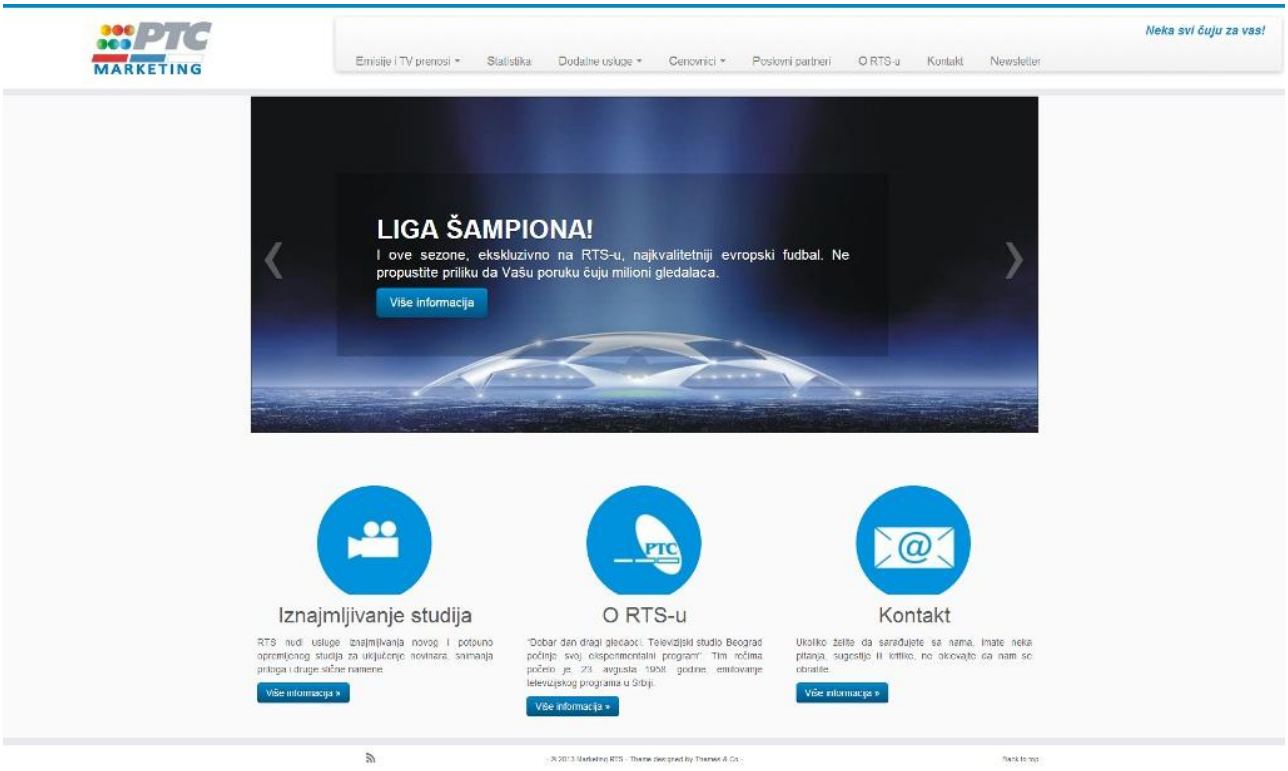

Figure 3: Home page of the portal

Slider is positioned in the central part of the home page. The slider presents selected news. Below the slider are three columns with links to description of the services and information about RTS.

Links toward main features are situated in the main menu:

- Emissions and broadcasts – each emission has its own page with title, description of content, schedule, information about host, photos and price of commercials during the emission (Figure 4.).

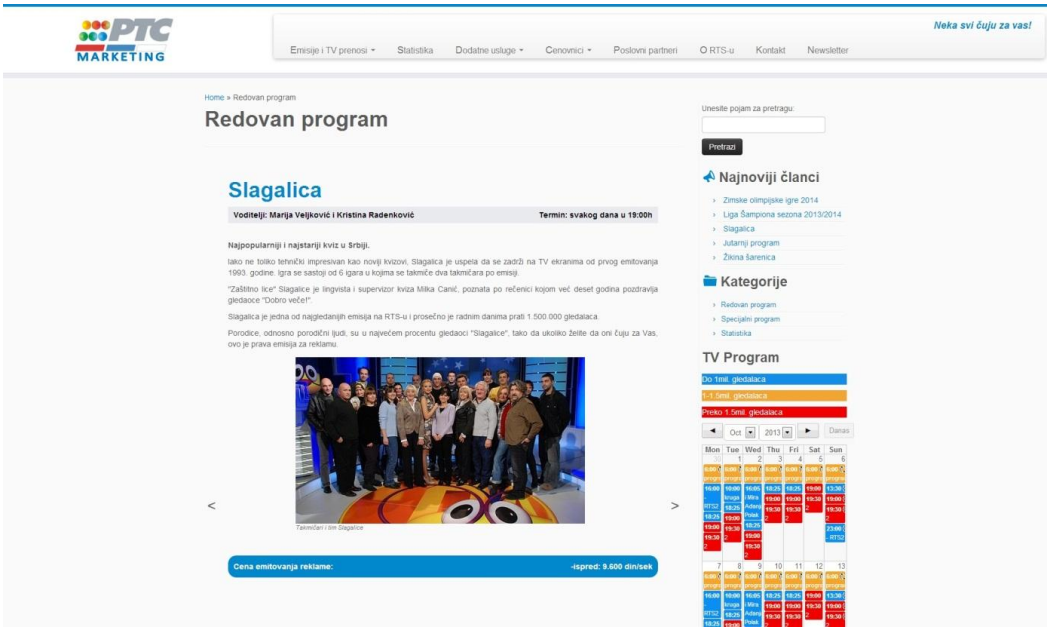

Figure 4: Page of TV emission “Slagalica”

- Reports – detailed statistics about ratings, advanced reports, advices for advertisement on RTS
- Additional services – description of services, such as studio for recording, direct broadcast, etc.
- Pricelist – detailed pricelist of RTS's services and products
- Business partners – List of RTS's business partners, partner networks, partnerships, etc
- About RTS
- Contact – form that enable business partners to contact RTS marketing department
- Newsletters – business partners have possibility to apply for newsletters

Adapted calendar, i.e. schedule of the emissions on RTS is provided in right column. All the programs are classified in three categories, based on number of viewers (red, orange and blue colour in Figure 4).

Variety of CRM services are integrated within the portal (table 2.)

Table 2: List of CRM services available via web portal (internal and external services)

Name of CRM process	Service
Marketing	• Campaign management • E-mail marketing campaign • Loyalty programs • Budget management • Campaigns analysis • User analysis
Sales	• Sales strategy • Business partners management • Analytics
Customer service	• Lead and contact management • Tickets management • Integration with external services for compliances
Social module	• Communication and collaboration service • Integration with enterprise social networking services

4. CONCLUSION

We proposed an approach for providing electronic media services for business partners via web portal. The portal integrated a number of services for business partners, with particular focus on informing potential partners about possibilities to advertise on RTS. The portal usage in real system and evaluation will provide additional information about users' experience in using the services, as well as data about web portal's performance and impact on business process outcome. Harnessing proposed model of CRM metrics will give an insight and clear picture of CRM performances. Future researches are directed toward improving CRM results and automation of CRM processes, as well as complete integration of all B2B processes in the web portal.

ACKNOWLEDGMENTS

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REFERENCES

Adams, W. (2000). How people watch television as investigated using focus group techniques. Journal of Broadcasting & Electronic Media, 44, 78–93.

Bayma, N. K., & Boyda, D. (2012). Socially Mediated Publicness: An Introduction. Journal of Broadcasting & Electronic Media, 56(3), 320-329.

Cha, J. (2013). Does genre type influence choice of video platform? A study of college student use of internet and television for specific video genres. Telematics and Informatics, 30(2), 189–200.

Cooper, R., & Tang, T. (2009). Predicting audience exposure to television in today's media environment: An empirical investigation of active audience and structural theories. Journal of Broadcasting & Electronic Media, 53(3), 400–418.

DeAndrea, D. C., Ellison, N. B., LaRose, R., Steinfield, C., & Fiore, A. (2012). Serious social media: On the use of social media for improving students' adjustment to college. Internet and Higher Education, 15(1, SI), 15–23. doi:10.1016/j.iheduc.2011.05.009

Diddi, A., & LaRose, R. (2006). Getting hooked on news: Uses and gratifications and the formation of news habits among college students in an Internet environment. Journal of Broadcasting & Electronic Media, 50, 193–210.

Greer, C. F., & Ferguson, D.A. (2011). Using Twitter for Promotion and Branding: A Content Analysis of Local Television Twitter Sites. Journal of Broadcasting & Electronic Media, 55(2), 198-214. doi: 10.1080/08838151.2011.570824.

Kellen, V., CRM Measurement Frameworks. http://www.kellen.net/crm_mf.pdf, (accessed April 2014).

Kishi, M. (2008). Perceptions and use of electronic media: Testing the relationship between organizational interpretation differences and media richness. Information & Management, 45(5), 281–287.

LaRose, R. (2010). The Problem of Media Habits. Communication Theory, 20(2), 194–222, doi:10.1111/j.1468-2885.2010.01360.x.

LaRose, R., & Eastin, M. S. (2004). A social cognitive theory of Internet uses and gratifications: Toward a new model of media attendance. Journal of Broadcasting and Electronic Media, 48, 358–377.

Mahrta, M., Scharkow, M. (2013). The Value of Big Data in Digital Media Research. Journal of Broadcasting & Electronic Media, 57(1), 20-33.

Napoli, P. M. (2010). Audience evolution: New technologies and the transformation of media audiences. New York: Columbia University Press.

Seybold, P. Rethinking CRM: Provide Customers the Information They Care About in a Seamless Fashion. Seybold Group White Paper, 2008. psgroup.com/detail.aspx?id=900 (accessed April 2014).

Webster, J. G. (2008). Developments in audience measurement and research. In B. Calder (Ed.), Kellogg on advertising and media, New York: Wiley, 123–138.

Webster, J. G. (2011). The Duality of Media: A Structurational Theory of Public Attention. Communication Theory.21(1), 43-66.

ENTREPRENEURSHIP AND MANAGEMENT OF SMALL AND MEDIUM ENTERPRISES

THE BANKING FOR SMALL AND MEDIUM ENTERPRISES

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Abstract: *The development of banking which provides services to small and medium-sized enterprises (SME) represents one of the key economic objectives in developing countries. Small and medium-sized enterprises are focused on the banking sector due to limited financing opportunities through alternative channels, especially in the countries where financial markets are insufficiently developed. The main reasons for the difficulty in financing the SME segment in developing countries are: complicated procedures, insufficiently defined laws, negative macroeconomic factors and lack of financing opportunities. However, there are a number of ways to overcome the problem, and it is in this process that the banks have found their place. This paper aims to better understand the potential of the SME market. The first part of this paper relates to the definition of key features of SME segment, and the literature review. The challenges which banks face are described further on, as well as the approaches used by banks in the value chain. A special emphasis is placed on risk management activities, due to the fact that it occurs in all phases of the business cycle. Finally, the paper provides a brief description of the economic importance of small and medium-sized enterprises.*

Keywords*: Small and medium-sized enterprises, the SME value banking chain, risk management, economic development*

1. KEY FEATURES OF SMALL AND MEDIUM-SIZED ENTERPRISES

Although it is widely accepted that the market of small and medium-sized enterprises is an important part of any economy, the definition of small and medium-sized enterprises is often different from country to country. However, they are most often defined as business entities that employ less than 250 people. It is estimated that over 95% of the companies worldwide are small and medium, while in Europe, their importance is even more prominent since they make up 99% of the total number of enterprises. In addition to small, medium and large enterprises, another segment has been classified as micro-enterprises. They are very similar in their characteristics to small and medium-sized enterprises, with the difference that they generally have fewer than 5 employees. Alternative criteria for the classification of companies include the volume of annual revenues, the value of assets on the balance sheet, as well as the ratio of borrowed and own funds. It is clear that defining the types of companies on the basis of quantitative criteria is not enough to describe the market of small and medium-sized enterprises.

Small and medium-sized enterprises and entrepreneurs are the most efficient segment of the economy in almost all countries of the world. Individually, these enterprises make the largest contribution to the increase in employment, gross added value and turnover, and are, therefore, considered to be the backbone of growth and development of a national economy. Their role is particularly important in countries in transition which are faced with problems of high unemployment, low level of economic activity, insufficient competition and lack of investment, and where large inefficient state-owned enterprises are still present. As a reliable source of employment, small and medium-sized enterprises have an important social role in absorbing surplus labour generated in the processes of transition and ownership transformation of state-owned and socially-owned enterprises.

Basic characteristics of small and medium-sized enterprises and entrepreneurs, primarily referring to their size, flexibility, propensity for innovative and risky ventures, and greater opportunity for specialization, enable these companies to adapt much easier than large business systems to continuous changes in consumer demand and business conditions in the global market. In this way, SMEs encourage the strengthening of competition, which results in the improvement of the quality of products and services and lower prices, innovations and development of new technologies, and the growth of the national economy in general.

Survival, growth and development of small and medium-sized enterprises are primarily determined by funding opportunities from favourable sources. Limited access to the sources of finance, both on the money market and the capital market, especially in terms of prices and conditions of use, is perhaps the most important feature and the biggest problem of these companies. In an effort to provide the necessary funding

from the most favourable sources, companies face, throughout their existence, the following dilemmas: should the investments and business development be financed from own resources or borrowed; how much capital should be obtained from loans; should the capital be provided by banks and other financial institutions, on the securities market, or by attracting formal or informal investors; and what is the desired capital structure. Depending on the objectives of growth and development, stage in the life cycle, financial status, nature of business activity and investment structure, the stability of cash flows, the relationship to risk management and the availability of certain resources, companies decide to obtain capital from one or a combination of funding sources, while aiming for the optimal capital structure. The number of available sources of financing SMEs is small and they meet their needs for capital much harder than large business systems.

2. LITERATURE REVIEW

In academic circles, it is widely believed that large and foreign banks are generally not interested in investing in SMEs, while on the other hand, small banks which are focused on a specific niche are more motivated to overcome the problems which arise within SMEs. A research conducted by Torre et al. (2010) showed that there are no sufficient arguments for this claim, and that banks believe that small and medium-sized enterprises are highly profitable clients. In addition, regardless of the size of the bank, the practice has shown that they will always strive to maintain long-term relationships with the SME segment, especially when it comes to developing countries where the number of financial sources is limited. Through new technologies, business models and management systems, the banking sector is giving their best to meet the requirements of small and medium-sized enterprises. Financial experts argue that the limits of small and medium-sized enterprises in financial terms are very large and that this represents the main potential of credit institutions. Bankers, through continuous, personalized and direct contacts with SMEs, gather information relevant to the decision to grant loans.

Large banks, as well as foreign universal banks are leaders in the banking industry, as they are operating under the laws of economy of scale. In addition to having developed mechanisms for analysis and control of the clients, the large banks are capable of developing products and services for the specific needs of small and medium-sized enterprises. However, in recent years there has been an increase in number of specialized banks which do business with only one market segment. Torre et al. (2010) state that it appears that, despite the strengthening of relations between banks and companies, there are still limited opportunities in developing countries for key products, such as loans secured by adequate collateral, and loans that have long-term fixed interest rates indexed in the local currency.

Hanedar, Broccard and Bazzana (2013) have conducted a research on the characteristics of the collateral of small and medium-sized enterprises in developing countries. Regarding the type of collaterals, the results show that the specific features of a loan applicant are much more important than the characteristics of the country they come from. These authors emphasize the importance of credit risk which a specific loan applicant brings, as well as the level of transaction costs compared with the characteristics of the underlying collateral. Menkhoff et al. (2012) state that, in developing countries, companies are less interested in loans that require collateral. The reason for this lies in the fact that they do not have enough high-quality collateral, and that they have access to relatively expensive sources of funding and insufficiently attractive credit terms.

The World Bank has conducted a research on the business environment and the performance of small and medium-sized enterprises in Eastern Europe and Central Asia. The results show that high demands for collateral are the third factor influencing the decision of the company not to apply for loan financing. The first two reasons are related to high interest rates and complicated procedures, which are also very time consuming. The results of this study can be found in the Niinimaki (2009) paper. In addition, Berger et al. (2011) emphasize that, in developing countries, it is very difficult to obtain relevant quality assessment of the collateral, and that a high risk occurs due to information asymmetry.

In their research, Bartoli et al. (2013) classify the information that banks use as "hard" and "soft". Hard information includes various quantitative data that banks obtain from the data in the financial reports or collateral offered by the loan applicant as security. Soft information relates to qualitative data, and their main source is the personalized relationship between banks and clients. It goes without saying that the soft information is more difficult to collect and there is a higher probability of errors, but the aforementioned group of authors believes that it is this information that presents a competitive advantage of the small banks relative to the large. They explain this attitude with the fact that small banks are more focused on their clients, that they meet specific requirements better, and that, in this process, they obtain valuable data of insufficiently transparent companies more easily.

3. THE SME BANKING OPPORTUNITY

Even though banks have recognized the need to provide services to small and medium-sized enterprises, studies have shown that, underdeveloped bank services and products are becoming a critical factor for growth and development of SMEs. Bank fees make the business transactions more difficult and, according to the research of the World Bank, even in the developed financial markets, one third of the enterprises define limited financial sources as one of the main problems. As a result, more than half of the companies in the developing countries cannot reach their goals due to financial difficulties. This research has also shown that SMEs, in comparison to large enterprises, use external financial sources less, which increases the costs of their liabilities. SMEs usually use bank loans as the only available financial source. It is much easier for large corporations to decide and finance investment projects through loans.

SMEs are more focused on banks and their services due to the limited options they have to borrow money through alternative channels. They do not have enough capital to finance big projects and cannot participate in the financial market in a way large corporations can. The reason for this is very often the lack of qualified financial experts who would define an adequate financial source structure. Bank loans contribute to the long-term strategies of SME and thus enable the ownership structure to remain unchanged. Another advantage of banking development in the SME section is related to the banking consulting services. SMEs can have benefits such as adequate financial reports, business plan development, as well as the selection of optimal financial sources. Banking consulting services enable SMEs to follow the bank loan contract terms.

It is a fact that banks have greater concerns regarding risk when it comes to investing in the developing countries. The basic reasons for this include: complicated procedures, undefined laws and negative macroeconomic factors. These restraints lead to situations where banks require good quality collaterals, are less interested in financing investment ventures, and are defining high interest rates. All of the above mentioned directly reduce the profitability of SMEs and lead to a great number of uncollectible debts. Governmental interference very often creates competition misbalance and price instability. If regulatory organs and the government of a country recognized the importance of SMEs, they could support them through redefining the legal limits and through export inducement. Although there is no unique solution to boost SME segment, any intervention to improve the market conditions is welcomed.

4. THE BANKING VALUE CHAIN

To frame the discussion of how banks approach the challenge of serving SMEs, we adopt a standard banking value chain framework consisting of five discrete stages and one cross-cutting task. The five stages of this banking value chain are (1) understanding the market, (2) developing products and services, (3) acquiring and screening clients, (4) serving clients, and (5) managing information and knowledge. Cutting across each of these five stages is the ongoing and critical task of risk management. At each stage of the value chain, there are actions and considerations particularly relevant to the SME sector. Each part of further discussed challenges banks face, describes how banks are approaching this stage, and provides examples of leading banks moving toward excellence in SME banking. Table 1 provides a condensed overview of the key activities within each stage of the banking value chain in the context of serving SMEs.

Table 1. SME banking value chain

Risk management →

Understand the SME market →	**Develop products & services** →	**Acquire & screen SME clients** →	**Serve SME clients** →	**Manage Information & knowledge** →
• Define the SME sector • Research SME needs & preferences • Sub-segment the market	• Design & bundle lending and non-lending products • Ensure profitability of product offering • Develop SME-specific lending technologies	• Market product & service offering to clients • Build a growing & diversified portfolio • Distinguish profitable from unprofitable prospective clients	• Meet the needs of existing clients • Cultivate new business through cross-selling •Use teams organized for front & back-end servicing • Monitor loans	• Model & manage risks using portfolio data • Use current customer data to adapt service approaches • Analyze & respond to profitability data at segment, product & client level

(Source: World Bank group, 2010)

According to World Bank group (2010), highlighted observations from the five value chain stages are: understanding the market is critical and serves as a foundation to being able to address the unique needs of SMEs, nonlending products should not be overlooked, as they may generate more revenues than SME loans, a bank's current portfolio is a critical potential source of new business, segmenting service approaches (i.e., the level of relationship management by client value) can help banks balance customer service and operating cost concerns, and effective information management means knowing how to maximize the use of IT systems.

5. CHALLENGES AND APPROACHES ALONG THE BANKING VALUE CHAIN

Risk management is always one of the most difficult tasks in the banking industry, especially when you take into account the existence of all the informational asymmetries in the SMEs banking sector. Although a bank is faced with credit, market, strategic and operational risks, the most important ones to mention here are the credit risk and the risk of high costs of providing services. The credit risk is related to the bank`s inability to collect the debt and the interest within the agreed time. Due to the limited information sources, banks require additional insurance such as different collaterals whose value depends on the assessed risk and the amount of the wanted resources. In the emerging markets more than 80% of the loans for the SMEs are insured (Beck et al., 2008). A bank encounters costs inefficiency because there is no unique model of financing identical for every SME. Corporations are clients whose transactions have great value for the banks. On the other hand, SMEs demand more transactions of a lower value. If you add consulting services, assessments, specific requests of a SME, it is clear why banks often have high costs and lower profits when investing in SME segment. There is, however, a great number of ways to overcome these problems. In the table 2 some of the key steps and approaches for managing the above mentioned risks are given.

When considering risk management strategies more attention should be paid to the occurrence and the role of uncollectible debts. It is crucial to recognize the loans which are very likely to become bad debts. Proactive solutions reduce the costs and ensure a better bank portfolio.
These proactive strategies include:

- quick reactions,
- timely and frequent communication with clients and
- minimizing the credit risk.

The steps bank will take depend on the informational system the bank is using, as well as on recognizing the first indicators of credit risk appearance. Some of the basic indicators of the credit risks are irregular payments, frequent changes of the loan terms, unusually high interest rates, incomplete documentation collected by a client, poor quality collaterals, lack of reports and cash flow forecasts, as well as the client`s reliance on non-renewable sources. Taking all these into consideration, banks are required to control the situation and thus prevent the losses.

The first stage of the banking value chain is the adequate understanding of the market needs. In order to diversify their portfolios, banks need to analyze the market and client`s preferences constantly. SMEs on the Eastern European territory do not use bank loans as a way to finance their business as much as they are able. The strategy to be used on this territory should be significantly different from the one used on the developed financial markets. Even when they choose the market segment to invest in, banks should define the annual range of services they will provide and their conditions. The segmentation of the SME market is very demanding and important because, among other things, every firm has its own specific needs. Techniques banks are using in order to research the SME market include the surveys, direct insight into company's business transactions and the interaction with the employees of the particular firm. If the owner of the firm which is in the SME market segment is already the bank`s client, the bank can have the insight into their business transactions and responsibilities. SME can also be a part of a larger corporate chain that a bank cooperated with in the past or still cooperates with at present.

The products and services a bank offers are usually related to the loans and deposit collection as traditional ways of conducting business. In order to expand its market share and strengthen its position on the SME market, a bank has to update its offer and attract new clients.

- The first challenge to face on this market is related to defining the range of products suitable for one particular client. In this process the key role lies in the appropriate communication with the client, which means investing into a loyal and long-standing relationship.
- The second challenge is related to the overall profitability that a bank realizes through its services, since the bank`s politics regarding the costs influences the SME segments.
- The third challenge is about balancing the market offer increase and recognizing bank`s limits. The experience in banking has shown that some banks would take high risks when financing SMEs

without having adequate collateral on the other side. If this kind of contract is made with several clients, diversification is achieved, but in case when the number of unsecured loans is getting disproportionately higher, especially during the expansion period, the bank loses control and this can lead to losses. Price, contract terms and monitoring mechanism have to be aligned in order to have a good estimate of the costs and the risk level. Banks will have exceptional results in the process of designing and selecting the products they offer only if they are certain that their offer is cost-efficient and if they can recognize the moment when providing their services is no longer profitable.

Table 2. Common approaches to risk management

	Risk management →				
	Understand the SME market →	**Develop products & services** →	**Acquire & screen SME clients** →	**Serve SME clients** →	**Manage Information & knowledge** →
Approaches to managing credit risk	• Quantify risks in target market by leveraging existing research & other bank data • Sub-segment the SME market by risk profile • Enhance predictive capabilities by gathering information on local SME success factors	• Develop loan pricing models that match client risk profile • Incorporate innovative forms of collateral, such as accounts receivable • Prioritize role of non-lending products in establishing customer relationship & providing predictive data	• Lend to current clients first, learning from portfolio information • Use internal rating & scoring methods to assess loans • Separate sales from credit approval for more rigorous underwriting	• Dedicate staff to spot signs of SME default early • Provide advisory services to assist SMEs in cash flow management	• Establish centralized teams to monitor loan data for risks & early warning signs & to incorporate data into improved credit policies • Use portfolio data to customize models for statistical credit scoring
Approaches to managing risk of excessive cost to serve	• Inform pricing & operational approach by understanding level of unmet SME demand • Segment the market in order to identify & limit effects of cost drivers linked to SME characteristics	• Use sophisticated but standardized products to minimize transaction costs • Increase the overall value of each SME client by offering & building a wide variety of products & services	• Focus customer acquisition on clients “close to” the current portfolio • Separate business development from relationship management for efficiency • Use automated screening processes to reduce underwriting costs	• Dedicate processes & staff to SME segment to streamline operations • Use direct channels like branches & call centers to reduce relationship management cost • Adjust level of personal service to SME size or value	• Enhance profitability analysis capabilities to disaggregate revenue & costs by key units (branch, product, client) • Apply cost-saving innovations discovered at branches and learn from it

(Source: World Bank group, 2010)

The main challenges a bank faces when attracting new clients include cost efficiency of the marketing strategy the bank is conducting, as well as the credit risk management which is done through an effective analysis and through recognizing the profitable clients in spite of insufficient information. Majority of SMEs cannot recognize the benefits of using bank services due to the lack of knowledge and information, and because of this the firms are reluctant to cooperate with bank sector, especially in the developing countries. This problem can become more complicated if the credit bureau cannot find any relevant historical data on the business transactions of the particular firm. Successful banks overcome these problems through

benchmarking process and through conducting proactive strategies and developing a great number of communication channels through which they try to gain insight into the client`s real state. Banks will profit if they can recognize the needs of the current clients and adjust their offer accordingly. In order to diversify their portfolio, developed banks adopt the concept of “one stop shop”, which implies having a wide range of different services in one financial institution.

Long-term cooperation with clients from the SME sector provides a stable income with the tendency to increase and is an excellent source of desired information. However, banks are faced with the risk when an individual approach to a different company leads to high operational costs and this can put the investment in question. Bank has priorities when choosing clients for approving the loan. This very often leads to loss of client`s trust, higher interest rates and lower sale possibilities. Clients very often do not want to accept the loan conditions which are barely profitable for the banks. The process of collecting all the necessary documents is not easy for both the bank and the clients and many of them are not ready to wait patiently for the loan to be approved. Banks serving SMEs have found ways to cost-effectively meet and even capitalize on the unique demands of SMEs. They do this by using direct delivery channels, segmenting and redefining relationship management, and turning demands into opportunities through cross selling.

The fifth stage of the banking value chain is related to the information and knowledge management in banks. SME banking is a relatively young and dynamic industry and it is clear why experience has the crucial role. Banks that invest into information technology have better chances to have a profitable and safe business, as well as to maintain long-standing relationships with clients. This effective information and knowledge management is the key to improving relations with clients. Two main challenges to managing information and knowledge include developing the infrastructure (tools and systems) to collect and analyze information, and developing the capacity (skills and processes) to turn information into knowledge and adjust operations accordingly. In order to use the knowledge potential, a bank should have a portfolio check and risk analysis. Client relations management and profitability analyses are crucial steps for running a good business.

6. BANK APPROACHES IN SME MARKETS

Each bank has different possibilities and capacities for achieving strategic goals. Bank performances primarily depend on the way that income is generated (the profit rate), required quality of assets (the risk level), and defined level of management efficiency.

In order to make an adequate profit with the cost-efficiency and risk minimization banks should, in the first place, define a strategy that suits their capacities and the chosen market segment. Successful banks focus on the business structure, human resources and software support. At the same time, the bank management is in charge of the implementation of the essential procedures and processes, as well as their constant control and coordination. The ordering of above-mentioned activities is significant for the banks that enter the SME market for the first time. The SME banking requires the realization of scale economy and greater selling power of employees in comparison to the corporate banking. On the other hand, it means even more detailed processing of claims and risk analysis when defining the offer that refers to consumer banking. The process of corporate governance and organization is a crucial element, especially when positioning the bank on the global market.

One of the crucial economic goals of the developing countries is the development of banking that provides services to small and medium-sized enterprises. Small and medium-sized enterprises provide a healthy economic system, contribute to creating new business opportunities, employ a large number of people and are responsible for the increase in gross national product. Due to their contribution to the economic diversification and social stability, their role in the market is rather significant. Limited market and capital access increase financial expenses and has a negative influence on the productivity and competitiveness of enterprises.

7. CLOSING REMARKS

In recent years, financing of small and medium-sized enterprises has attracted a lot of attention and has become one of the main topics for economists and regulators who are working on economic and financial development strategies. One of the reasons for the great interest in this segment is the fact that most businesses are small and medium-sized, and they employ a significant number of people. In addition, practice has shown that it often happens that small employers eventually become large. Furthermore, they are necessary for further economic prosperity. The majority of banks have organized a special department for cooperation with the SME segment, not only in the field of credit, but in light of the various advisory roles which banks can offer as one of their services. Since Serbia is extremely bank-centered country, it is clear that products and services offered by banks should be constantly innovated and thus contribute to the development of small and medium-sized enterprises which have limited possibilities for borrowing through

alternative channels. The aim of this paper is to stimulate discussion and further research in the field of small and medium-sized enterprises, particularly in the context of improving their performance through external financing in the form of bank loans.

REFERENCES

Bartoli, F., Ferri, G., Murro P., & Rotondi, Z. (2013). SME financing and the choice of lending technology in Italy: Complementarity or substitutability? Journal of Banking & Finance, 37, 5476–5485, doi:10.1016/j.jbankfin.2013.08.007

Beck, T., Asli D.-K., & Pería, M. S. M. (2008). Bank Financing for SMEs around the World: Drivers, Obstacles, Business Models, and Lending Practices. Washington, D.C. World Bank.

Berger, A., Rosen, R., & Udell, G. (2007). Does market size structure affect competition? The case of small business lending. Journal of Banking and Finance, 31, 11–33.

Berger, A. N., Frame, W.S., & Ioannidou, V. (2011). Tests of ex ante versus ex posttheories of collateral using private and public information. Journal of Financial Economics, 100, 85–97.

Chong, T., T. L., Lu, L., & Ongena S. (2013). Does banking competition alleviate or worsen credit constraints faced by small and medium-sized enterprises? Evidence from China. Journal of Banking & Finance, 37, 3412-3424. doi:10.1016/j.jbankfin.2013.05.006

Hanedar, E. Y., Broccardo, E., Bazzana, F., (2014) Collateral requirements of SMEs: The evidence from less-developed countries, Journal of Banking & Finance, 38, 106–121, doi:10.1016/j.jbankfin.2013.09.019

Menkhoff, L., Neuberger, D., & Rungruxsirivorn, O. (2012). Collateral and its substitutes in emerging markets' lending. Journal of Banking and Finance, 36, 817–834.

Niinimäki, J. P. (2009). Does collateral fuel moral hazard in banking? Journal of Banking and Finance, 33, 514–521.

Ryan, R. M., O'Toole, C. M., & McCann, F. (2014). Does bank market power affect SME financing constraints? Journal of Banking & Finance, doi:10.1016/j.jbankfin.2013.12.024

Torre, A., Pería M. S. M., & Schmukler, S. L. (2010). Bank involvement with SMEs: Beyond relationship lending. Journal of Banking & Finance, 34, 2280–2293. doi:10.1016/j.jbankfin.2010.02.014

World bank group (2010), The SME banking knowledge guide, International Finance Corporation, Washington, D.C.: World Bank.

ORGANIZATION OF NON-WOOD FOREST PRODUCTS SELLING IN SMALL AND MEDIUM ENTERPRISES IN CENTRAL SERBIA

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Abstract: *If one takes into account consequences of excessive use of natural resource, the need for its sustainable use is understandable. Bearing in mind increasing importance of non-wood forest products (NWFPs) for sustainable use of natural resources, and for revenue generating, the role of entrepreneurs and small and medium enterprises (SMEs) in this sector also increases. The aim of this research is to gain knowledge on the organization of the process of NWFPs selling in SMEs in Central Serbia. Research was conducted in two phases. In the first phase, 91 representatives of SMEs (ΣSME) were surveyed and in the second, survey was conducted with representatives of 19 leading enterprises (LEs). The results are showing that process of NWFPs selling is present in most of ΣSME and all LEs. Wholesale is present in most ΣSME and LEs, which is opposite to retail. The most present form of wholesale is to "foreign buyers", although in the most ΣSME is also present selling to "other processors". The most common export destinations (ΣSME and LEs) are countries of EU, mainly Italy and Germany. The analysis indicated specific problems in organization of selling in these SME. Hence, recommendations for improvement are given.*

Keywords*: organization, selling, small and medium enterprises, non-wood forest products, forestry*

1. INTRODUCTION

The role of **small and medium-sized enterprises** (SMEs) in the economic development is of increasing importance and particularly challenging in rural areas, which are less attractive for the development of entrepreneurial activities than urban and semi-urban (Niskanen et al., 2007). Forest products (wood and non-wood) have a particularly important role in the development of rural areas (López-Feldman, 2014). In this paper, as non-wood forest products (NWFPs) are considered: mushrooms, medicinal and aromatic plants (MAP), wild berries and other forest fruits (WBFF), i.e., products that can be quite quickly and successfully collected in nature, processed and sold. These characteristics, and increasing demand for NWFPs[1] in recent years (Booker, Johnston, & Heinrich, 2012; Pettenella, Secco, & Maso, 2007), make these products extremely attractive to private entrepreneurs.

Collection, purchase, processing and **selling of NWFPs in Serbia** have a long tradition. In the period after Second World War until the 1990s, revenues from NWFPs were significant (USAID, 2008; Donnelly, Helberg, 2003). Serbia was, until 1992 "*...one of the largest exporters of medicinal plants in South Eastern Europe ...*" with "*... about 6000 t of raw materials and sales of about 11 million $*" (Turudija-Ţivanović, 2010, p 68). However, collection and trade in NWFPs were centralized at that time, because the sector was dominated by a small number of state enterprises. Attempt of privatization of these enterprises was mostly unsuccessful. This, in combination with all the economic events during the 1990s, has led to fact that, today, this sector is largely unorganized. As a consequence, NWFPs are marketed mainly as unprocessed raw materials or semi-finished product (Donnelly & Helberg, 2003; USAID, 2008).

However, after 2000 activities in MAP market gradually were revitalized i.e. "*…new enterprises are being established, contacts with old customers are renewed and new ones gained, which have resulted in increasing export of herbal raw material*" (Turudija-Ţivanović, 2010, p. 68).

In accordance with the increasing importance of NWFPs for achieving the objectives of multifunctional forest management (Wang & Wilson, 2007), as well as for revenue generating, the role of SMEs engaged in the procurement, processing and selling of NWFPs (NWFP-SMEs)[2] increases.

[1] According to data of World Health Organization (WHO), "*…the demand for medicinal plants is approximately $14 billion per annum, and growing at the rate of 15–25% annually. The WHO estimates that by 2050 the trade will be up to US$ 5 trillion*" (Booker et al., 2012, p. 625).
[2] In support of this goes the fact that, e.g. "*…MAP market is often dominated by SMEs*" (Booker et al., 2012, p. 632).

Results of previous studies indicated several types of NWFPs selling: directly marketed products[3], selling of fresh and semi-products, and selling of final products (USAID, 2008). This research also shows that "...*only one-third of fresh and semi-products goes to final processing, while the majority is sold via wholesalers and retailers to consumers (domestic or foreign) and to foreign processors*" (USAID, 2008 p. 19).

Studies conducted in Central Serbia showed that "...*the most common way of selling is wholesale, i.e. it is only exports*" (Nonić, Rankovic, & Nedeljkovic, 2013, p. 151). The reason for that is, primarily, unorganized NWFP sector, but also underdevelopment of the domestic market (Nedeljković, Nonić, Ranković, & Mandić, 2012; Nonić et al., 2013; Turudija-Ţivanović, 2010).

The need for this research comes from the lack of comprehensive knowledge on the characteristics of selling and its organization in NWFP-SMEs. In previous studies were primarily analysed:

- indicators related to the selling of only one type of NWFPs (but not from an organizational perspective);
- all business entities that operate in this sector (not only SMEs);
- only one of the sub-processes within the process of selling.

In this paper are presented and analyzed results related to all NWFP-SMEs (ΣSME), and selected leading enterprises (LEs) in Central Serbia, whose representatives participated in the study.

In accordance with the previous, the **aim** of this research is to gain knowledge on the organization of NWFPs selling in SMEs in Central Serbia[4]. The **objects** of research are sub-processes in NWFPs selling (retail and wholesale). The **purpose** is to provide recommendations for improvement of NWFPs selling in SMEs.

2. METHODS

Methods of analysis and synthesis, comparative, and statistical method are applied. Partial structural analysis (Nonić et al., 2013), was used in order to study organization of selling within NWFP-SMEs. Method of synthesis was used for drawing conclusions and giving recommendations for improvement of organization of NWFP selling. The comparative method was applied to determine similarities and differences in the organization of selling in ΣSME and LEs.

"Door to door" survey (Aker, Kumar, & Daj, 2008) was used as a research **technique**. The survey was conducted during 2011 and 2012, within 17 forest areas (FAs)[5] in Central Serbia. Distribution of the analyzed enterprises in forest areas is shown in Figure 1.

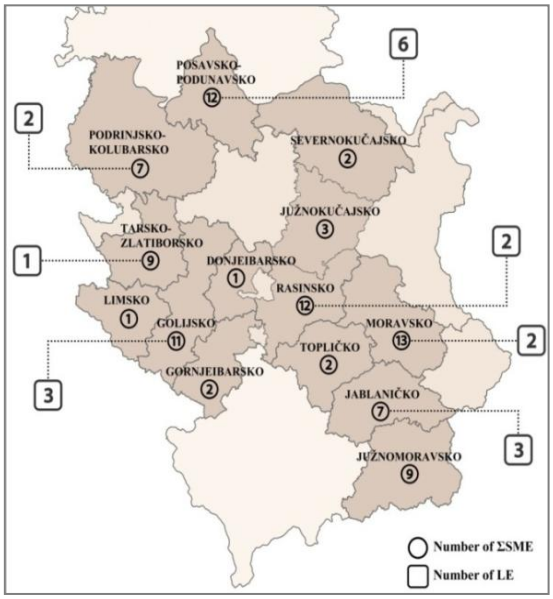


Figure 1. Distribution of ΣSME and LEs in forest areas

[3] Research has shown that about 2% of NWFP collectors sell products directly to consumers, mainly at local green markets and road stalls (USAID, 2008).

[4] The term "central" Serbia refers to the territory of Serbia, without AP Vojvodina and Kosovo and Metohija.

[5] Detail information about forest areas in Serbia can be found in Law on forests (2010) and professional literature (see Aleksić, Stingić, & Milić, 2007). On FAs which were included in the research, state forests are managed by the State Enterprise "Srbijašume", which also performs extension service in private forests.

Data were **collected** in two phases. In the first phase, representatives of 91 NWFP-SMEs in Central Serbia were surveyed. Representatives of 19 LEs were surveyed in the second phase. LEs were selected on the basis of pre-established criteria[6], as "best practice" examples in: i) the organization of all NWFPs-related business activities and ii) business management.

In the first phase of data collection, the questionnaire consisted of 65 questions, and in the second, there were 40 questions. In both questionnaires, there were open- and close-ended questions, where close-ended were with multiple-answer (one or more choices), and Likert scale. For the purposes of this paper, only questions related the organization of selling in ΣSME and LEs were selected from both questionnaires.

Data processing was performed in the statistical program SPSS ver. 20. Bearing in mind that all variables in questions selected for this paper were categorical (discontinuous), frequency analysis was used.

3. RESULTS

Within the results are presented and analyzed data related to the organization of selling in ΣSME and selected LEs:

- share of selling (retail and wholesale);
- organizational forms of selling (retail and wholesale);
- organizational forms of NWFP transport (to customers);
- exports destinations;
- attitudes of respondents toward NWFP market;
- attitudes of LEs representatives toward the improvement of NWFP selling.

3.1. Analysis of organization in the selling of NWFPs in ΣSME/LEs

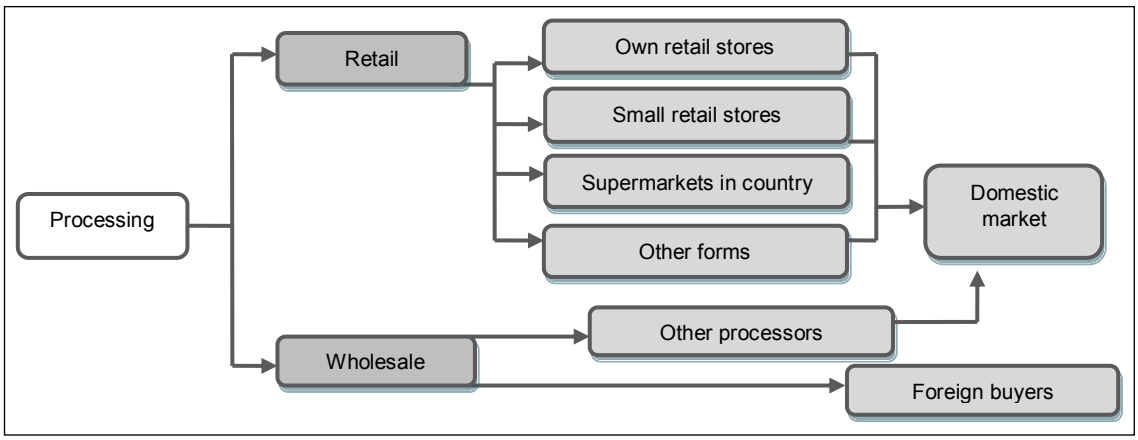
Share of selling, retail and wholesale in ΣSME and LEs is shown in Table 1.

Table 1. Share of NWFP selling in ΣSME/LEs on the territory of Central Serbia

Process / sub-process	ΣSME	LEs
Selling	68.1%	100%
Retail	8.8%	15.8%
Wholesale	96.7%	100%

Selling is present in more than ⅔ of ΣSME (69.2%), as well as in all LEs. Also, NWFPs wholesale is present in dominant share of ΣSME (96.7%) and all LEs. Retail is present in lesser extent (only 8.8% in ΣSME and 15.8% in LEs), which indicates that selling strategies of NWFP-SMEs are not focused on retail, but on other business subjects.

In Central Serbia are present different forms of **organizing of NWFP selling** in SMEs (Figure).



[6] The criteria were: 1) criteria prescribed by the *Law on accounting and auditing* from 2006 (number of employees, total income and value of assets); 2) characteristics of the company (all NWFPs-related business activities, quantity of purchased products, etc.; 3) general impression of researcher (method of observation) on advanced business activities (Nonić, Nedeljković, & Jovanović, 2012).

Figure 2. Forms of organizing of NWFP selling in ΣSME/LEs

Retail can be organized through:
- own retail stores;
- small retail stores;
- supermarkets in country;
- other forms.

Wholesale is done in two ways:
- foreign buyers;
- other processors.

Share of specific forms of NWFPs selling in ΣSME/LEs is given in Table 2.

Table 2. Share of specific forms of NWFP selling in ΣSME/LEs in Central Serbia

Form of selling		ΣSME	LEs
Retail	Own retail stores	4.4%	5.3%
	Small retail stores	3.3%	5.3%
	Supermarkets in country	4.4%	5.3%
	Other	11%	5.3%
Wholesale	Foreign buyers	**61.5%**	**100%**
	Other processors	**53.8%**	31.6%

In **NWFPs retail** are, mostly present "other forms" (11% in ΣSME primarily, through sale to labour unions, while 5.3% in LEs and mostly, catering enterprises). A small number of analyzed enterprises have own retail stores (4.4% in ΣSME and 5.3% in LEs), or they sell products to supermarkets in the country (3.3% in ΣSME and 5.3% in LEs).

The most common form of **NWFPs wholesale** is selling to foreign buyers (dominant in ΣSME-61.5% and in all LEs). The reason for this is mostly, huge demand and quality of these products from Serbia. In terms of selling to foreign buyers, 29.7% ΣSME and 47.4% LEs, only exports, with no selling on the domestic market.

Selling on foreign markets can be organized differently (sale agents, offices abroad, etc.). Representatives of all LEs noted that sale on foreign markets is organized in cooperation with regular customers, with whom they have direct contact and long-term cooperation.

In more than ½ ΣSME (53.8%) and about ⅓ LEs (31.6%), wholesale is also done to other processors, which, after additional processing, sell NWFPs.

In all LEs selling is arranged from headquarters, and products are sold from processing facilities[7]. Also, most of these enterprises sell to known customers, with whom they have long-term cooperation.

As part of organizing of NWFPs selling, **transportation** to the place of delivery, or customers, can be:
- own;
- organized by customers;
- engagement of transport enterprises.

Share of specific forms of NWFPs transport in ΣSME/LEs in Central Serbia is given in Table 3.

Table 3. Share of transport forms in ΣSME/LEs in Central Serbia

Form of transport	ΣSME	LEs
Own	45.6%	57.9%
Organized by customers	**66.7%**	52.6%
Engagement of transport enterprises	23.3%	47.4%

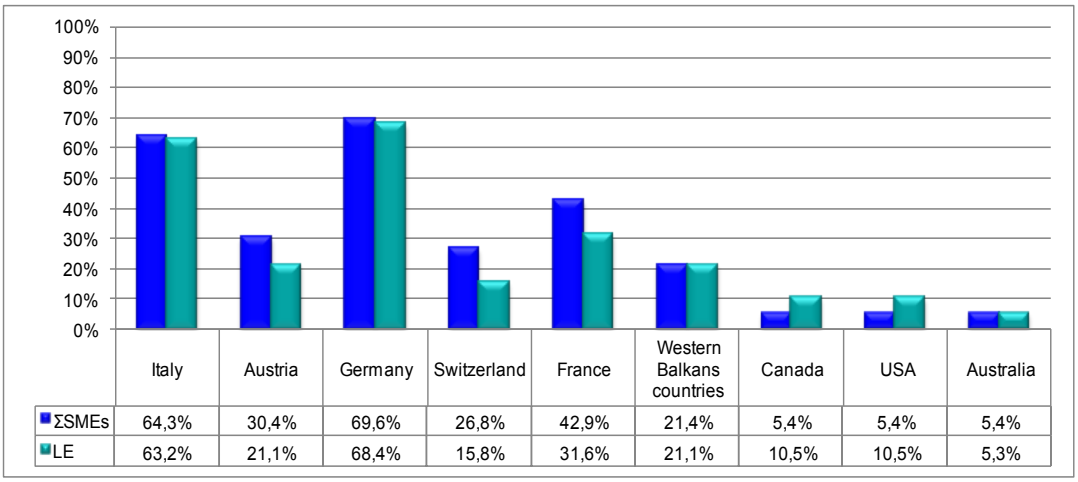
In most ΣSME (66.7%), NWFPs transport is organized by customers. On the other hand, in LEs are present all three forms, to approximately same extent, but organization of own transport (57.9%) stands out. This

[7] Only representative of one LE, located at Rasinsko FA, stated that, if "*...no processing is done, then goods are directly sold from purchasing stations*".

especially relates to the transportation to buyers on the domestic market, which is, mainly, performed by their own means of transport.

3.2. Analysis of export destinations

Export destinations of NWFPs are shown in Figure .



	Italy	Austria	Germany	Switzerland	France	Western Balkans countries	Canada	USA	Australia
ΣSMEs	64,3%	30,4%	69,6%	26,8%	42,9%	21,4%	5,4%	5,4%	5,4%
LE	63,2%	21,1%	68,4%	15,8%	31,6%	21,1%	10,5%	10,5%	5,3%

Figure 3. Share of ΣSME/LEs in export destinations of NWFPs

NWFPs are usually exported to Germany (69.6% in ΣSME and 68.4% in LEs) and Italy (64.3% in ΣSME and 63.2% in LEs). Important export destinations are also France (42.9% in ΣSME and 31.6% in LEs), Austria (30.4% ΣSME and 21.1% for LEs), and Switzerland (26.8% in ΣSME and 15.8% in LEs).

In addition, NWFPs are exported in some countries of the Western Balkan region (WBR)[8] (21.4% in ΣSME and 21.1% in LEs), in Canada and USA (each 5.4% in ΣSME and 10.5% in LEs), and Australia[9] (5.4% in ΣSME and 5.3% in LEs).

There are differences in relation to the export destinations of **certain types of NWFPs** (Table 4). Only data for enterprises (ΣSME/LEs) which business activities relate to one type of NWFPs[10] (mushrooms, MAP or WBFF) were taken into account during this analysis.

It was found that the most important export destinations of certain types of NWFPs are:
- mushrooms: Italy (81.3% in ΣSME and 100% in LEs) and Germany (68.8% in ΣSME and 100% in LEs);
- MAP: WBR (85.7% in ΣSME and 100% in LEs) and France (57.1% in ΣSME);
- WBFF: Germany (80% in ΣSME and 100% in LEs).

Table 4. Share of ΣSME/LEs to export destinations for specific types of NWFPs

Product / State	Mushrooms		MAP		WBFF	
	ΣSME	LEs	ΣSME	LEs	ΣSME	LEs
Italy	**81.3%**	**100%**	28.6%	–	40%	50%
Germany	**68.8%**	**100%**	42.9%	33.3%	**80%**	**100%**
Austria	31.3%	–	14.3%	–	20%	50%
France	43.8%	–	**57.1%**	–	40%	–
Switzerland	37.5%	50%	–	33.3%	–	–
USA	6.3%	–	14.3%	–	–	50%
Canada	–	–	–	–	–	50%
Australia	–	–	14.3%	–	–	–
WBR	6.3%	–	**85.7%**	**100%**	20%	–

[8] Term WBR here refers to some former Yugoslavian republics (BiH, Croatia, Macedonia, and Montenegro).
[9] It is interesting to emphasize that one enterprise from Posavsko-podunavsko FA, beside export to countries of west and north Europe, sell products in Japan.
[10] 23 ΣSME and 2 LEs are engaged only in mushrooms, 10 ΣSME and 3 LEs only in MAP, and 12 ΣSME and 2 LEs only in WBFF business.

For ΣSME, other countries are not quite important export destination, while for LEs, as significant export destinations, in terms of the share of the enterprises, stands out Switzerland (with 50% for mushrooms) and Italy, Austria, Canada and the United States (all with 50% for WBFF).

3.3. Analysis of attitudes of representatives of ΣSME/LEs

Despite the smooth sale of products, most of representatives of ΣSME (70.3%) and LEs (63.2%), believe that **NWFPs market**, in this moment, is not stable enough.

As reasons for the instability of the market, representatives of ΣSME, stated: "*impact of the global economic crisis*", "*dependence on weather conditions*" and "*insufficient number of collectors*". These reasons influence, on the one hand, decrease in the purchasing power ("*impact of global economic crisis*"), and, on the other hand, the amount of available NWFPs, i.e., market of raw materials ("*dependence of weather conditions*" and "*insufficient number of collectors*"), despite the high demand for final products for the end-consumer.

According to the attitudes of representatives of LEs, beside above mention facts, reasons for the instability of the market are: "*lack of organization of NWFPs sector",* "*problems with payments*", "*existence of a grey market*", "*unfair competition*", "*price fluctuations*" (often on a daily basis), etc.

In terms of **improvement of selling**, approximately ⅓ representatives of LEs (31.6%) are satisfied with existing organization and did not indicate need for its improvement. Their attitudes are claimed with fact that they "...*can respond to all customer requirements, if there are enough NWFPs in nature*", and that they have "...*permanent customers abroad, with whom successfully cooperate*".

However, most representatives of LEs (68.4%) believe that the organization of NWFPs selling can be improved through:

- "…*opening offices (branches) in some EU country*…";
- "…*engaging permanent representatives abroad*…", through which they "…*will always be up to date with prices, type of goods that are required, etc.*…";
- increase in the number of employees, so, they could quickly respond to customer demands;
- expansion of the distribution network, "…*visiting customers*…", i.e. making direct contact with them;
- associating, which would allow "…*to act with unit price from Serbia on foreign market*…".

Representative of one LE from Posavsko-podunavsko FA believe that possible solution could be "...*establishment of one more enterprise, which will deal with transport*". This is because "...*it is absolutely not profitable that vehicles which transport the goods to a foreign buyer return 'empty' to Serbia*". A similar proposal comes from representative of the other LE from the same FA, who stated that they should "...*get their own transport vehicle (truck), with which they would drive the goods alone*", because "...*this is the best way for foreign buyer to be satisfied*". Purchase of new vehicles, as believes representative of one LE from Rasinsko FA, can support improvement of organization of selling, because, in this way, they "...*would not depend on third parties*," as they do now.

4. DISCUSSION

When it comes to **forms of organization** of retail, most ΣSME and LEs do not have their own retail stores, nor do they sell products to small retail stores and/or supermarkets in the country. Following causes of the lack of direct selling to consumers are distinguished: low finalization of products (primarily mushrooms and WBFF), insufficient consumption of NWFPs in Serbia and underdevelopment of the domestic market (Nedeljkovic et al., 2012). Also, the cause may be the lack of sufficient human and technical capacities. In addition, when products are not sold directly to end consumers, but through third parties (retail chains), business success also depends on the acceptance of business partners, their support and quality of mutual cooperation (Chris Lin & Chang, 2012).

In terms of wholesale organization, usually it is selling to foreign buyers, i.e. exports, which is understandable if one bears in mind, that in our case, e.g. "...*market of MAP is not sufficiently developed*" (Turudija-Ţivanović, 2010, p. 78). However, it is evident that export opportunities are not fully exploited[11]. In order to achieve competitive advantage in selling on foreign markets, especially to EU, less successful enterprises

[11] Results of previous studies indicate that, in terms of MAP "…*Serbia is the marginal supplier to the EU, because Serbian exports accounts for less than two percent to the EU imports of this product group*" (Zarić, Deljanin, Petković, & Beatović, 2012, p. 477).

need to implement business strategies of leaders in the markets of the „old" EU member states, which are aimed at highlighting the product quality, and not on the price (Glob & Podnar, 2007).

Bearing in mind the fact that exports is risky business activity (D'Angelo, Majocchi, Zucchella, & Buck, 2013), it is understandable that all analyzed LEs organize selling on foreign markets in cooperation with long-time customers. This type of exports organization, with presence of adequate resources, provides LEs opportunity to "...*successfully overcome obstacles to foreign development and to manage a process of international growth*" (D'Angelo et al., 2013, p. 82).

Results of previous research show positive relationship between the use of business networks that consist of business partners and customers, and reduce the uncertainty on foreign markets. Those networks provide necessary information and knowledge, understanding of customer needs and reduce the risk of failure (Helm & Gritsch, 2014).

In Serbia, the most ΣSME sell products to other processors, which, after additional processing, sell NWFPs to wholesalers or retailers. On the other hand, this type of selling is not present in most of LEs. Selling to other processors indicates lack of product finalization. This was confirmed by previous studies, which emphasize that NWFPs from Serbia are, on foreign market, mostly sold as a raw material or semi-finished products (Nonić et al., 2013; USAID, 2008).

Transportation of NWFPs to the delivery point, in ΣSME, is usually, organized by customers, while in most LEs is present own transport. Optimal organisation of transport activities is of special importance for enterprises engaged in food business (Bosona & Gebresenbet, 2011). Because of this, it is needed, within each enterprise, to well consider which type of transport is mostly suitable to particular situation.

The most important **export destinations** are countries of central, west and south Europe (Austria, France, Germany, Switzerland, Italy, etc.), between which particularly stand out Germany and Italy. Similar results occurred in previous studies, which indicated that the most common export destinations are EU countries, as well as Switzerland, but also United States (Nonić et al., 2013; Sitta & Floriani, 2008; Zarić et al., 2012).

Most representatives of ΣSME and LEs believe that NWFPs **market** is not stable. Market instability is caused by various factors: economic (e.g. the global economic crisis, price fluctuations[12], insufficient development of the domestic market), ecological (e.g. dependence of yield on the weather conditions, the vulnerability of biodiversity) and social (e.g., decreasing purchasing power, insufficient number of collectors). Instability of the market has been marked in previous studies as one of the challenges for performing successful selling (Chris Lin & Chang, 2012). However, it is emphasized that "...*addressing market needs leads to increased acceptance by consumers and retailers*" (Chris Lin, & Chang 2012, p. 91), regardless of its stability.

5. CONCLUSIONS

Conducted analysis of organization of NWFPs selling in SME has led to following **conclusions:**

- selling is present in most studied enterprises, where:
  - retail is not performed in the biggest number of ΣSME and LEs;
  - wholesale is present in most of ΣSME and LEs;
- in relations to forms of retail organization, it can be concluded that:
  - most of ΣSME and LEs do not have their own retails nor do they perform selling through small retail stores/supermarkets in the country;
  - most common form of organizing of this activity in ΣSME is "other forms", primary selling to labour unions;
- in relations to forms of wholesale organization, it was concluded that:
  - in ΣSME, two forms are the most common: "foreign buyers" and "other processors";
  - in LEs is mostly present selling to "foreign buyers", while small number of these enterprises conduct selling to "other processors";
- transport of products to customers can be organized in three ways ("own", "organized by customer" and "engagement of transport enterprises"), where:
  - in ΣSME, the most common form is "organized by customer";
  - in most LEs is organized "own" transport;
- the most common export destinations, in both ΣSME and LEs are Germany and Italy:

[12] For example, MAP prices on domestic and international market "…*are subject to constant corrections*….", i.e. "…*respecting exchange rate of euro and growth of fuel prices and other inputs*" (Turudija-Ţivanović, 2010, p. 72). But it should be noted that "…*higher price fluctuations are due to the deficit of specific raw material, when seller can achieve much higher price*" (Turudija-Ţivanović, 2010, p. 72).

    - mushrooms are, mostly, exported to Italy and Germany, MAP in WBC and WBFF in Germany;
- most representatives of ΣSME and LEs, believe that market of NWFPs is not stable;
- most representatives of LEs believe that there is a need for improvement of organization of selling.

Based on the analysis of results, following specific **problems** in organization of NWFPs selling in SMEs are noticed:

- in relation to organization of retail:
  - insufficient representation of this form of selling, and insufficient cooperation of SMEs;
- in relation to organization of wholesale:
  - high share of selling to "other processors".

According to this, as well as to the attitudes of LEs representatives, following **recommendations** are defined for improving the process of selling:

- networking of SMEs, though creation of "business networks" in selling and joint cooperation with customers, within the supply chain of NWFPs;
- reduction of presence of selling to "other processors".

If enterprises do not organize own selling, their business success is partly dependent on third parties, entrusted with these activities. For this reason, SMEs could establish business networks in supply chains for joint cooperation in the selling, and for entering into certain markets. Risk to enter into the domestic market is connected with its insufficient development. On the other hand, foreign markets of NWFPs have specific requirements in relation to quantity and quality, which NWFP-SMEs from Central Serbia can hardly meet. In addition, there is competition from other EU countries (Romania, Bulgaria, Poland, etc.), which, because of EU membership, have easier access to the major markets for NWFPs.

Recommendation that relates to the reduction of presence of selling to "other processors" means greater product finalization, which will also have positive impact on increasing income of the enterprises.

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REFERENCES

Aker, D., Kumar, V., & Daj, G. (2008). *Marketinško istraživanje* [Marketing research] (9th ed.). Beograd: Centar za izdavačku delatnost Ekonomskog fakulteta u Beogradu.

Aleksić, P., Stingić, M., Milić, S. (2007). Stanje šuma šumskih područja: Šume i šumsko zemljište kojima gazduje JP "Srbijašume" [State of forests in forest areas: Forests and forest lands managed by SE "Srbijašume"]. *Šumarstvo 3-4*, 33-54.

Booker, A., Johnston, D. & Heinrich M. (2012). Value chains of herbal medicines - Research needs and key challenges in the context of ethnopharmacology. *Journal of Ethnopharmacology, 140*(3), 624–633. doi:10.1016/j.jep.2012.01.039

Bosona, T.G., & Gebresenbet, G. (2011). Cluster building and logistics network integration of local food supply chain. *Biosystems Engineering, 108*(4), 293–302. doi:10.1016/j.biosystemseng.2011.01.001

Chris Lin, J.S., & Chang, Y.C. (2012). Retailers" new product acceptance decisions: incorporating the buyer-supplier relationship perspective. *Journal of Business & Industrial Marketing, 27*(2), 89–99. doi:10.1108/08858621211196967

D'Angelo, A., Majocchi, A., Zucchella, A., & Buck, T. (2013). Geographical pathways for SME internationalization: insights from an Italian sample. *International Marketing Review 30*(2), 80-105. doi:10.1108/02651331311314538

Donnelly, R. & Helberg, U. (2003). Balkans Herbal Development Initiative – Phase 1: Final Summary Report - Serbia and Montenegro, SEED and CCF.

FAO (1999). Towards a harmonized definition of non-wood forest product. *Unasylva, 198*(50), 63-64.

Glob, U., & Podnar, K. (2007). Competitive advantage in the marketing of products within the enlarged European Union. *European Journal of Marketing 41*(3-4), 245-256. doi:10.1108/03090560710728318

Helm, R., & Gritsch, S. (2014). Examining the influence of uncertainty on marketing mix strategy elements in emerging business to business export-markets, *International Business Review, 23*(2), 418–428. doi: 10.1016/j.ibusrev.2013.06.007

Law on forests (2010). Official Gazette of the Republic of Serbia 30/10, Belgrade.

López-Feldman, A. (2014). Shocks, Income and Wealth: Do They Affect the Extraction of Natural Resources by Rural Households?. *World Development*. Advance online publication, doi: 10.1016/j.worlddev.2014.03.012

Nedeljković, J., Nonić, D., Ranković, N., & Mandić, V. (2012). *Non-wood forest products-based enterprises in Western Serbia: Organisation of external supply chain*. In Lj. Rakonjac (Ed.), *Proceedings from International Scientific Conference Forests in Future - Sustainable Use, Risks and Challenges* (pp. 831-840) [CD]. Belgrade: Institute of Forestry.

Niskanen, A., Slee, B., Ollonqvist, P., Pettenella, D., Bouriaud, L., Rametsteiner, E. (2007). *Entrepreneurship in the forest sector in Europe*, Silva Carelica 52, Joensuu: University of Joensuu, Faculty of Forestry.

Nonić, D., Nedeljković, J., & Jovanović, M. (2012). Organizacija elemenata internog lanca snabdevanja nedrvnim šumskim proizvodima u Posavsko-podunavskom šumskom području [Organisation of NWFPs internal supply chain elements in Posavsko-podunavsko forest area]. *Šumarstvo 3-4*, 83-96.

Nonić, D., Ranković ,N., & Nedeljković, J. (2013). Tipologija lanaca snabdevanja nedrvnim šumskim proizvodima u centralnoj Srbiji [Typology of the supply chains of non‐wood forest products in Central Serbia]. *Glasnik Šumarskog fakulteta 108*, 145-168. doi:10.2298/GSF1308147N

Pettenella, D., Secco, L., & Maso, D. (2007). NWFP&S Marketing: Lessons Learned and New Development Paths from Case Studies in Some European Countries. *Small-scale Forestry 6*(4), 373–390. doi:10.1007/s11842-007-9032-0

Sitta, N., & Floriani, M. (2008). Nationalization and Globalization Trends in the Wild Mushroom Commerce of Italy with Emphasis on Porcini (Boletus edulis and Allied Species). *Economic Botany 62*(3), 307–322. doi:10.1007/s12231-008-9037-4

Turudija-Ţivanović, S. (2010). Razvoj trţišta i kanali marketinga lekovitog i aromatičnog bilja u Srbiji [Development of medicinal and aromatic plants market and marketing channels in Serbia]. *Lekovite sirovine 30*, 65-84.

USAID (2008). *Herbs, mushrooms and forest fruit (medicinal and aromatic plants): Value chain assessment*. Belgrade: USAID Agribusiness Project.

Wang, S., & Wilson, B. (2007). Pluralism in the economics of sustainable forest management. *Forest Policy and Economics 9*(7), 743–750. doi:10.1016/j.forpol.2006.03.013

Zarić, V., Deljanin, A., Petković, D., & Beatović, D. (2012). Foreign trade tendencies of medicinal, aromatic and spice herbs in the Republic of Serbia, In Z. Dajić Stevanović & D. Radanović (Eds.), *Proceedings of the 7th Conference on Medicinal and Aromatic Plants of Southeast European Countries* (pp.473-477). Belgrade: Institute for Medicinal Plant Research “Dr Josif Pančić” and AMAPSEEC.

SMALL AND MEDIUM ENTERPRISES BASED ON NON-WOOD FOREST PRODUCTS: CHARACTERISTICS AND TYPES IN SERBIA

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Abstract: *In order to increase the contribution of forestry sector to economic and social development, it is necessary to support the establishment and development of small and medium-sized enterprises (SMEs) which business is based on wood and non-wood forest products (NWFPs). To properly plan development of the private forestry sector, it is also necessary to establish the basic structure and forms of SMEs for procurement, processing and sale of NWFPs (NWFP-SMEs) and their business. In this context, the aim of the research was to determine the characteristics and types of NWFP-SMEs. The study included 91 representatives of NWFP-SMEs in Central Serbia. Analysis of the results showed that, based on the characteristics and activities they perform, there are three types of NWFP-SMEs. Based on the characteristics and attitudes towards additional training, four types of NWFP-SMEs representatives can be distinguished. The results can serve as a basis for further study on types of SMEs and improving the entrepreneurship in NWFP sector.*

Keywords*: small and medium enterprises, entrepreneurship, types, non-wood forest products, forestry*

1. INTRODUCTION

Small and medium enterprises (SMEs) have an important role in every economic sector, primarily due to "*...contribution to social stability and significant fiscal revenues generation*" (Premović, Boljević, & Arsić, 2011). In order to increase the contribution of forestry sector to the economic and social development, it is necessary to support the establishment and development of forest-based SMEs (Ranković, Nonić, Nedeljković, Marinković, & Glavonjić, 2012). To properly plan development of the private forestry sector and ensure the development of SMEs in forestry, it is necessary, in addition to wood products, to pay special attention to non-wood forest products[1] (NWFPs).

Previous research show that entrepreneurs in forestry sector should take into account NWFPs, when exploring new development strategies, as these products provide significant opportunities for additional revenues (Niskanen et al., 2007). In this paper, as NWFPs are considered mushrooms, medicinal and aromatic plants (MAP), wild berries and other forest fruits (WBFF).

Research on SMEs for procurement, processing and selling of NWFPs (NWFP-SMEs) in Serbia argue that structure of these enterprises is very heterogeneous, and production capacities are underutilized and often inadequate. One of the reasons for this may be the lack of adequate support, as it was determined that most of these enterprises do not have sufficient financial resources, nor do they have access to favourable bank loans (Nonić, Nedeljković, & Jovanović, 2012; Nonić, Ranković, & Nedeljković, 2013a).

Results of research conducted in different countries indicate that SMEs need more support in order to enlarge and improve production capacities, obtain necessary technical knowledge and increase profitability (Pettenella, Secco, & Maso, 2007; Uddin et al., 2008). However, in many countries is noticeable lack of support for development of SMEs in forestry and, if support exists, it is often inadequate or poorly targeted (Macqueen, 2007). Therefore, policy-makers may need "*...policies that support the varying needs of different types of entrepreneur, rather than provide broad 'blanket' policies to all types of entrepreneur, irrespective of need or ability*" (Westhead, Ucbasaran, Wright, & Binks 2005, p. 110). For these reasons, it is essential that decision-makers have necessary information about the types of enterprises in the private forestry sector, or in this case, NWFP-SMEs.

In literature, there are several typologies of entrepreneurs (Dowell, Dawson, Fuller-Love, & Hopkins, 2012; Schwienbacher, 2007; Westhead et al., 2005), and SMEs (Andersén, 2012; Franco & Haase, 2013; Swoboda & Olejnik, 2013). Also, some authors have studied types of business strategies, which are not

[1] NWFPs are "*…goods of biological origin other than wood, derived from forests, other wooded land and trees outside forests*" (FAO, 1999).

directly related to SMEs, but can be applied to them (Grant, Cadden, McIvor, & Humphreys, 2013; Löfving, Säfsten, & Winroth, 2014; Miller & Roth, 1994).

Previous studies in private forestry sector in Serbia, have determined several types of classification, in relation to: private forest owners (Nonić, Ranković, Glavonjić, & Nedeljković, 2013); SMEs and entrepreneurs operating with wood products (Ranković et al., 2012); supply chains of NWFPs (Nonić, Ranković, & Nedeljković, 2013b), and the attitudes of representatives of NWFP-SMEs towards the documentation needed for NWFPs collection (Nedeljković et al., 2013).

However, there is a lack of knowledge about the types of NWFP-SMEs and their representatives. For these reasons, the **aim** of the research was to determine the characteristics and types of NWFP-SMEs in Central Serbia[2]. The **purpose** of the research is to create a basis for further research and improvement of the entrepreneurship in NWFP sector. The **subjects** are attitudes of the representatives of NWFP-SMEs.

2. METHODS

Different scientific methods are applied in the paper: statistical, comparative, analysis and synthesis. As research techniques for data collection, “door-to-door" survey was used (Malhotra, 2007). The questionnaire was created as a combination of 65 open- and close-ended questions, divided into six groups. Only those questions that relate to the basic characteristics of NWFP-SMEs and their business, and basic (socio-demographic) characteristics of the respondents, were selected for the purposes of this paper.

During the statistical processing of answers to questions that were continuous variables, descriptive statistics was used, while in the case of categorical variables, frequency analysis was applied. Cluster analysis was used as statistical analysis, which is mainly applied in determining the specific typology in socio-economic studies (Grant et al., 2013; Swoboda & Olejnik, 2013).

For grouping objects into relatively homogeneous groups (so-called clusters), i.e. to determine the types of SMEs and theirs representatives, two-step cluster analysis (Malhotra, 2007) was applied. The criterion for clustering was Schwarz’s Bayesian Criterion (BIC). Two-step cluster analysis allows grouping of categorical, and categorical and non-categorical variables, and does not require prior knowledge on number and characteristics of clusters. Those are determined by the value of BIC and Ratio of distance measures (RDM). The quality of the grouping is determined on the basis of Silhouette coefficient[3]. To test the differences in the obtained (empiric) and expected frequencies[4], χ^2 test for goodness-of-fit was used.

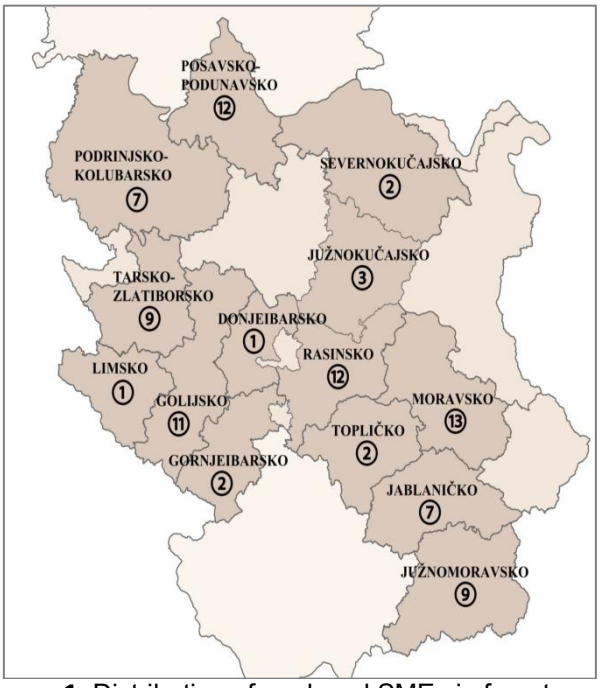

Figure 1. Distribution of analyzed SMEs in forest areas

[2] Term “Central Serbia” refers to the territory of Serbia without AP Vojvodina and Kosovo and Metohija.
[3] If the average value of Silhouette is 0.70-1, quality of data grouping is strong, if >0.50 and ≤0.70, quality is reasonable, if >0.25 and ≤0.50, quality is week, and if ≤0.25, grouping is not statistically significant (Pearson et al., 2004).
[4] In all cases it was assumed that expected (hypothetical) frequency distribution was 50%:50%, i.e. null hypothesis was that all proportions were equal.

Basic information (name, registered office, contact) on NWFP-SMEs, were obtained from internal reports of the Ministry of Environment, Mining and Spatial Planning[5], which was, in the research period (2011-2012), responsible for these tasks. Data collection was conducted with representatives of 91 enterprises (from the total number of 127 SMEs active in the moment of research)[6]. Distribution of these SMEs in forest areas[7] is shown in Figure 1. Sampling was not used in research, i.e. census was conducted because of the small population (Malhotra, 2007).

3. RESULTS

In results are presented and analysed data related to characteristics and types of NWFP-SMEs and its representatives.

3.1. Characteristics and types of NWFP-SMEs

As basic **characteristics of NWFP-SMEs**, in this research are considered (Table 1):

- location;
- number of employees and seasonal workers;
- type of NWFPs;
- transportation equipment and mechanization.

Table 1. Share of NWFP-SMEs in regard to basic characteristic

NWFP-SMEs basic characteristics		**Frequencies** (%)
Location	Rural	**70,3**
	Urban	**57,1**
Number of employees	Up to 10	31,9
	11-50	**49,5**
	51-250	18,7
Type of NWFPs	Mushrooms	**62,6**
	MAP	35,2
	WBFF	**62,6**
Transportation equipment and mechanization	Van with refrigerator	42,9
	Van without refrigerator	**60,4**
	Weighing machine	**95,6**
	Drying machine	**65,9**
	Machine for processing	**75,8**
	Machine for packaging	22.0
	Cold-store	**56.0**

In relation to the location, most NWFP-SMEs are located in urban, but also in rural areas, i.e. there is certain number (27.5%) that is performing business activities in both locations.

Around ½ of NWFP-SMEs (49.5%) has 11-50 employees. Results of χ^2 test for goodness-of-fit show statistically significant difference between these groups (χ^2=13.01, df=2, p=0.00). Most enterprises, in regard to the number of employees, belong to the group of small enterprises[8].

Most NWFP-SMEs (84.6%) hire seasonal workers, whose average number is 10 and maximal 250. NWFP-SMEs have need for hiring seasonal workers because collection, purchase and processing of NWFPs are seasonal activities, mainly preformed during summer and autumn.

When it comes to type of NWFPs, most SMEs (62.2%) are engaged in mushrooms and WBFF business and 35.2% in MAP.

[5] In accordance to Decree on putting under control the use of and trade in wild flora and fauna, all legal entities, engaged in collection of NWFPs for commercial purposes, are obliged to have the permit. The register of these legal entities is kept, based on the data from the permits.

[6] After determining the final number of SMEs that asked for the permit for commercial collection of NWFPs in the period 2007-2010, their liquidity was verified (telephone contact and checking databases of Serbian Business Register Agency and National Bank of Serbia).

[7] Detail information about forest areas are given in Law on forests (2010).

[8] If only number of employees is taken as a criterion, these enterprises, in accordance with the current Law on accounting (from 2013), belong to the category of small enterprises.

Regarding transportation equipment and mechanization, most NWFP-SMEs have van without refrigerator (60.4%) and other equipment, necessary for secondary processing of NWFPs (weighing machine, drying machine, machine for processing and cold-stores).

The oldest equipment, which enterprises purchased at the time of establishment, are drying machines, vans, machines for processing (10 yrs.) and packaging (8 yrs.), and cold (7 yrs.). The average age of weighing machine is smaller (5 yrs.), because they need to be renewed frequently.

Analysed **major characteristic of NWFP-SMEs**[9] business are (Table 2):

- business activities;
- average use of technological capacity;
- working conditions;
- problems in business;
- relationship to investments.

Table 2. Share of NWFP-SMEs in regard to basic characteristic of business

Basic characteristics of NWFP-SMEs business		**Frequencies** (%)
Business activity	Procurement	98.9
	Processing	95.6
	Selling	68.1
	NWFPs main/sole activity	**73.6**
Average utilization of technological capacity	Coldstore	57.6
	Drying machine	74.8
	Equipment for other processing	70.8
Working conditions	Old equipment and mechanization	14.6
	Dependence of weather conditions	**78.7**
	Inadequate legal framework	**70.8**
Problems in business	Unqualified labour	22.0
	Insufficient labour	39.6
	Lack of trainings	14.3
	Unfair competition	**60.4**
	Lack of export	16.5
	Undeveloped national market	39.6
	Insufficient utilization of capacities	27.5
	Payments	39.6
	Clients	9.9
	Cooperation with other enterprises	11.0
	Other	14.3
Investments	Fixed assets of expanded reproduction	**74.1**
	Product finalization	17.6
	Introduction of additional activities	7.1
	Marketing instruments	7.1
	Working assets	9.4

Business activities of most NWFP-SMEs include procurement (98.9%), processing (95.6%) and selling (68.1%). Also, NWFP-related business activities are main or sole activity for around ¾ (73.6%) SMEs.

In analysed enterprises, there is high degree of utilization of drying machine (74.8%) and equipment used for other processing (70.8%), while degree of utilization of cold-stores is slightly less (57.6%).

Respondents believe that working conditions are mostly defined by weather (78.7%), which is understandable bearing in mind that NWFPs yield depends solely on nature and weather conditions. Also, majority of respondents (70.8%) claim that legal framework is inadequate.

Unfair competition is the most important problem in business (60.4% of SMEs representatives). Representatives also think that insufficient labour, undeveloped national market, and payments (each

[9] In relation to legal form, most enterprises are registered as business companies (74.7% as Limited Liability Company and 1.1% as Joint Stock Company). In addition, there are entrepreneurs (22.0%) and cooperatives (2.2%).

39.6%) cause problems in business. On the other hand, the smallest number of respondents believes that problems are caused by clients (9.9%) and cooperation with other enterprises (11.0%)[10].

Most SMEs representatives (74.1%) believe that financial resources should be invested in new equipment, i.e. fixed assets.

Types of NWFP-SMEs were determined based on two groups of variables:
1) basic characteristics (location, number of employees and seasonal workers);
2) SMEs activities.

Three types[11] of enterprises are distinguished based on the characteristics (Table 3):
- "small rural" (50.6%);
- "small urban" (29.9%);
- "medium urban" (19.5%).

Table 3. Types of enterprises in relation to the characteristics

Type of enterprise	Location	Number of employees	Number of seasonal workers
Small rural	Rural	11-50	16
Small urban	Urban	11-50	17
Medium urban	Urban	51-250	133

Most SMEs belong to the type "small rural enterprises", which is understandable, bearing in mind that the activities related to NWFPs, particularly procurement of raw materials, belong to rural areas. This is because NWFPs collection and purchase are performed in villages and their surroundings, which are closer to the forest resources than urban areas.

Results of χ^2 test goodness-of-fit show a statistically significant difference between these types (χ^2=11.64, df=2, p=0.003).

"Small rural" and "small urban" types are very similar (differ only in location). On the other hand, "medium urban" type clearly differs, both in terms of the number of employees and seasonal workers.

Three types of enterprises are determined, based on SMEs business activities[12]:
- SMEs engaged in procurement, processing and selling of NWFPs (64.8%);
- SMEs engaged in procurement, and processing of NWFPs (30.8%);
- SMEs engaged in procurement, and selling of NWFPs (4.4%).

Results of χ^2 test goodness-of-fit show a statistically significant difference between these types (χ^2=50.13, df=2, p=0.0).

The majority of enterprises belong to the type engaged in all three activities. This is understandable if one takes into account the above results, which indicate that procurement and processing are present in almost all studied SMEs and selling in the majority.

3.2. Characteristics and types of representatives of NWFP-SMEs

Following **characteristics of representatives of NWFP-SMEs** were analysed (Table 4):
- position;
- age;
- gender;
- education.

In terms of positions in the enterprise, 69.2% of all representatives NWFP-SMEs are owners and/or managers (27.5% owners, 22.0% owner-managers and 19.8% managers). Presented results indicate that no position prevails. However, results of the χ^2 test goodness-of-fit show a statistically significant difference between observed variables (χ^2=40.31, df=6, p=0.0).

[10] Most respondents believe that unfair competition represents „*...problem in NWFP purchase*", while on the other hand majority emphasize that "*...with other enterprises usually cooperate in selling*".
[11] Silhouette=0.5, BIC=253.87, RDM=1.86
[12] Silhouette=1.0, BIC=55.23, RDM=3.01

Table 4. Share of NWFP-SMEs representatives' in regard to the characteristic

Characteristics		Owner	Manager	Owner-manager	All respondents
		Frequencies (%)			
Position	Owner	100	-	-	27.5
	Manager	-	100	-	19.8
	Owner-manager	-	-	100	22.0
	Employee	-	-	-	17.6
	PR	-	-	-	1.1
	Consultant	-	-	-	1.1
	Other	-	-	-	11.0
Age	18-25	-	-	-	2.2
	26-45	**52.0**	27.8	**55.0**	49.5
	46-65	48.0	**72.5**	40.0	47.3
	More than 65	-	-	5.0	1.1
Gender	Male	**84.0**	**83.3**	**75.0**	**74.7**
	Female	16.0	16.7	25.0	25.3
Education	Secondary school	40.0	22.2	**55.0**	41.8
	High school	28.0	33.3	20.0	22.0
	Faculty	32.0	44.4	25.0	36.3

Regarding gender, representatives of SMEs are mostly males (74.7%). The majority of owners and owner-managers belong to age group 26-45 years.

In relation to education, results of χ^2 test goodness-of-fit indicated no statistically significant difference between education categories[13], i.e. none of them can be described as prevailing.

Following **attitudes of NWFP-SMEs representatives**, towards additional trainings were analysed (Table 5):

- importance of additional trainings;
- previous trainings;
- type of training;
- interest in future trainings;
- type of training required in future.

Table 5. Share of NWFP-SMEs representatives' in regard to attitudes toward training

Attitudes		Owner	Manager	Owner-manager	All respondents
		Frequencies (%)			
Importance of additional trainings[14]	Negative	8.0	11.1	5.0	7.7
	Indifferent	28.0	11.1	15.0	16.5
	Positive	**64.0**	**77.8**	**80.0**	**75.8**
Previous trainings	Yes	**56.0**	44.4	**60.0**	**52.7**
	No	44.0	**55.6**	40.0	47.3
Type of training	Informal	7.1	28.6	25.0	15.2
	Formal	**92.9**	**71.4**	**75.0**	**84.8**
Interest in future trainings	Yes	**80.0**	**72.2**	**80.0**	**79.1**
	No	20.0	27.8	20.0	20.9
Type of training required in future	Entrepreneurship	42.9	30.8	37.5	35.6
	Business administration	42.9	46.2	43.8	43.8
	Management	**57.1**	**61.5**	37.5	**53.4**
	Supply chain management	42.9	38.5	31.3	35.6
	Legislation	42.9	38.5	37.5	35.6
	Professional knowledge on NWFPs	**66.7**	**61.5**	**75.0**	**68.5**
	Other	9.5	23.1	12.5	16.7

[13] Values of χ^2 test goodness-of-fit are: owners-χ^2=0.56, df=2, p=0.76; managers-χ^2=1.33, df=2, p=0.51, owner-managers-χ^2=4.3, df=2, p=0.12.

[14] 5-degree Likert scale was applied for evaluation of additional training importance. In this paper, points 1 (very unimportant) and 2 (unimportant) are shown as negative, 3 (neither important nor unimportant) as indifferent, and 4 (important) and 5 (very important) as positive attitude.

Most respondents have a positive attitude toward the importance of additional training. Also, most of them, except those in the position of managers, have attended some training, mostly formal. The majority of respondents, regardless of the position, showed interest in attending trainings in the future.

In relation to the type of training, 68.5% of respondents believe that they need professional knowledge on NWFP and 53.4% require training in management.

Types of NWFP-SMEs representatives (owner, manager and owner- manager), were distinguished on the basis of two groups of variables: basic characteristics, and attitudes toward type of training.

In regard to characteristics (**Error! Not a valid bookmark self-reference.**), majority of owners (52.0%) and the highest number of owner-managers (45.0%) are "younger secondary school graduates", and 44.4% of managers are "older secondary school graduates". Common characteristics of these types are male sex and secondary education.

Table 6. Share of types of NWFP-SMEs representatives in regard to the basic characteristics

Type[15] of NWFP-SMEs representatives	Owner	Manager	Owner-manager
	Frequencies (%)		
Younger secondary school graduates	**52.0**	-	45.0
Older secondary school graduates	-	44.4	-
Older high school graduates[16]	-	16.7	20.0
Older with faculty	48.0	38.9	35.0

However, results of χ^2 test goodness-of-fit indicated no statistically significant difference between these types (none can be described as prevailing), because:
- for owners, χ^2=0.04, df=1, p=0.84;
- for managers, χ^2=2.33, df=2, p=0.31;
- for owner-managers, χ^2=1.90, df=2, p=0.39.

In regard to attitudes toward type of training (**Error! Not a valid bookmark self-reference.**), following types of NWFP-SMEs representatives are distinguished:
- "professional knowledge on NWFPs" – only professional knowledge of NWFPs, related to the type of product, methods of collection, processing, etc. (75% owner-managers);
- "broad managerial & professional knowledge" – knowledge from the field of management and related disciplines (entrepreneurship, business administration, etc.), and professional knowledge on NWFPs;
- "narrow managerial & professional knowledge" – knowledge from the field of management, and professional knowledge on NWFPs (61.5% of managers);
- "lack of interest in additional training in proposed fields" – no need for additional training from management and related disciplines, nor professional knowledge on NWFPs, but still show interest in additional education (61.9% of owners).

Table 7. Share of types of NWFP-SMEs representatives in regard to the type of training

Type[17] of NWFP-SMEs representatives	Owner	Manager	Owner-manager
	Frequencies (%)		
Professional knowledge on NWFPs	-	-	**75.0**
Broad managerial & professional knowledge	38.1	38.5	25.0
Narrow managerial & professional knowledge	-	**61.5**	-
Lack of interest in additional training in proposed fields	**61.9**	-	-

However, results of χ^2 test goodness-of-fit show that there is no statistically significant difference between these types (none can be described as prevailing, except in case of owner-managers), because:
- for owners, χ^2=1.19, df=1, p=0.28;
- for managers, χ^2=0.69, df=1, p=0.41;
- for owner-managers, χ^2=4.0, df=1, p=0.046.

[15] Owners: Silhouette=0.5, BIC=99.85, RDM=1.81; managers: Silhouette=0.6, BIC=64.50, RDM=1.66; owner-managers: Silhouette=0.5, BIC=87.01, RDM=1.53.
[16] Types of managers and owner-managers "older high school graduates" are 46-65 years old, with high school. The difference is in gender: managers are females and owner-managers are males.
[17] Owners: Silhouette=0.7, BIC=108.87, RDM=4.28; managers: Silhouette=0.5, BIC=93.01, RDM=2.56; owner-managers: Silhouette=0.7, BIC=101.37, RDM=2.32.

Common characteristic for owners, managers and owner-managers is that few of them show interest in acquiring "broad managerial & professional knowledge".

4. DISCUSSION

In relation to **basic characteristics of NWFP-SMEs**, it can be seen that their location is both in urban and rural areas, and that they are small enterprises, in regard to the number of employees. The most common NWFPs are mushrooms and WBFF. Most NWFP-SMEs belong to the type "small rural enterprises".

Previous studies on forest-based enterprises indicate that small family enterprises (FAO, 2005; USAID, 2008), located in rural areas (FAO, 2005; Niskanen et al., 2007; Pettenella et al., 2007), are mainly engaged in these activities.

Regarding **characteristics of NWFP-SMEs business**, it is noticeable that selling is present in most enterprises, while almost all of them are engaged in procurement and processing. The prevailing type of NWFP-SMEs, distinguished on the basis of their activities, is the one that integrates procurement, processing and selling. Previous studies in the region of Šumadija and Western Serbia showed similar results (Nonić, Ranković, & Nedeljković, 2013b).

Most NWFP-SMEs representatives believe that working conditions are defined by weather. Considering that NWFPs are seasonal products, whose yields depend on nature and weather "*...their supply cannot be regular and fully reliable*" (FAO, 2005, p. 6). This is the reason why SMEs in this sector "*...seldom rely on one product*" (FAO, 2005, p. 6). In this way, they are trying to minimize potential losses.

Unfair competition, insufficient labour, underdevelopment of national market, and payments are important problems in business. Although there are certain differences in attitudes, these problems are to some extent similar to those reported in the literature. Research conducted abroad show that the main problems are: "…*lack of capital investment and shortage of raw materials, skilled manpower and up-to-date information*" (Uddin et al., 2008, p. 147). Also, problem can be caused by "…*financial and technical limitations, (…), market insecurity (with large price fluctuations) and lack of research*" (Uddin et al., 2008, p. 148).

Despite appropriate technological equipment, most respondents believe that additional funds should be invested in fixed assets (cold-stores, drying machines, etc.). According to the results of previous research in Serbia, representatives of NWFP-SMEs emphasize the need for additional financial support measures, which would be used for purchase of new equipment and machinery (Nonić, Ranković, & Nedeljković, 2013a).

In regard to the basic **characteristics of NWFP-SMEs representatives**, most respondents are owners and/or managers. The biggest (but not prevailing) number of owners and owner-managers belong to the type "younger secondary school graduates". This means that all of them are males, 26-45 years old, with secondary school. These results are in line with previous studies that indicate entrepreneurs are mainly males, 20-50 years old, and have secondary school education (Ayala & Manzano, 2014).

Most respondents have positive attitude towards additional education and have attended some kind of formal training. In terms of types of NWFP-SMEs representatives, most owner-managers belong to the type being interested in professional knowledge on NWFPs. On the other hand, most owners show lack of interest in additional training in proposed fields. Reason for this may be the fact that "owner-managers" in forestry "…*see their businesses primarily as a source of revenue and a way to provide for their own employment*" (St-Jean, LeBel, & Audet, 2010, p. 212). The importance of additional education is emphasized in previous studies showing that "…*certain factors such as human capital and characteristics (education, training, manager experience) have a direct influence on rural business growth*" (St-Jean et al., 2010, p. 213).

5. CONCLUSION

In regard to **characteristics of NWFP-SMEs**, following conclusion can be drawn:

- most enterprises have 11-50 employees and operate with mushrooms and/or WBFF;
- most enterprises have van without refrigerator, weighing and drying machines, machine for processing and cold-stores.

In regard to **characteristics of NWFP-SMEs business**, following can be concluded:

- most enterprises are engaged in all three activities (procurement, processing, selling), and NWFPs are predominant/sole activity;
- there is high degree of utilization of drying machine and equipment for other processing;
- working conditions are defined by dependence on weather and inadequate legal framework;

- the most important problem in business is “unfair competition”;
- financial resources should be invested in fixed assets.

Research results showed following **types of NWFP-SMEs**:
- in regard to basic characteristics of SMEs:
  1) “small rural” (prevailing);
  2) “small urban”;
  3) “medium urban”;
- in regard to business activities:
  1) “procurement, processing, selling” (prevailing);
  2) “procurement, processing”;
  3) “procurement, selling”.

Following can be concluded in relation to **characteristics of NWFP-SMEs representatives**:
- most are at the position of the owner and/or manager, are 26-45 years old, male with secondary school education;
- most have positive attitude towards the importance of additional training, have attended formal trainings and show interests in additional education, mainly in the field of management and professional knowledge on NWFPs.

Following **types of NWFP-SMEs representatives** are distinguished:
- in regard to some basic characteristics (none is prevailing):
  1) “younger secondary school graduates”;
  2) “older secondary school graduates”;
  3) “older high school graduates”;
  4) “older with faculty”;
- in regard to attitudes toward the type of additional training:
  1) “professional knowledge on NWFPs” (prevailing within owner-managers);
  2) “broad managerial & professional knowledge”
  3) “narrow managerial & professional knowledge”
  4) “lack of interest in additional training in proposed fields”.

These results can serve as a basis for further research on types of SMEs and possibilities of improvement of entrepreneurship in NWFPs sector. Also, in the coming period should be studied the need for specific support measures in relation to different types of entrepreneurs.

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REFERENCES

Andersén, J. (2012). A resource-based taxonomy of manufacturing MSMEs, *International Journal of Entrepreneurial Behaviour & Research 18*(1), 98-122. doi:10.1108/13552551211201394

Ayala, J.C., Mazano, G. (2014). The resilience of the entrepreneur. Influence on the success of the business. A longitudinal analysis. *Journal of Economic Psychology*. Advance online publication. doi:10.1016/j.joep.2014.02.004

Dowell, D., Dawson, C, Fuller-Love, N., & Hopkins, B. (2012). Entrepreneurial groups in Ireland and Wales: A preliminary typology of entrepreneurs using a marketing segmentation approach. *Journal of Research in Marketing and Entrepreneurship, 14*(2), 184 – 198. doi:10.1108/14715201211271401

FAO (2005). *Microfinance and forest-based small-scale enterprises* (FAO Forestry Paper 146). Rome: FAO.

FAO (1999). Towards a harmonized definition of non-wood forest product. *Unasylva, 198*(50), 63-64.

Franco, M., & Haase, H. (2013). Interfirm Alliances: A Taxonomy for SMEs. *Long Range Planning*. Advance online publication, doi:10.1016/j.lrp.2013.08.007

Grant, N., Cadden, T., McIvor, R., & Humphreys, P. (2013). A taxonomy of manufacturing strategies in manufacturing companies in Ireland. *Journal of Manufacturing Technology Management 24*(4), 488 – 510. doi: 10.1108/17410381311327378

Law on forests (2010). Official Gazette of the Republic of Serbia 30/10, Belgrade.

Löfving, M, Säfsten, K., & Winroth, M. (2014). Manufacturing strategy frameworks suitable for SMEs. *Journal of Manufacturing Technology Management 25*(1), (7-26). doi:10.1108/JMTM-08-2012-0081

Macqueen, D. (2007). *The role of small and medium forest enterprise associations in reducing poverty*. London: IIED.

Malhotra, N. (2007). *Marketing research-an applied orientation*. Upper Saddle River: Pearson Prentice Hall.

Miller, J. G., & Roth, A. V. (1994). A Taxonomy of Manufacturing Strategies. *Management Science, 40*(3), 285-304.

Nedeljković, J., Lovrić, M., Nonić, D., Stojanovska, M., Nedanovska, V., Lovrić, N., Stojanovski, V. (2013). Utjecaj političkih instrumenata na poslovanje sa nedrvnim šumskim proizvodima u Hrvatskoj, Makedoniji i Srbiji,

[Influence of policy instruments on non-wood forest products commercialization in Croatia, Macedonia and Serbia]. *Šumarski list 9-10*, 473–486.
Niskanen, A., Slee, B., Ollonqvist, P., Pettenella, D., Bouriaud, L., Rametsteiner, E. (2007). *Entrepreneurship in the forest sector in Europe*. Silva Carelica 52, Joensuu: University of Joensuu, Faculty of Forestry.
Nonić, D., Nedeljković, J., & Jovanović, M. (2012). Organizacija elemenata internog lanca snabdevanja nedrvnim šumskim proizvodima u Posavsko-podunavskom šumskom području [Organisation of NWFPs internal supply chain elements in Posavsko-podunavsko forest area]. *Šumarstvo 3-4*, 83-96.
Nonić, D., Ranković, N., Glavonjić, P., & Nedeljković, J. (2013). Tipologija vlasnika privatnih šuma u Srbiji [Typology of private forest owners in Serbia]. *Šumarstvo 3-4*, 133-156.
Nonić, D., Ranković ,N., & Nedeljković, J. (2013a). Institucionalni okviri i finansijska podrška preduzećima koja posluju sa nedrvnim šumskim proizvodima u EU i Jugoistočnoj Evropi [Institutional framework and financial support to non-wood forest products-based enterprises in EU and Southeast Europe]. *Šumarstvo 3-4*, 85-111.
Nonić, D., Ranković ,N., & Nedeljković, J. (2013b). Tipologija lanaca snabdevanja nedrvnim šumskim proizvodima u centralnoj Srbiji [Typology of the supply chains of non‐wood forest products in Central Serbia]. *Glasnik Šumarskog fakulteta 108*, 145-168. doi:10.2298/GSF1308147N
Pearson, R.K., Zylkin, T., Schwaber, J., & Gonye G.E. (2004). Quantitative evaluation of clustering results using computational negative controls. In Berry M. (ed.), *Proceedings of the Fourth SIAM International Conference on Data Mining, Society for Industrial and Applied Mathematics* (pp. 188-199). Lake Buena Vista: SIAM.
Pettenella, D., Secco, L., & Maso, D. (2007). NWFP&S Marketing: Lessons Learned and New Development Paths from Case Studies in Some European Countries. *Small-scale Forestry 6*(4), 373–390. doi:10.1007/s11842-007-9032-0
Premović, J., Boljević, A., & Arsić, LJ. (2011). Mala i srednja preduzeća kao generatori održivog regionalnog razvoja [Small and medium enterprises as generators of the sustainable regional development]. *Ekonomika poljoprivrede 58*(SB1), 137-144.
Ranković, N., Nonić, D., Nedeljković, J., Marinković, M., Glavonjić, P. (2012). *Mala i srednja preduzeća u Timočkom šumskom području-sistem mera podrške i model organizovanja* [Small and medium enterprises in Timok forest area – system of support measures and model of organization]. Beograd: Univerzitet Beogradu-Šumarski fakultet.
Schwienbacher, A. (2007). A theoretical analysis of optimal financing strategies for different types of capital-constrained entrepreneurs. *Journal of Business Venturing 22*(6), 753–781. doi:10.1016/j.jbusvent.2006.07.003
St-Jean, E., LeBel, L., & Audet, J. (2010). Entrepreneurial orientation in the forestry industry: a population ecology perspective. *Journal of Small Business and Enterprise Development 17*(2), 204-217. doi:10.1108/14626001011041210
Swoboda, B., & Olejnik, E. (2013). A taxonomy of small- and medium-sized international family firms. *Journal of International Entrepreneurship 11*(2), 130-157. doi:10.1007/s10843-012-0101-x
Uddin, M.S., Mukul, S.A., Khan, M.A.S.A., Alamgir, M., Harun, Md.Y., & Ala, M.S. (2008). Small-scale Agar (*Aquilaria agallocha* Roxb.) Based Cottage Enterprises in Maulvibazar District of Bangladesh: Production, Marketing and Potential Contribution to Rural Development. *Small-scale Forestry 7*(2), 139–149. doi:10.1007/s11842-008-9046-2
USAID (2008). *Herbs, mushrooms and forest fruit (medicinal and aromatic plants): Value chain assessment*. Belgrade: USAID Agribusiness Project.
Westhead, P., Ucbasaran, D., Wright, M., & Binks, M. (2005). Novice, Serial and Portfolio Entrepreneur Behaviour and Contributions. *Small Business Economics 25*(2), 109-132. doi:10.1007/s11187-003-6461-9

THE IMPORTANCE OF HUMAN RESOURCES DEVELOPMENT AS NON-FINANCIAL SUPPORT TO SMES IN SEE AND SERBIA

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Abstract: *Having in mind that systematic approach to developing human capital requires the identification of training needs of SMEs, this paper will present the main results of the comparative analysis on the main challenges in HR of SMEs in South- East Europe, including Serbia which was done by SEECEL[1]. The key challenges of SMEs in choosing the relevant training program will be presented as well. The paper will also highlight the specific needs of SMEs in Serbia regarding the non-financial services. This part of analysis is based on the Report which is regularly published by National Agency for regional development so that the progress achieved in 2013. could be measured and presented as well.*

Keywords*: training, SME, HR, needs, challenges, non-financial service*

1. INTRODUCTION

Human capital development is considered as one of the key areas for fostering the competitiveness of SMEs as the basis for sustainable growth. Since economic crisis affected SMEs considerably, EU countries prepared the appropriate response in many relevant development aspects, including the human capital. Training needs analysis is one of the backbone for the systematic approach to developing human capital. Although the financial support prevailed among the priorities for SMEs growth, non-financial support which refers to the training needs mainly, is becoming more and more important.

It is widely promoted over the Europe that key successes factor for growth is smart, sustainable and inclusive development. In order to take advantage of this opportunity, steps were outlined in the EU 2020 Strategy which set the targets and key priorities and initiatives. Recognizing that Europe can "count on the talent and creativity of [its] people"[2], the EU 2020 strategy places a great focus on the development of Europe's human capital. In particular, it stipulates that promoting smart growth driven by knowledge and innovation necessitates reforms which should improve the quality of education and training, and reforms should contribute to "ensuring that innovative ideas can be turned into new products and services that create growth, quality jobs and help address European and global societal challenges. But, to succeed, this must be combined with entrepreneurship, finance, and a focus on user needs and market opportunities."[3]

The development of the SME sector has consistently been highlighted in national SME strategies, programs and action plans as one of the economic priorities of South East European countries. To achieve this economic priority, the focus has been placed on fostering the competitiveness of SMEs by improving the competences of SME's human capital. The education and training system, which plays a crucial role in strengthening the competences of SME's human capital, should remain flexible and respond accurately to the demands of the labor market. The discrepancy between the expressed needs for training and the training provision offered in the market and the lack of data on SME's training needs should be addressed through systematic Training Needs Analysis (TNA) (SEECEL, 2013). All pre-accession countries which belong to SEE region are committed to the performing of TNA as this is a milestone for the evidence-based policy making. The SEECEL developed instrument and associated methodology as well as the first implementation of an SEE-wide TNA provides the platform for future Training Needs Analysis System (TNAS). The results

[1] South East European Center for Entrepreneurial Learning (SEECEL) is regional institution with the mission to promote the development of the lifelong entrepreneurial learning system and entrepreneurship as key competence in eight pre-accession countries of South East Europe (SEE). SEECEL is funded by EU, under the IPA and from the state budget of the Government of the Republic of Croatia.
[2] Europe 2020: A strategy for smart, sustainable and inclusive growth" (COM(2010)), p.7
[3] Europe 2020: A strategy for smart, sustainable and inclusive growth" (COM(2010)), p.11-12

which will be presented in this paper on the main challenges that SMEs are facing in human capital development, will be based on the recently published SEECEL comparative analysis in SEE[4].

EU 2020 Strategy and other relevant documents recognize the impact that entrepreneurship has on economy and society and consequently support human capital development in the SME sector as a key driver of competitiveness. This message was further reinforced with the Entrepreneurship 2020 Action Plan (2012). Another important policy document which highlight the importance of human capital development is Small Business Act (SBA). SBA is a key instrument of the policy of promotion of entrepreneurship and small enterprises, which replaced European Charter for Small Enterprises**.** The SBA builds on Commission and Member States policy achievements and creates a new policy framework that integrates the existing enterprise policy instruments. SBA also promotes SMEs to grow by helping them tackle the remaining problems which hamper their development. Similar to the European Charter, this document also contains 10 key areas for the development of SME and is, basically, conceived as a shift from guidelines to real, targeted activities. SBA is a part of *acquis communautaire*, which makes it even more important for candidate countries and potential candidate for EU membership.
Progress in entrepreneurship learning according to SBA, in Serbia was slow. Except the establishment of the Council of Partnership for Entrepreneurial Learning by the end 2012., there was not other significant signs of progress in this particular area. The main responsibilities of the Council are to coordinate policy action in order to develop a lifelong entrepreneurial learning system (LLEL) (2012). There are also some training programs for start ups and growing companies available through the network of the regional agencies for SME development and National agency for regional development.

2. KEY CHALLENGES IN HUMAN CAPITAL DEVELOPMENT SMEs ARE FACING

Human resources are the most valuable asset of each enterprise, as a key driver of individual, organizational, civic, and national integrated, inclusive, smart and sustainable growth. Improving human resources is essential as improved competences, higher motivation and greater activation of employees are crucial preconditions for increasing productivity, innovation and high performance-competitiveness of SMEs. However, SMEs are facing both external and internal barriers in improving their key business competence base. In addition to this there are also practical financial and organizational barriers (Buschfeld, D. and all, 2011). Organization of training programs is time and money consuming, therefore small companies can hardly afford them. On the other hand, existing training offers and programs are normally designed and organized from the point of view of larger companies and they simply don't fit into the organizational needs of smaller companies EC, (Directorate-General for Employment, Social Affairs and Equal Opportunities, 2009). This is particularly evident in terms of financing of training where SMEs cannot match the learning and training investments of larger companies. There appear to be a number of misconceptions about SMEs and their capacity to provide timely, practical and effective learning and training activities (Watt, D., Kitagawa, K. 2009). This is largely due to unfavorable comparisons with larger companies in terms of organization, financing and training and learning activities. One of the biggest challenges that SMEs are facing is the organization and funding of human resources and training in South East countries.

The share of enterprises that prepare financial and budgeting plans for learning and training investments and human resources development increases with the size of the enterprise, which is an expected result. The stated share is generally higher in medium-sized enterprises, in comparison with micro and small. Consequently, in micro and small enterprises a slightly higher percentage of interviewees stated that HR development is financed mostly by employees themselves (SEECEL,2013). Governmental subsidies in the form of total financing are extremely rarely used. According to the research conducted by SEECEL in 2013[5]. the highest share of enterprises that use such subsidies is recorded in Turkey and amounts to only 11%, while in Former Yugoslav Republic of Macedonia (FYROM) there are no such enterprises in the sample. Governmental subsidies in the form of co-financing are also rarely used, but slightly more often than subsidies in the form of total financing. Governmental subsidies in the form of tax incentives are generally the least used subsidy form.

Although in the last three years many enterprises were strongly affected by the impact of the crisis, investments made in development of human resources generally stayed on the same level or even slightly

[4] The overall sample used in the analysis contains 2.335 enterprises in eight SEE countries, which of 51% are micro, 34% are small and 15% are medium-sized enterprises.

[5] The overall sample used in the analysis contains 2.335 enterprises in eight SEE countries, which of 51% are micro, 34% are small and 15% are medium-sized enterprises.

increased. This is undoubtedly an important finding, particularly as most enterprises had to reduce their operating costs, which usually leads to a restriction of the available budget for training and HR development (SEECEL, 2013). The findings from the SEECEL study confirms that enterprises in SEE region are still very aware of the need for constant employee competence development. Furthermore, they recognize the quality and expertise of employees as a necessary precondition for the maintenance and development of business entities in difficult market and economic conditions.

Second challenge that SMEs are usually facing in SEE refers to the availability of the information on learning and training programs. The most of interviewed SMEs claimed that media is the most important source for information on the training opportunities. On the other hand, in Albania only 8.4% of enterprises acquire information from media, but over 70% of Albania SMEs obtain information from other sources. Mouth to mouth advertisement is the most pronounced in Croatia and holds the same place of importance as media (36.6%). In Serbia, this percentage accounts for 25.2%. Finding information about available training from other enterprises is also relatively important in countries where approximately one third of enterprises from the survey stressed its relevance (Serbia 33.3%) (SEECEL, 2013).

The training needs analysis in SEE also has shown that training programs providers are not fully adjusted to the needs of SMEs and that policy makers should base future development of programs and policies on concrete feedback provided by the SMEs themselves. The relative usefulness of training areas, can be, therefore the next challenge for SMEs and for training providers as well. Taking into account the entire regional sample, it may be concluded that financial management, information technologies and accounting were the most useful training areas performed within the company, while intellectual and industrial property rights and innovation management were the least useful training areas performed within the company, although they may be considered as partially useful (SEECEL, 2013). The highest usefulness of the training areas is associated with market trends and regulations, and financial management in case of FYROM and accounting in case of Albania, where every enterprise that responded to the questionnaire found these training areas useful. Bosnia and Herzegovina and Croatia also set accounting as the most useful one while Serbia put the highest usefulness score on market trends and regulations.

Export/import related knowledge and skills have the lowest average usefulness score amongst the five observed training areas, as well as the highest standard deviation among countries.
The overall highest usefulness score is associated with product development and the lowest one with intellectual and industrial property rights.

Other challenges that influence decision –making process for the selection of training and learning programs could be proper timing, duration, applicable competencies in work environment, location, methodology applied, certificates, price, quality and so on. The highest importance is recorded in Serbia where in average 96% of these decision factors are considered important.

All SMEs (100%) that responded to the question from Serbia specify that the duration of the program, the development of relevant competencies applicable in work environment and the applied methodology, the price and the trainers' quality and eligibility are important to make the decision.

There are significant differences amongst the observed countries related to the most suitable timing for conducting the training, education and skill improvement programmes. Enterprises from FYROM and Serbia think that the most suitable timing for training of the employees is during work hours, while on the other hand the majority of enterprises from Albania (54%) think that the timing during work hours is not appropriate.

The enterprises differs also in the attitude on the most appropriate method of training. Practical on-the-job training and a mix of lecturing and interactive approach are generally the most appropriate methods used for conducting the learning and training programmes, with quite a similar level of appropriateness in all countries. Technology and ICT oriented methods like using simulation, distant learning, video conference and similar, as well as different kinds of study tours may also be considered as appropriate methods in the majority of the observed countries, although showing a generally lower level of appropriateness than the first two. Albania and Serbia prefer practical on-the-job training, a mix of lecturing and interactive approach and technology and ICT oriented methods (SEECEL, 2013).

3. NEEDS FOR NON-FINANCIAL SUPPORT OF SMEs IN SERBIA

3.1 The use of non-financial support among SMEs

Non-financial support of SMEs like training, advising and consulting service are focusing to human resource development in the SMEs. However, this support is usually considered as a second the most important service to SMEs after enabling better access to finance. Human resources for competitive SMEs and entrepreneurs (SMEE) has been identified as one among 5 pillars within the Development Strategy of Innovative and Competitive SME for the period of 2008-2013. in Serbia (Report on SMEE, 2011). National Agency for Regional Development is the key stakeholder in providing the training to SMEs with the aim to make them more successful and competitive at the market. The main target group to which NARD provided training was start up companies. The topic of the training which prevailed was business plan writing but also mentoring .

The findings from the recently conducted research on the conditions, needs and problems of SMEs in Serbia, in 2013. (NARD, 2013) also indicates that the need for financial support is much more significant in relation to non-financial types of support. Majority of enterprises (80%) express the need for financial support, whereas non-financial support is needed in only one out of two enterprises. Actually 43 % of enterprises claimed that non-financial support mostly is not needed and is not needed at all. On the other hand, some 52% is positive toward the non-financial services, as 35% think that non-financial support is needed, but not necessary while 15% claimed that they are very much needed. Enterprises who underlined the need for non -financial support belong mostly to South Serbia and are medium-sized (NARD, 2013).

As to gender structure, one out of two women entrepreneurs believe that non-financial support services (advice, trainings and consulting services) are needed, of which 36% consider them needed, but not necessary.

Table 1: Need for non-financial types of support-by type of business entity

Need for non-financial types of support – by type of business entity					
	Micro	Small	Medium	Sole trader	**Total SMEs**
Very much needed	18.4%	17.7%	24.7%	13.4%	**16.7%**
Needed, but not necessary	33.3%	39.0%	44.7%	33.3%	**35.4%**
Mostly not needed	26.0%	25.5%	18.7%	23.5%	**24.5%**
Not needed at all	19.4%	12.7%	4.7%	23.1%	**18.3%**
Don't know/no answer	2.9%	5.0%	7.3%	6.7%	**5.1%**
Total	100.0%	100.0%	100.0%	100.0%	**100.0%**

Source: Research on conditions, needs and problems of small and medium-sized enterprises and entrepreneurs (SMEs) in Serbia in 2013., National Agency for Regional Development, 2013.

Table 2. Need for non-financial types of support-by region

Need for non-financial types of support – by region					
	Belgrade Region	Vojvodina Region	Šumadija and West Serbia	South and East Serbia	**Total SMEs**
Very much needed	20.5%	18.2%	12.5%	12.6%	**16.7%**
Needed, but not necessary	31.8%	35.9%	32.4%	45.5%	**35.4%**
Mostly not needed	22.9%	28.4%	24.2%	22.4%	**24.5%**
Not needed at all	21.1%	11.6%	23.7%	15.3%	**18.3%**
Don't know/no answer	3.7%	5.9%	7.1%	4.1%	**5.1%**
Total	100.0%	100.0%	100.0%	100.0%	**100.0%**

Source: Research on conditions, needs and problems of small and medium-sized enterprises and entrepreneurs (SMEs) in Serbia in 2013., National Agency for Regional Development, 2013.

3.2 Services used

While start ups are mostly focused to the training as a type of non-financial support, developed companies are more using advisory service. Actually, more than half of surveyed enterprises have previously used advisory services, whereas around two fifths have not used them. In relation to the previous year, there was a growth in the use of advisory services (NARD research,2013). This type of support has so far mostly been used by medium-sized enterprises, as well as enterprises from Belgrade.

More than half of women entrepreneurs (56%) have so far used some sort of non-financial support.

Among free services which rise the capacity of human resources in-house, there is a growth in relation to the previous year in the field of marketing / promotion / sales, whereas a drop was recorded in the following services: human resources management, accounting, audit and taxes, financial management and preparation of documents to apply for funds.

As for paid service, in relation to the previous year, there is a growth in used services in the field of legal support, quality control/certification and participation in research and development projects. This services are usually outsourced and not necessarily rise the capacity of in-house human resources. The drop in used services was recorded in the following services: work safety and protection, environmental protection, financial management, production and technology operations, IT, technical testing / maintenance / supervision and PC training.

Of the free of charge programmes, women entrepreneurs most often used consulting for start-ups (38%), then marketing services (26%), business development strategies (24%) and legal services (24%). In case of paid non-financial services, the leading services are accounting, audit and taxes (39%), legal services (31%), and marketing/promotion/sales (39%).

3.3 Interest in non-financial services in the future in Serbia

Entrepreneurs in Serbia show most interest in free use of marketing services (36%) and business development strategy (29%). Women entrepreneurs significantly more than men see the need for PC training (29%) and foreign language courses (28%). Entrepreneurs in Serbia consider accounting, audit and tax assistance the most needed paid services in the future (NARD 2013).
Entrepreneurs were asked also about the importance of the sources of business information relevant for company development. Business entities consider Internet, business partners and colleagues to be the most important sources of information needed for business. In Vojvodina region, enterprises are significantly more informed from accountants / bookkeepers, whereas in Southeast Serbia they use significantly more the information from local self-government / local economic development office. Women entrepreneurs are significantly more than men informed by their friends and family (30%), as well as from TV (24%). Agencies for support to small and medium-sized enterprises are a source for only a fifth of SMEs (19%).

4. CONCLUSION

Serbian entrepreneurs are divided in almost two equal groups according to the attitudes about the importance, sort and usage of non-financial services which refers to training, advisory and consulting as a part of human resources development. While 43% of entrepreneurs claimed that non-financial support mostly is not needed and is not needed at all, more than half is positive toward the usage of non-financial services . Mostly used non-financial services refer to the advisory services and training programs in marketing/sales/promotion, whereas a drop was recorded in the following services: human resources management, accounting, audit and taxes, financial management and preparation of documents to apply for funds. It can be concluded that Serbian enterprises have a developed awareness on the need for non – financial support including the need for constant employee competence development but still the need for financial support prevailed. The lack of financial resources is the most important reason for the insufficient usage of non-financial services. The economic crisis is still affecting the budgets for non-financial services in the region including Serbia, which resulted in the still limited scope of the non-financial services used by enterprises in the region. It especially stands for micro companies which stated that i.e HR development is financed mostly by employees themselves while the share of enterprises that prepare financial and budgeting plans for learning and training investments is more practiced among the medium sized companies. Maybe launch of the voucher system for micro, small and medium sized companies in Serbia could increase

the number of entrepreneurs users of non-financial services since it had good results in other countries in the region and EU, where it was applied. It seems to be the win-win situation as it represents good solution for the government as provider of voucher, as voucher system enables subsides available only for the purpose of training, advisory or some other non-financial support which will contribute to the human resources development in the SMEs and raise their competitiveness.

REFERENCES

Buschfeld, D. Bernadette D., Luisa Sabina H., Kurt S., Eckhard V., Wilke, Maack und partner, 2011: Final report: Identification of future skills needs in micro and craft (-type) enterprises up to 2020, Cologne, Hamburg, Vienna, 2011

EC, Directorate-General for Employment, Social Affairs and Equal Opportunities, 2009: Guide for Training in SMEs, p. 16

Entrepreneurship 2020 Action Plan: Reigniting the entrepreneurial spirit in Europe, COM(2012) 795 final, Brussels, 9.1.2013

Europe 2020: “A strategy for smart, sustainable and inclusive growth” (COM(2010))

Report on SMEE, 2011, Ministry of Finance and Economy, Serbia, 2011.

Research on conditions, needs and problems of small and medium-sized enterprises and entrepreneurs (SMEs) in Serbia in 2013., National Agency for Regional Development, prepared by TNS, Medium, Gallup, November 2013.

SBA Facts sheet 2012, http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/performance-review/files/countries-sheets/2013/serbia_en.pdf

Training needs analysis for SMEs, Western Balkans and Turkey’s experience, SEECEL, 2013.

Watt, D., Kitagawa, K. 2009: Overview report: Workplace Learning in SMEs: Effective Practices for Improving Productivity and Competitiveness, The Conference Board of Canada

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SURVEY ON ENTREPRENEURIAL READINESS: MANAGEMENT VS ENGINEERING STUDENTS IN SERBIA

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Abstract: *This paper presents a study on the entrepreneurial readiness of 113 students from several faculties in Serbia. Research data were collected through the scientifically verified questionnaire. Authors examined the opinions of the students related to the five dimensions of Entrepreneurial readiness (Entrepreneurial intention, Perceived ability, Perceived attractiveness, Learning Orientation, Passion for work). The aim of the study was to determine whether the following characteristics of students have an impact on their entrepreneurial intentions: a) Education (manager, engineer); b) Education in entrepreneurship – through classes at the faculty; c) Entrepreneurial experience in the environment (family) and d) Different socio-demographic characteristics of the students. According to this, authors define nine research questions that are analyzed on a sample of students using statistical analysis (correlation coefficient, T - test and multivariate analysis). The most interesting research question refers to the comparison of two groups of students (1. management education and 2. engineering education) according to their tendency towards entrepreneurship and starting their own business. Based on the analyzed sample of students, the difference between these two groups is statistically proven and shown in this paper, together with all other research results. The presented results can be useful for: a) Educational institutions – in order to create educational programs for youth entrepreneurship support; b) The state – to stimulate entrepreneurial economy among youth, and c) Individuals who would like to examine their entrepreneurial readiness and intentions.*

Keywords*: Entrepreneurship, Entrepreneurial readiness, Entrepreneurial intention, University students in Serbia.*

1. INTRODUCTION

Each entrepreneurial venture which is launched presents the result of the entrepreneurial intentions of individuals or groups. The future success of a business largely depends on the individual's entrepreneurial intentions (future entrepreneurs) and his willingness to "sacrifice" for achieving business objectives. Entrepreneurial intention refers to the intention of setting up the business in the future.

Different authors examine the entrepreneurial intentions and its relation with other factors: De Clercq et al. (2013) examined the effects of learning orientation and passion for work on the entrepreneurial intentions of students; Dinis et al. (2013) and Zampetakis et al. (2011) explored the impact of psychological characteristics of students (creativity and emotional intelligence); Farashah (2013) and Souitaris (2013) examined the impact of entrepreneurship education and training; Lee et al. (2011) showed the influence of work environment and job satisfaction; Nabi et al. (2010) and Zhang et al. (2013) explored the influence of high education. Domestic research on the students' entrepreneurial intentions is conducted by Markov & Mirkov (2006), Markov & Stankovic (2008) and Đorđević et al. (2010).

This paper examines the entrepreneurial intention of students from several faculties in Serbia, through questioning their entrepreneurial readiness. The data were collected by using a questionnaire that is scientifically verified by De Clercq et al. (2013). This questionnaire contains questions about the entrepreneurial intention, perceived ability and attractiveness for entrepreneurship, learning orientation, passion for work and students' characteristics. According to that, we define the following research questions (RQ1-RQ9):

RQ1: Do the students' age predetermine their entrepreneurial readiness?
RQ2: Is there a relationship between the students' grade point average at studies and their entrepreneurial readiness?
RQ3: Does the students' gender predetermine their entrepreneurial readiness?
RQ4: Do the students from the capital city (Belgrade) differ from those who don't live in it, regarding the level of their entrepreneurial readiness?
RQ5: Are the final-year students more prepared for entrepreneurship than the students at the lower years of studies?

RQ6: Do the engineering and management students differ regarding their entrepreneurial readiness?
RQ7: Do the students who have entrepreneurs in their family, or a close environment, have higher level of the entrepreneurial readiness, than those students who do not have family entrepreneurs?
RQ8: Do the students who attended the entrepreneurship course at faculty have higher level of readiness for entrepreneurship?
RQ9: Do the students who have shown a real interest in entrepreneurship (by attending the seminars about entrepreneurship) have a higher level of entrepreneurial readiness?

For answering the previously defined research questions, we use the techniques of statistical inference based on the analysis of the correlation coefficient, t-test and multivariate analysis.

The paper consists of the following sections. After the introduction, Section 2 discusses the topic of entrepreneurship. Section 3 describes the concept of entrepreneurial readiness and presents the factors which, according to various authors, affect the entrepreneurial readiness. Section 4 presents the conducted research on the entrepreneurial readiness of university students in Serbia. Section 5 discusses the results of the research and gives the answers to the posed research questions. Section 6 concludes the paper.

2. ENTREPRENEURSHIP

Entrepreneurship is defined as the process by which individuals follow opportunities without regard to resources they currently control, and as "art of turning an idea into a business" (Beringer & Ireland, 2010, p. 30). Entrepreneurs recognize opportunities (i.e. discover market needs) and turn them into successful businesses (launch new firms to meet those needs) (Hsieh et al., 2007; Moore et al., 2008, p. 6). According to Omerbegović-Bijelović (2010, p. 234), entrepreneurship can be defined as "a social function of creating new values through the creative combination of business resources". Zampetakis et al. (2013) claim that entrepreneurship is linked with the value creation, and has a significant impact on economic growth and employment.

There are two types of entrepreneurship activities (Tang & Koveos, 2004): 1) Venture entrepreneurship, which deals with new venture creation, and 2) Innovation entrepreneurship, which involves innovations within existing enterprises. List of personal characteristics that make some people better at recognizing business opportunities than others are (Beringer & Ireland, 2010, p. 77-79): 1) Prior experience in an industry (which helps entrepreneurs to recognize business opportunities); 2) Cognitive factors (opportunity recognition may be an innate skill or a cognitive process); 3) Social networks (the extent and depth of an individual's social network affects opportunity recognition); 4) Creativity (encourages the process of generating novel or useful ideas).

3. ENTREPRENEURIAL READINESS

One of the most common questions about entrepreneurs is whether entrepreneurs are born or created. This question is based on a myth that some people are genetically predisposed to be entrepreneurs. Two main factors that may affect the initiation of successful business venture are entrepreneurial opportunity and person's tendency towards entrepreneurship. Entrepreneurship opportunity is an auspicious set of circumstances that creates a need for new product, service or business (Beringer & Ireland, 2010, p 66). Souitaris et al. (2007) believe that inspiration for entrepreneurship comes from the emotional chemistry between an individual and particular opportunity (Zampetakis et al., 2013). Person's tendency towards entrepreneurship is defined as an entrepreneurial intention (De Clercq et al., 2013). Entrepreneurial intention refers to the intention of setting up business in the future. In the entrepreneurial context, Thompson (2009, p. 676) defines intention as the "self-acknowledged conviction by a person that they intend to set up a new business venture and consciously plan to do so at some point in the future". Ajzen (1991) states a generic definition of intention as "a person's readiness to perform a given behaviour". This means that the intention and readiness can be considered as synonyms.

In this paper we observe entrepreneurial readiness as a broader concept than entrepreneurial intention. Entrepreneurial readiness is defined as a personal competence and potential for entrepreneurship, which includes entrepreneurial intention as a part. Entrepreneurial intention is considered as existence of personal decision to start a new business at some point of time.

Different types of relationship between entrepreneurial intention and personal and environmental factors are explored in the literature:

- **Entrepreneurial environment**: People with self-employed parents are more likely to become entrepreneurs (Solesvik et al., 2013). The same relationship is proven for those who have entrepreneur acquaintances (Beringer & Ireland, 2010, p. 40).

- **High Education**: According to Nabi et al. (2010), higher education reduces the likelihood of entrepreneurship. Opposite to this, Zhang et al. (2013) state that relationship between high education and entrepreneurship is positive.
- **Entrepreneurial education**: This type of education in childhood and adolescence was confirmed as important for later entrepreneurial intentions (Dinis et al., 2013). Farashah (2013), Solesvik et al. (2013) and Souitaris et al. (2007) showed that there is positive relation between entrepreneurship education and entrepreneurial intention. Farashah (2013) differ tree types of entrepreneurial education: learn to understand entrepreneurship, learn to act in an entrepreneurial way and learn to become an entrepreneur.
- **Personality and psychological factors**: Those are the factors that attract the greatest research attention. The main psychological characteristics associated with entrepreneurial intention, according to Dinis et al. (2013) are: propensity to take risks (has a negative influence on entrepreneurial intentions), self-confidence (has a positive influence on entrepreneurial intentions) and need for achievement (has a positive influence on entrepreneurial intentions). Zampetakis et al. (2013) showed the link between emotional intelligence and students' entrepreneurship attitudes and intentions. In another paper Zampetakis et al. (2011) established the links between individual creativity and entrepreneurial intention of students.
- **Gender**: Lee et al. (2011) and Zhang et al. (2013) showed that women have less desire to start a new business than men.
- **Economic environment:** Entrepreneurial intentions can also depend on external factors such as the existence of an unfavourable economic environment or a lack of regular employment options (De Clercq et al., 2013).
- **Work environment:** Lee et al. (2011) suggest that work environments, with an unfavourable innovation climate and/or lack of technical excellence incentives influence entrepreneurial intentions, through low job satisfaction.
- **Learning orientation and passion for work:** De Clercq et al. (2013) claim that learning orientation and passion for work are not relevant only for formation of entrepreneurial intention, but they support translation of every entrepreneurial feasibility and desirability into entrepreneurial intentions.

In this paper, for collecting data on students' entrepreneurial readiness, we use De Clercq et al.'s (2013) questionnaire. We define Entrepreneurial readiness as a vector which contains five different dimensions: *Entrepreneurial intention* – individual intention to set up business in the future; *Perceived ability* – potential with which people see them capable of becoming successful entrepreneurs; *Perceived attractiveness* – perception of the attractiveness for becoming an entrepreneur*; Learning orientation* – people's tendency to update and expand their knowledge continuously; *Passion for work* - the degree to which people love work-related activities. All questions about these five dimensions of entrepreneurial readiness are given in Table 3.

4. SURVEY ON ENTREPRENEURIAL READINESS OF STUDENTS IN SERBIA

Survey about entrepreneurial readiness was conducted between December 2013 and February 2014. It included 113 students from state and private universities in Serbia. Students responded to two sets of questions. The first set of questions consists of general information about students: gender, age, faculty, year of studies, grade point average at studies, student's living place, information about entrepreneurs in the family, information about having lectures in entrepreneurship and attending entrepreneurship seminars. Table 1 presents general information about the survey sample, while Table 2 presents the categorical variables and frequencies of their values obtained from the survey sample.

Table 1: Structure of the sample

Sampling units	Students from faculties in Serbia
Sample	115 students
Response rate	98% (113 students)
Research technique	Self-administered questionnaire

The second part of the questionnaire included five groups of questions about entrepreneurial readiness, defined through the five dimensions: *Entrepreneurial intention, Perceived ability, Perceived attractiveness, Learning Orientation,* and *Passion for work* (Table 3). All these questions are formulated as statements with five-point Likert-scale answers, from 1 – "completely disagree" to 5 – "completely agree". These questions were interspersed throughout the questionnaire in order to avoid bias in responses. Based on the collected data, we defined nine research questions (RQ1-RQ9) which are presented on Figure 1. Survey results and discussion, and answers to the posed research questions and presented in the next section.

Table 2: Categorical variables and frequencies

Categorical variables (for N = 113) *		Number	Percentage
Gender	Male	46	40,7%
	Female	67	59,3%
Faculty	**State**	**104**	**92%**
	Faculty of Organizational Sciences, University of Belgrade	74	65,5%
	Faculty of Mechanical Engineering, University of Belgrade	8	7,1%
	Faculty of Economics, University of Belgrade	3	2,7%
	Faculty of Electrical Engineering, University of Belgrade	3	2,7%
	Faculty of Technology and Metallurgy, University of Belgrade	3	2,7%
	Faculty of Architecture, University of Belgrade	2	1,8%
	Faculty of Dramatic Arts, University of Belgrade	2	1,8%
	Others	9	8,1%
	Private	**9**	**8%**
	Faculty of Culture and Media, Megatrend University	1	0,9%
	Graduate School of Business Studies, Megatrend University	4	3,5%
	School of computing, Union University	2	1,8%
	Faculty of Business, Singidunum University	2	1,8%
Education	Management	43	38,1%
	Arts and Humanities Science	3	2,7%
	Engineering	67	59,3%
Year of studies	First	2	1,8%
	Second	18	15,9%
	Third	33	29,2%
	Fourth	47	41,6%
	Master	11	9,7%
	Graduated	2	1,8%
Living place	The Capital city (Belgrade)	68	60,2%
	Outside of the Capital city (Non-Belgrade)	45	39,8%
Entrepreneurs in family	Yes	36	31,9%
	No	77	68,1%
Entrepreneurship education	Yes	20	18,2%
	No	90	81,8%
Entrepreneurship seminar	Yes	52	46 %
	No	61	54 %
* The number of respondents who answered the questions			

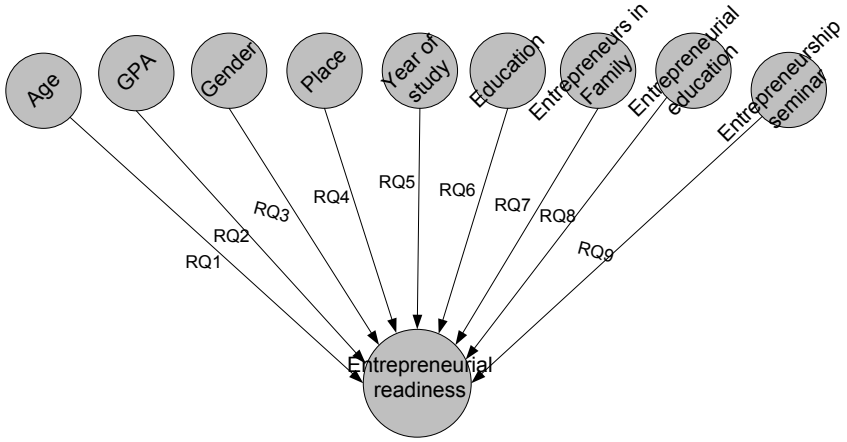

Figure 1: Research questions - relationships between students' characteristics and entrepreneurial readiness

5. SURVEY RESULTS AND DISCUSSION

Survey data were statistically analysed using the "PASW Statistics - SPSS 18" statistical software. Table 3 shows the descriptive statistics of scale variables (five dimensions of entrepreneurial readiness) from the second part of the questionnaire.

Table 3: Scale variables and descriptive statistics

Variables	Mean	Std. deviation
Age (N=113)	21,98	1,685
Grade point average (GPA) (N=109)	8,524	0,806
Entrepreneurial readiness:	**3,73**	**0,632**
Entrepreneurial intention (Likert scale 1-5):	**3,23**	**1,099**
I am likely to start my own business soon.	3,32	1,054
I have been preparing to start my own business.	3,14	1,238
Perceived ability (Likert scale 1-5):	**3,34**	**0,917**
It is highly feasible that I could start my own business.	3,03	1,022
I feel certain that I would be able to start my own business if I wished to do so.	3,65	1,024
Perceived attractiveness (Likert scale 1-5):	**3,80**	**1,114**
I have a strong desire to start my own business.	3,80	1,189
I feel a strong urge to become self-employed. My overall wish is to have my own business.	3,81	1,151
Learning orientation (Likert scale 1-5):	**4,41**	**0,476**
I often read materials (articles, internet, books, etc.) to improve my abilities.	4,42	0,729
I often look for opportunities to develop new skills and knowledge.	4,50	0,709
For me, developing my abilities is important enough to take risks.	4,25	0,829
I enjoy challenging and difficult tasks through which I can learn new skills.	4,41	0,650
I prefer to work in situations that require a high level of ability and talent.	4,42	0,624
I like to take on a challenging task from which I can learn a lot.	4,50	0,614
Passion for work (Likert scale 1-5):	**3,90**	**0,546**
I derive most of my life satisfaction from working hard. I love to work hard.	4,15	0,759
I accomplish a lot because I love to work hard.	4,19	0,739
Sometimes I wish that I could be working harder when I am not.	3,86	1,068
I look forward to returning to work when I am away from it.	3,41	1,023

From the table 3, it can be seen that Entrepreneurial readiness mean is 3.73. Within that, the mean values of the five dimensions are as follows: Entrepreneurial intention (3.23); Perceived ability (3.34); Perceived attractiveness (3.80); Learning orientation (4.41); Passion for work (3.90). Total value of Entrepreneurial readiness is calculated as average value of previously listed five dimensions, i.e. all dimensions have equal weights. Consideration of different weights among dimensions can be the subject of the future work.

Before comparing different groups of students (which is defined in research questions), we need to verify the reliability of measurement scale, which we use for measuring the vector Entrepreneurial readiness. For this purpose, we use *Cronbah's Alpha coefficient* and average inter-correlation between five dimensions of entrepreneurial readiness. These results are obtained using reliability analysis in the SPSS. For five dimensions, *Cronbah's Alpha* = 0.78. The reliability criterion is satisfied, because *Cronbah's Alpha*, according to DeVellis (2011), needs to be higher than 0.7. Another way to measure reliability of measurement scale is with inter-item correlation. According to Briggs & Cheek (1986), this value needs to be between 0.2 and 0.4 as an optimal range between the items-correlation on the measurement scale. In our case this condition is also satisfied, because inter-item correlation equals 0.39.

Also, before answering the research questions, it is necessary to present the correlation table (Table 4) which shows the correlations between dimensions of entrepreneurial readiness. Table 4 shows that, compared with entrepreneurial readiness, entrepreneurial intention, perceived attractiveness and perceived ability have large correlation coefficients (0.896; 0.880 and 0.795, respectively), learning orientation has medium correlation (0.577), while passion for work has small correlation (0.378). All correlation coefficients are statistically significant at the level 0.01 or 0.05.

Table 4: Pearson's correlation coefficient among variables

Variables:	**(ER)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
(ER) Entrepreneurial readiness	1	0.896**	0.795**	0.880**	0.577**	0.378**
(1) Entrepreneurial intention	0.896**	1	0.619**	0.804**	0.449**	0.146
(2) Perceived ability	0.795**	0.619**	1	0.611**	0.327**	0.191*
(3) Perceived attractiveness	0.880**	0.804**	0.611**	1	0.349**	0.124
(4) Learning orientation	0.577**	0.449**	0.327**	0.349**	1	0.338**
(5) Passion for work	0.378**	0.146	0.191*	0.124	0.338**	1
**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).						

Next analysis (Tables 5-7) provides the answers to the research questions (RQ1-RQ9). First two research questions are analyzed using the Pearson's correlation coefficient.

RQ1: *Do the students' age predetermine their entrepreneurial readiness?*
Regarding the value of correlation coefficients from Table 5, it is not possible to prove the existence of this relation (students' age and their entrepreneurial readiness), because correlation coefficients are not statistically significant and are very close to zero.

RQ2: *Is there a relationship between the students' grade point average at studies (GPA) and their entrepreneurial readiness?*
Based on the results presented in Table 5, statistically significant correlation between the grade point average and the entrepreneurial readiness is not obtained. Therefore, the relation is not proven. It is very interesting to notice that GPA is not in correlation with learning orientation (correlation coefficient equals 0.067).

Table 5: Correlation coefficient and t-test: Entrepreneurial readiness and students' age, GPA and gender

Variables:	**Correlation Coefficient**		**Mean values (T-test)**	
			Gender	
	Age	**GPA**	**Male** N = 46	**Female** N = 67
(ER) Entrepreneurial readiness	- 0.007	- 0.120	3,86	3,64
(1) Entrepreneurial intention	0.053	- 0.110	3,59* ~	2,98* ~
(2) Perceived ability	- 0.057	- 0.202*	3,53	3,21
(3) Perceived attractiveness	- 0.094	- 0.168	4,01	3,66
(4) Learning orientation	0.078	0.067	4,42	4,41
(5) Passion for work	0.037	0.036	3,83	3,95
Correlation coefficient and stat. significance	** 0.01 level (2-tailed); * 0.05 level (2-tailed).			
T-test stat. significance and eta square value	* p<0,05 (T - test); ~ 0,06-0,07 (middle effect size);			

Next group of research questions (RQ3-RQ9) are analysed using the T-test.

RQ3: *Does the students' gender predetermine their entrepreneurial readiness?*
Based on the results in Table 5, there is statistically significant difference (p<0.05) between male and female students, regarding their attitudes towards entrepreneurial intention. This difference has the middle effect size (eta square: 0.06-0.07). However, the existence of relation between students' gender and their entrepreneurial readiness is not proven, since the mean values of two groups (male, female) do not differ significantly.

RQ4: *Do the students from the capital city (Belgrade) differ from those who don't live there (non-Belgrade students), regarding the level of their entrepreneurial readiness?*
We ask this research question because Belgrade, as the capital city and the most developed part of Serbia, gives more challenges for setting up business. According to the results presented in Table 6, there is no statistically significant difference between these two groups (Belgrade, Non-Belgrade students), regarding their entrepreneurial readiness.

Table 6: Mean values of students' ER by categorical variables: living place, study year, education

Variables and mean value	**Living place**		**Study year**		**Education**	
	Bgd N = 68	**Non-Bgd** N = 45	**F** N = 60	**Non F** N = 53	**Managers** N = 43	**Engineers** N = 67
(ER) Entrepreneurial readiness	3.77	3.67	3,63	3,85	3,98**°	3,53**°
(1) Entrepreneurial intention	3.37	3.01	3,13	3,35	3,56**~	2,98**~
(2) Perceived ability	3.43	3.20	3,18* ¬	3,53* ¬	3,58*~	3,15*~
(3) Perceived attractiveness	3.85	3.72	3,54** ~	4,10** ~	4,21**•	3,50**•
(4) Learning orientation	4.38	4.46	4,40	4,43	4,53*~	4,32*~
(5) Passion for work	3.88	3.93	3,90	3,89	4,02*¬	3,79*¬
Stat. significance:	* p<0,05 (T - test); ** p<0,01 (T - test)					
Eta square:	° 0,12-0,13 (large effect size); • 0,09-0,10 (medium-large effect size); ~ 0,05-0,07 (medium effect size); ¬ 0,03-0,04 (small effect size).					

RQ5: *Are the final-year students more prepared for entrepreneurship than the students at the lower years of studies?*
We ask this question based on the assumption that final-year students, who passed more exams, think more about their future employment, so they could have higher level of readiness for self-employment, i.e.

entrepreneurship. Unlike them, students at earlier years of studies are more oriented towards passing exams. Two groups of students were analysed (Table 6). The first group (F) consists of students that are close to finishing studies (4th year of studies or master studies). Second group (Non-F) consists of students that are not close to finishing studies (3rd, 2nd or 1st year of studies). These two groups are compared in terms of their entrepreneurial readiness. Regarding the results in Table 6, it is noticed that there isn't a statistically significant difference between two groups (F, Non-F), in terms of entrepreneurial readiness. If we consider all five dimensions, there is a difference in perceived ability ($p<0.05$) and perceived attractiveness ($p<0.01$) of entrepreneurship.

RQ6: *Do the engineering and management students differ regarding their entrepreneurial readiness?*

In the survey sample there are two large groups of students (Table 2): students with management education (Faculty of Organizational Sciences – management department, Faculty of Economics, Faculty of Business, etc.) and students with engineering education (Faculty of Organizational Sciences – department for information technology, Faculty of Mechanical Engineering, Faculty of Electrical Engineering, Faculty of Technology and Metallurgy, School of computing, etc.). These two groups are compared in terms of their entrepreneurial readiness for all five dimensions. The results of t-test (Table 7) show a statistically significant difference between the students of management and students of engineering, regarding the readiness for entrepreneurship. Actually, students from management faculties have higher entrepreneurial readiness than students from engineering faculties (difference between mean values is $\Delta 0.45$; $p<0.01$). If we compare these groups through all five dimensions, the differences in favour of management students are: entrepreneurial intention ($\Delta 0.58$); perceived ability ($\Delta 0.43$); perceived attractiveness ($\Delta 0.71$); learning orientation ($\Delta 0.21$); passion for work ($\Delta 0.23$). Large difference is present regarding perceived attractiveness and entrepreneurial intention, while small difference regarding the learning orientation and passion for work.

Table 7: Mean values of students' ER by categorical variables: entrepreneurs in family, subject entrepreneurship and seminar in entrepreneurship

Variables and mean value	Entrepreneurs in Family		Subject Entrepreneurship		Entrepreneurship seminar	
	Yes N = 36	**No** N = 77	**Yes** N = 20	**No** N = 90	**Yes** N = 52	**No** N = 21
(ER) Entrepreneurial readiness	3,88	3,66	3,80	3,71	4,07** °	3,45** °
(1) Entrepreneurial intention	3,50♦¬	3,10♦¬	3,55	3,15	3,78** °	2,76** °
(2) Perceived ability	3,67**~	3,19**~	3,32	3,35	3,69** °	3,04** °
(3) Perceived attractiveness	4,00	3,71	4,03	3,74	4,29** °	3,38** °
(4) Learning orientation	4,43	4,40	4,47	4,39	4,59** °	4,26** °
(5) Passion for work	3,87	3,92	3,84	3,93	4,02* ¬	3,80* ¬
Stat. significance:	** p<0,01 (T - test); * p<0,05 (T - test); ♦ p<0,08 (T - test).					
Eta square:	° 0,12-0,13 (large effect size); • 0,09-0,10 (medium-large effect size); ~ 0,05-0,07 (medium effect size); ¬ 0,03-0,04 (small effect size).					

RQ7: *Do the students who have entrepreneurs in their family, or a close environment, have higher level of the entrepreneurial readiness, than those students who do not have family entrepreneurs?*

Students in the survey were asked whether they have entrepreneurs in their family or close environment. Based on the response, students are divided into two groups and analysed. Results in Table 7 show that there is no statistically significant difference in readiness for entrepreneurship. The only difference ($p<0.01$) is noticed in perceived ability for entrepreneurship.

RQ8: *Do the students who attended the entrepreneurship course at faculty have higher level of readiness for entrepreneurship?*

In our survey, students were asked if they attended entrepreneurship course at faculty within their studies. Based on the answers, two groups were generated (students who had lectures in entrepreneurship and those who did not). The comparison of the groups (Table 7) did not show statistically significant result. There was a difference in terms of entrepreneurial intention ($\Delta 0.40$) and perceived attractiveness ($\Delta 0.29$), but not statistically significant because of unequal size of groups. This result may indicate to the existence of effect of the entrepreneurship education on entrepreneurial intentions and attractiveness towards entrepreneurship as a profession. However, existence of this relation could not be proven with our survey sample.

RQ9: *Do the students who have shown a real interest in entrepreneurship (by attending the seminars about entrepreneurship) have a higher level of entrepreneurial readiness?*

In our survey we questioned students during the seminar: "Academy of Modern Management – Entrepreneurship and Start-up" that was organized by student's organization ESTIEM LG Belgrade. The students, who attended this seminar, expressed real interest in entrepreneurship, so we wanted to examine and compare this group of students with students who didn't attend the seminar. The results are presented in

Table 7. Students who attended entrepreneurship seminar have higher level of entrepreneurial readiness (difference between mean values is ∆0.62; p<0.01). The difference between groups regarding five dimensions are: entrepreneurial intention (∆1.02), perceived ability (∆0.65), perceived attractiveness (∆0.91), learning orientation (∆0.33) and passion for work (∆0.22). These results show that students who express interest in entrepreneurship and attended entrepreneurship seminar differ from other students, regarding their entrepreneurial readiness.

The most interesting research question - RQ6 was also analysed using multivariate analysis (MANOVA) in order to further explore the statistically significant differences between entrepreneurial readiness between students of management and engineering, through the linear combinations of the five dimensions (entrepreneurial intention, perceived ability, perceived attractiveness, learning orientation, passion for work). The necessary conditions for the implementation of the MANOVA, at the sample size of 113 respondents are:
1) Multivariate normality: The essence of this analysis is to check the extreme points in respondents' answers (answers which mostly differ from the average answers) using Mahalanobis distance (the distance of a particular case – respondent's answer – from the centroid of other cases). Centroid is the point in n-dimensional space, whose dimensions are the mean values of all variables in considered cases, i.e. respondent's answers. In our case, this is a point whose dimensions are average values of the five variables, i.e. dimensions that form the vector entrepreneurial readiness. Mahalanobis distance value is 12.788 (generated by the SPSS), which is not higher than the critical value for the model of five variables (which equals 20.52). This means that the assumption of the multivariate normality is proven.
2) Homogeneity of variance and covariance: This assumption is proven because the values of statistical significance obtained in *Box's test of equality of covariance matrices* and *Levene's test of equality of error variances* is greater than 0.05 (which means that variances of five dimensions don't differ in the survey sample; the same is with the covariances).

After applying the MANOVA, statistically significant difference between the students of management and engineering is determined, regarding combinations of the five dimensions of the vector entrepreneurial readiness*: F (5,103) = 3.24, p = 0.009, Wilks' lambda = 0.87, partial eta squared = 0.136 (representing large effect size).* When these two groups of students are compared using the considered dimensions separately (entrepreneurial intention, perceived ability, perceived attractiveness, learning orientation and passion for work), statistically significant differences ($p < 0.01$) are determined only for the following three dimensions: Entrepreneurial intention: *F(1,107) = 8.425, p = 0.004, partial eta squared = 0.073 (representing medium effect size)*; Perceived ability: *F(1,107) = 7.421, p = 0.008, partial eta squared = 0.065 (representing medium effect size)*; and Perceived attractiveness: *F(1,107) = 11.431, p = 0.001, Partial eta squared = 0.097 (representing medium-large effect size)*. Dimension with the greatest impact on the observed groups of students is perceived attractiveness. Statistically significant difference between the students of management and engineering is not obtained for the dimensions learning orientation and passion for work.

6. CONCLUSION

In this paper the authors analyse entrepreneurial readiness of university students in Serbia. The survey was inspired with the study conducted by De Clercq et al. (2013). The idea was to compare different groups of students in order to make relationship between entrepreneurial readiness and different characteristics of students. The questioned characteristics of students were: gender, age, year of studies, living place, grade point average at studies, educational profile (management or engineering), entrepreneurial environment (in terms of having entrepreneurs in the family), entrepreneurial education (in terms of entrepreneurship lectures at studies and attending entrepreneurship seminars). All these variables are considered in the research questions (RQ1-RQ9), which were analyzed using different statistical methods (correlation coefficients, T-test, Multivariate analysis). The most interesting research question was: *Do the engineering and management students differ regarding their entrepreneurial readiness?* It is shown that students of management have grater entrepreneurial readiness than students of engineering. This result can help as an evidence for promoting Entrepreneurship among students at technical and engineering faculties, because it is well-know that the greatest innovations in industry come from engineers. Therefore, it is particularly important to stimulate youth entrepreneurship and teach creative and innovative engineering students how to venture new businesses based on their ideas. This can lead to the economic development of every country. The limitation of this paper is reflected in the small sample of students from several faculties who participated in this survey. In the future, the authors intend to spread the survey by increasing the sample of students (through questioning students from more universities in the country and abroad). The authors also desire to create and apply other interesting research methods and techniques (questionnaires) which can be used for measuring students' entrepreneurial readiness, intention and mindset.

REFERENCES

Ajzen, I. (1991). The theory of planned behaviour. *Organizational behaviour and human decision processes*, *50*(2), 179-211.

Barringer, B. R., & Ireland, R. D. (2010). *Entrepreneurship: Successfully launching new ventures*. 3th edition, Pearson Education, Upper Saddle River, New Yersey, ISBN: 978-0-13-8155808-8

Briggs, S. R., & Cheek, J. M. (1986). The role of factor analysis in the development and evaluation of personality scales. *Journal of personality*, 54(1), 106-148.

De Clercq, D., Honig, B., & Martin, B. (2013). The roles of learning orientation and passion for work in the formation of entrepreneurial intention. *International Small Business Journal*, 31(6), 652-676.

DeVellis, R. F. (2011). Scale development: Theory and applications (Vol. 26). Sage Publications

Dinis, A., Paço, A. F., Ferreira, J., Raposo, M., & Rodrigues, R. G. (2013). Psychological characteristics and entrepreneurial intentions among secondary students. *Education+ Training*, 55(8/9), 763-780.

Đorđević, D., Ćoćkalo, D., & Bogetić, S. (2010). The Youth's Enterprising Behaviour –The Research Results From Serbia. *Economic Themes*, *48*(3) 467-479.

Farashah, A. D. (2013). The process of impact of entrepreneurship education and training on entrepreneurship perception and intention: Study of educational system of Iran. *Education+ Training*, 55(8/9), 868-885.

Hsieh, C., Nickerson, J. A., & Zenger, T. R. (2007). Opportunity discovery, problem solving and a theory of the entrepreneurial firm. *Journal of Management Studies*, 44(7), 1255-1277.

Lee, L., Wong, P., Foo, M., & Leung, A. (2011). Entrepreneurial intentions: the influence of organizational and individual factors. *Journal of Business Venturing*, 26(1), 124-136.

Nabi, G., Holden, R., & Walmsley, A. (2010). Entrepreneurial intentions among students: towards a re-focused research agenda. *Journal of Small Business and Enterprise Development*, 17(4), 537-551.

Markov, S., & Mirkov, S. (2006). Entrepreneurial aspirations of students in Vojvodina. Proceedings: "Social capital and social integration" (in Serbian language) 433-453, Faculty of Philosophy, Novi Sad.

Markov, S., & Stanković, F. (2008). University environment and entrepreneurial aspirations of students Monograph: "University and entrepreneurship" (in Serbian language), 73-113, Novi Sad.

Moore, C.V., Petty, J.W., Palich, L.E., & Longenecker, J.G. (2008). Managing Small Business: An Entrepreneurial Emphasis, International Edition, 14th Edition, Cengage Learning.

Omerbegović-Bijelović, J. (2010). Basics of Operations management. University of Belgrade - Faculty of Organizational Sciences.

Solesvik, M., Westhead, P., Matlay, H., & Parsyak, V. N. (2013). Entrepreneurial assets and mindsets: benefit from university entrepreneurship education investment. *Education + Training*, 55(8/9), 748-762.

Souitaris, V., Zerbinati, S., & Al-Laham, A. (2007). Do entrepreneurship programmes raise entrepreneurial intention of science and engineering students? The effect of learning, inspiration and resources. *Journal of Business Venturing*, 22(4), 566-591.

Tang, L., & Koveos, P. E. (2004). Venture entrepreneurship, innovation entrepreneurship, and economic growth. *Journal of Developmental Entrepreneurship*, 9(2), 161-171.

Thompson, E. R. (2009). Individual entrepreneurial intent: Construct clarification and development of an internationally reliable metric. *Entrepreneurship Theory and Practice*, 33(3), 669-694.

Zampetakis, L. A., Gotsi, M., Andriopoulos, C., & Moustakis, V. (2011). Creativity and entrepreneurial intention in young people Empirical insights from business school students. *The International Journal of Entrepreneurship and Innovation*, *12*(3), 189-199.

Zampetakis, L. A., Kafetsios, K., & Moustakis, V. (2013). The role of students' anticipated emotions in enterpreneurial intentions, IX Symposium of business and academics – SPIN 2013, 5-6 November, Belgrade, Serbia, 179-188.

Zhang, Y., Duijsters, G., & Cloodt, M. (2013). The role of entrepreneurship education as a predictor of university students' entrepreneurial intention. *International Entrepreneurship and Management Journal*. DOI: 10.1007/s11365-012-0246-z.

ENTREPRENEURIAL MODEL OF FRANCHISING

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Abstract: *In contemporary conditions franchising experiences expansion and continued growth as a business model. The paper explains the entrepreneurial model of franchising, according to the coherence of the concepts of entrepreneurship and franchising. Based on the definitions of entrepreneurship and its applicability to the franchise concept, it is pointed out that the concept of franchising is almost fully compatible with the concept of entrepreneurship. The aim of this paper is to stress the relationship between the concept of entrepreneurship and concept of franchising, and to explain the theoretical model of entrepreneurial behavior in the franchising system. The theoretical model of entrepreneurial behavior that is exhibited in the paper shows that the maximization of franchisee entrepreneurial behavior can be achieved through the use of the franchisee networks. Through networks and entrepreneurial behavior, franchisees create new value in terms of business growth and entrepreneurial initiatives adaptation, achieve market leadership and solve business problems.*

Key words*: franchising, entrepreneurship, franchisor, franchisee, entrepreneurial behavior*

1. INTRODUCTION

Modern trends indicate the growing importance of the entrepreneurial model of franchising. As an organizational form, franchising is widely recognized as an important growth driver of entrepreneurship, mainly through customization of products to the needs of geographically dispersed customers. The essence of franchising are standardization and uniformity. However, under conditions of more intense generation of new ideas and innovations, participants in franchise systems are increasingly turning to entrepreneurial behavior. In the past, studies about franchising were based on the franchisor's attitudes and interests, while recent studies emphasize the importance of integration of both sides of the franchise system. The aim of this paper is to highlight the importance of connection between entrepreneurship and franchising and to explain the theoretical model for maximizing franchisee entrepreneurial behavior. In the first part of the paper, the relationship between entrepreneurship and franchising is explained, giving the definition of entrepreneurship and identifying ways to apply these definitions to the franchising concept. The second part refers to the analysis of franchisors and franchisees as entrepreneurs and their franchise relationship as entrepreneurial partnership in which franchisor's innovative concept is distributed to the market through a network of franchised units. The third part presents a theoretical model of entrepreneurial behavior that indicates the possibility of maximizing the enterpreneurial behavior through the use of formal franchisee networks. These networks primarily include mutual learning and exchange of information between members of a franchise system. Based on a comprehensive analysis of available literature, relevant conclusions will be presented.

2. RELATIONSHIP BETWEEN ENTREPRENEURSHIP AND FRANCHISING

Franchising is an area that is still insufficiently researched by scholars and business professionals. In fact, franchising surveys have fairly short history, considering that the oldest known and most widely cited studies dating back to the late 1960s. Over the past two decades, franchising experienced expansion and continuous growth which is largely stimulated by the emergence of new forms of franchising in new areas, ranging from hotels, restaurants, real estate, to the education of children, beauty salons etc. (Grunhagen & Mittelstaedt, 2005). Franchising can be seen as a commercial relationship in which one party (franchisor) allows the another (franchisee) to clone a proven business system with payment of fee, which varies depending on the sector (Stefanović & Stanković, 2013). In fact, it can be said that franchising offers a combination of franchisor's economies of scale and franchisee's flexibility to exploit local market opportunities (Watson & Kirby, 2004). A successful franchising system entails the benefits for both franchisors and franchisees. Franchisor benefits from some franchisee's resources such as specific local knowledge, while franchisees benefit from franchisor's assets including brand, organizational routines, managerial inputs etc. Therefore, franchising can be seen as a form of intercompany cooperation in which two types of entrepreneurs share the tangible and intangible resources in order to increase performances (Chirico, Ireland & Sirmon, 2011).

In business studies, franchising is mainly viewed from the standpoint of marketing and trade as a form of international business and from the standpoint of management as a form of organization, strategy and cooperation between enterprises. Earlier studies on the franchising were largely isolated, insufficiently integrated and too relied on one side, the franchisor (Elango & Fried, 1997). In modern researches, it is emphasized that franchising creates entrepreneurial opportunities for both sides of the franchise relationship (Combs, Ketchen, Shook & Short, 2011). Correlation between franchising and entrepreneurship can be justified by the fact that franchising research is, in fact, research on entrepreneurial cooperation between the two different types of entrepreneurs, franchisors and franchisees. In addition, franchising can be defined as a type of entrepreneurial organization (Hoy & Shane, 1998). Franchisor's operations (for example, establishing a franchise system), as well as franchisee's operations (for example, implementation of entrepreneurship model within a franchise chain) are entrepreneurial activities. It is necessary to point out the significant overlaps of entrepreneurship and franchising into 7 main approaches dominant in entrepreneurship researches (Hoy & Shane, 1998):

1) Incubator organization. Franchising systems act as incubators for new ventures and franchising operations.
2) Business plans. The franchisor requires from franchisees to have a business plan. In the United States, franchisors are required to prepare a "public business plan" to ensure access to information for potential franchisees.
3) Investment criteria. Franchising is a source of capital necessary for growth when other sources of funding are not available to the franchisor.
4) Success factors. Failure and survival of franchisors and franchisees are subjects of continuous researches. The objective is to compare the results on the causes of failure and survival of franchise company with respect to the independent company.
5) Corridor principle. Franchisors recruit potential franchisees among active entrepreneurs. In addition, franchisors often have worked as entrepreneurs or business managers before starting the franchise.
6) Corporate culture. In franchising, the franchisor must be able to establish and maintain conditions in which new franchisees have units and manage them independently (franchise units), or together with the franchisor (units owned by the company, double-distribution).
7) Life cycle models. In franchising, the key issue is to understand the birth of a business organization and its subsequent evolution in the franchising system.

When analyzing the relationship between franchising and entrepreneurship and their research domain, we begin by categorizing the focus of various representative definitions of entrepreneurship. These definitions can be classified into 3 groups: definitions which emphasize personal characteristics or qualities of entrepreneurs, definitions that emphasize the entrepreneurial process and definitions focused on entrepreneurial activities. Examples of these definitions are given below and are summarized in Table 1 (Kaufmann & Dant, 1999). Definitions that emphasize the personal perspective of personal characteristics are as follows:

- Entrepreneur is an individual who possesses qualities of risk-taking, leadership, motivation, and the ability to resolve crises (Leibenstein, 1968).
- Entrepreneurs are leaders and major contributors to the process of creative destruction (Schumpeter, 1942).
- Entrepreneur is an individual who undertakes uncertain investments and possesses an unusually low level of uncertainty aversion (Knight, 1921).

Successful entrepreneurs are characterized by qualities such as creativity, adaptability, vision, leadership, managerial and organizational skills, quick decision making, rapid response to changing and uncertain environment, personal integrity and education. Taking into account the perspective of the entrepreneurial process, the concept of entrepreneurship can be defined as follows:

- Entrepreneurship is the creation of new organizations (Gartner, 1985).
- Entrepreneurship is the process of extracting profits from new, unique, and valuable combinations of resources (ambiguous in an uncertain and ambiguous environment (Amit, Glosten & Muller, 1993).

From the perspective of entrepreneurial activity, some of the definitions of entrepreneurship are as follows:

- Entrepreneurship is the purposeful activity to initiate, maintain, and develop a profit-oriented business (Cole, 1968).
- Entrepreneurs perceive profit opportunities and initiate actions to fill currently unsatisfied needs or to do more efficiently what is already being done (Kirzner, 1985).

Table 1. gives an overview of definitions of entrepreneurship and their applicability to the franchise concept. Based on the conducted comparisons it can be concluded that the concept of franchising is almost fully compatible with the concept of entrepreneurship.

Table 1: Definitions of entrepreneurship and their applicability to the franchising context

Definitions of entrepreneurship	Application to franchisors	Application to franchisees
Entrepreneur is an individual who possesses qualities of risk-taking, leadership, motivation, and the ability to resolve crises (Liebenstein 1968)	Yes	Yes
Entrepreneurs are leaders and major contributors to the process of creative destruction (Schumpeter 1942)	Yes	No
Entrepreneur is an individual who undertakes uncertain investments and possesses an unusually low level of uncertainty aversion (Knight 1921)	Yes	Yes
Entrepreneurship is the creation of new organizations (Gartner 1985)	Yes	Yes
Entrepreneurship is the process of extracting profits from new, unique, and valuable combinations of resources (ambiguous in an uncertain and ambiguous environment (Amit Glosten and Muller 1993)	Yes	Yes
Entrepreneurship is the purposeful activity to initiate, maintain, and develop a profit-oriented business (Cole 1968)	Yes	Yes
Entrepreneurs perceive profit opportunities and initiate actions to fill currently unsatisfied needs or to do more efficiently what is already being done (Kirzner 1985)	Yes	Yes

Source: Kaufmann, P., Dant, R. (1999), „Franchising and the domain of enterpreneurship research“, *Journal of Business Venturing*, Vol. 14, pp. 5–16.

3. FRANCHISOR AND FRANCHISEES AS ENTREPRENEURS

Through the reproduction of successful business concept in new market areas, franchising contributes to the efficient dissemination of innovation. Franchising offers a unique and fertile environment for future studies in entrepreneurship: the franchisor as an entrepreneur, franchisee as an entrepreneur, and franchise relationship as an entrepreneurial partnership. In fact, franchising is based on entrepreneurial partnership, where franchisor's innovative concept is distributed to the market through a network of franchised units operated by local franchisees. In the economic literature, there are two unique models that offer an explanation of the entrepreneurial model of franchising. The first model is the model of capital acquisition that suggests that franchisees are efficient source of financial capital for companies that want to expand on new markets (Dant, 1995). While franchisor's risk relates to the risk of brand development, franchisee's risk refers to the development of local markets. Very often, franchisee is more familiar with the local markets and their potential than franchisor. Also, since franchisors often depend on franchisees' local expertise and contacts, franchisees are encouraged to make appropriate marketing programs for specific markets. Another model is based on the agency theory. Franchising solves the problem that occurs because the franchisor can not monitor very widespread network of franchise units directly and effectively. Therefore, franchisees can generate profit in exchange for an appropriate fee, which provide incentives for both contractual parties. In this case, it is a quasi-independence which allows franchisees to qualify as entrepreneurs. Franchisees have to be proactive in exploiting local opportunities. Franchising literature suggests that franchisors and franchisees may have a lot in common, although they are partners with very different roles (Kaufmann & Stanworth, 1995).

Entrepreneurs can be divided into two groups based on the nature of the business idea: innovative and imitative entrepreneurs (Aldrich & Martinez, 2007). In the franchise system, franchisor can be seen as an innovative and franchisees are specified as imitative entrepreneurs. Thus, the role of the entrepreneur is primarily related to the franchisor, while franchisees generally work under the disciplined system of contractual obligations (Clarkin & Rosa, 2005). Individual roles and responsibilities in the franchise system are explicitly defined in the detailed contract documents. Providers, owners and creators of franchise concepts are widely accepted as entrepreneurs in accordance with the risk they take and innovative profile that is similar to individual entrepreneurs. It is pointed out that the franchisor may be considered as entrepreneur only if he/she enter the market with an innovative idea. Creating a franchise system can be viewed as an entrepreneurial growth strategy (Fillion, 1998).

In contrast, franchisees are often seen as the opposite of the entrepreneurs, since they only follow the model developed by the franchisor and lose the independence that is associated with entrepreneurship (Hoy, 2008). In fact, it is considered that franchisees have little or no role in the creation of innovative business

processes. They operate within the uniformed organizations focused on efficent production (Morgan, 1997). Franchisees only purchase the right to implement a franchise concept, often in a predetermined area in a very proper manner and only for a certain period of time. This role is traditionally associated with the manager, rather than the entrepreneur. Franchise agreements, made by the franchisor, include prescribed and restrictive provisions, leaving little or no room for franchisee's entrepreneurial creativity. These contracts are often unchangeable and they are usually offered to franchisees on a "take it or leave it" basis (Clarkin & Rosa, 2005). Replication and standardization, as a symbols of success within the franchise system, are in the sharp contrast to the creativity and innovation that are associated with entrepreneurship. Franchisor can prevent franchisees to deviate too much from the prescribed business formula through proper control systems (Phan, Butler & Lee, 1996). For this and many other reasons, the relationship between franchisor and franchisee is often seen as the relationship between innovators/entrepreneurs and implementers/managers. From the organizational perspective, franchising companies are generally understood as hybrid organizational form (Shane, 1996).

However, a systematic review of opportunities for entrepreneurship in the context of franchising is reasonable, primarily because franchisees take risks in their business ventures. While franchisors risk their resources during the development of the brand, franchisees risk their resources when developing local markets. In addition, franchisees can be considered as entrepreneurs because they invest their own capital in the business through fees paid to the franchisor (Ketchen, Short & Combs, 2011). Franchisees are also often seen as entrepreneurs because they have entrepreneurial profile and they are innovators in the franchising system, as they can provide the initiative for the improvement and introduction of new products with franchisor's agreement (Grunhagen & Mettelstaedt, 2005). For example, McDonald's has a number of new products developed by franchisees, including the Big Mac, Filet-O-Fish and Egg McMuffin (Morrison & Lashley, 2003). Franchisees transform existing and develop new market offers and create solutions to problems in the whole system by their efforts for local adaptation (Kaufmann & Eroglu, 1998). In many systems, franchisees stimulate innovative ideas and their proximity to clients provides better opportunities to recognize customer's needs (Burkle & Posselt, 2008). Despite evidence that franchisees can take an entrepreneurial role, it is necessary to point out how to maximize entrepreneurial behavior without compromising standardization and uniformity of franchising system.

4. THEORETICAL MODEL OF ENTREPRENEURIAL BEHAVIOR

Franchising is designed in the manner that it refers to equally replication of standardized business format throughout the entire system, which leads to many controversies about how entrepreneurial behavior can prosper in this organizational form. Standardization involves development of working patterns which are constantly applied and participants in franchising concept consistently adhere to them to minimize the difference in business (Gilson, Mathieu, Shalley & Ruddy, 2005). Franchising business model improves efficiency and enables economies of scale that allows both the franchisor and franchisees to minimize costs. In addition, franchise units share a common identity and operate under the common trade mark (Bradach, 1997). If franchisees deviate from the system's standard model in search of self-interest, it can lead to erosion and deterioration of the quality of trade mark. Franchisee's compliance with standardized framework is essential for maintenance and development of the desired image of franchise system (Pizanti & Lerner, 2003). However, the majority of franchisees operate within areas that differ in terms of market conditions, income levels, consumer tastes, competition level and demand nature. Company's ability to adapt to different market conditions is part of identity of an entrepreneurial oriented organization (Muzyka, De Koning & Churchill, 1995). Healthy franchise system should be developed over time according to changes in the external environment (Hoy, 2008).

Entrepreneurial behavior at the firm level is widely accepted as a tool for revitalization of the company and achievement of sustainable competitive advantage and superior performances in organizations of all types and sizes (Antoncic & Hisrich, 2004). In the context of franchising, encouraging entrepreneurial behavior in franchise units can be considered as contrast to the requirements of standardization and uniformity, which are the cornerstone of franchising (Cox & Mason, 2007). Franchising involves a set of established procedures and proven methods. It can be said that franchising refers to cloning successful business model. Although franchising relations are mainly regulated by strict contract, they often exceed formal interactions, so that franchisees still have a partial strategic flexibility as entrepreneurs. In addition, numerous studies showed that franchisees actually play an important role in innovative and entrepreneurial behavior, which is necessary in franchising system (Clarkin & Rosa, 2005). Franchisors should provide an appropriate structure that will allow franchisees to contribute to business development. Those who do not develop such an approach will risk that franchisees form their own association to raise a collective voice (Cochet & Ehrmann, 2007).

Entrepreneurial behavior among franchisees is certainly maximized through the use of formal franchisee network. Networks are forms of voluntary cooperation that involves mutual learning and exchange of information between members of the franchise system (Johannisson, Ramirez-Pasillas & Karlsson, 2002). Franchisee networks include using forums, working groups and regional and national meetings which

provides interaction between franchisees. Franchisees are allowed to work in a cluster for the dissemination of knowledge, which in turn maximizes entrepreneurial behavior in three ways: through acquisition of relational and informational capital, promotion of competition within the system and facilitation of franchisee learning through the generation of new knowledge. These processes produce significant organizational outcomes for both the franchisee and the whole system in terms of business growth, system adaptation, market leadership and solution of business problems (Dada, Watson & Kirby, 2010). The model of maximization the entrepreneurial behavior among franchisees is shown in Figure 1.

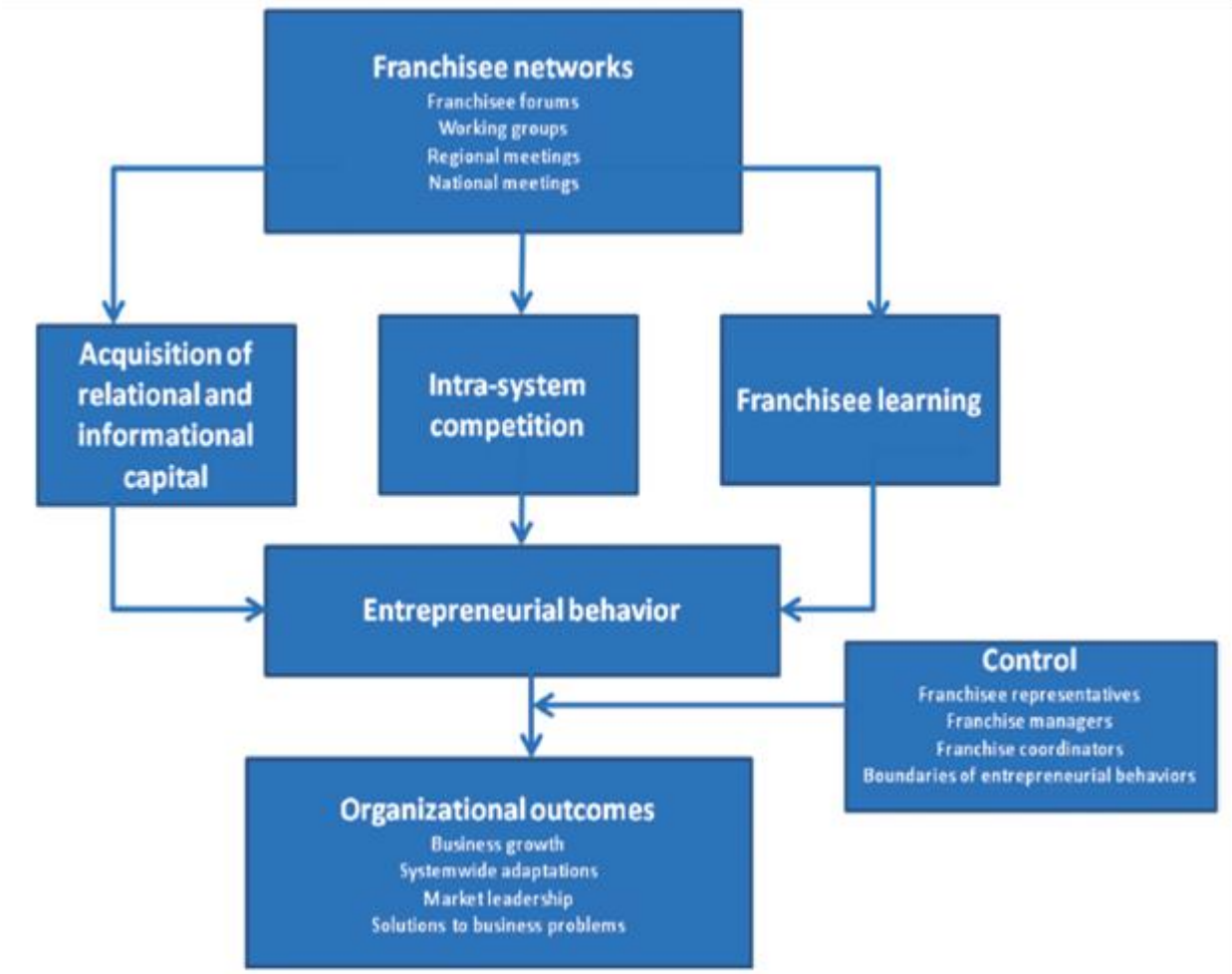

Figure 1: Model of maximization of entrepreneurial behavior amongst franchisees
Source: Dada, O., Watson, A., Kirby, D. (2010), „Toward a model of franchisee entrepreneurship“, International Small Business Journal, 30(5), pp. 559–583.

- Acquisition of relational and informational capital. Relational capital can be perceived as a set of business relationships between members of the organization. Information capital includes information about company's products or services, customers and competition (Griffith & Lusch, 2007). Franchisees particularly emphasize the importance of franchising forums within which they discuss issues related to entrepreneurship, exchange ideas, receive additional information about the business etc. A large number of franchisees provide their ideas in order to facilitate functioning of the entire franchising system. Depending on the system, forums are held a few times a year or a couple times a month and present formal way to exchange ideas. In this way, much more interaction between franchisors and franchisees can be realized. National forum is of great importance, since franchisors have ability to monitor operations of each of franchisees on a daily basis. A large number of ideas that arise on these forums can be implemented in practice, since in this way franchisees improve business operations of the entire franchising system. It can be concluded that franchisee networks affect the increase of information and relational capital which has a positive impact on franchisee's entrepreneurial behavior (Dada, Watson & Kirby, 2010).
- Competition within the system. The high level of competition has been observed between franchisees, as they try to be the best within franchising system through entrepreneurial behavior. Franchisee's competitive aggressiveness is attributed to networks that are designed by the franchisor, so that franchisees are informed about activities of other franchisees which leads to

intensified competition. So, franchisees often want to prove themselves in front of the franchisor and to make progress on the list of the best franchisees. "Club of high achievements" consists of the top 12 franchisees and they receive awards such as "Franchisee of the year". In order to win this award, franchisee must be more than just a franchisee, he/she should strive to improve himself/herself and to be better than others. A large number of franchisors organize competitions for franchisees to generate new ideas. Entrepreneurial minded franchisees have closer and better relations with the franchisor (Michael & Combs, 2008). Franchisees who have a more entrepreneurial initiatives often pay lower fee compared to other franchisees. Franchisees do not only compete within the system with other franchisees, but they are expected to win in the local market. This means that they are not expected to follow the market conditions, but to be market leaders. In order to become a market leader, franchisees try to do something different in relation to their competitors, which will make them entrepreneurs. They tend to achieve USP (Unique Selling Point). Franchisee network have positive impact on competition within the system and on franchisee's entrepreneurial behavior (Dada, Watson & Kirby, 2010).

- Franchisee's learning. Learning is process by which knowledge is generated (Harrison & Leitch, 2005). Networks facilitate the essential learning process through franchisee's experience that is exchanged via forums. Forums give a chance to franchisees to see errors of other franchisees, and to work together in order to solve problems. Franchisors emphasize the importance of using franchise network as learning medium, because there is a possibility that franchisees participate in entrepreneurial activities and thus contribute to the development of franchising system. In this regard, if a franchisee creates a successful innovation, he should forwards it to other members in order to contribute to a better functioning of franchising system as a whole. Some of franchisors hire a franchise coordinator to coordinate franchisees, so that they function simultaneously. Networks have a positive impact on the learning that encourages franchisee's entrepreneurial behavior. Organizations oriented on learning have a positive relationship with corporate entrepreneurship (Holt, Rutherford & Clohessy, 2007).

Franchisee network is a form of formalized and institutionalized management support for corporate entrepreneurship, which allows franchisees to discuss and exchange ideas (Kelley, Peters & O'Connor, 2009). Franchisors allow franchisees a degree of freedom, but do not allow them to go beyond the scope of franchising system too much. However, if franchisees do something completely different from what was established by franchise agreement, franchisors will be prepared to sanction such behavior. Entrepreneurial behavior leads to different outcomes at the individual and organizational level (Ireland, Covin & Kuratko, 2009). Franchisees create new value through entrepreneurial behavior. This refers to business growth, adjusting entrepreneurial initiatives throughout the system, solution of operational problems and market leadership. It rarely happens that franchisor comes to the franchisees with a new idea. More often happens the reverse. Then the product is marketed as a pilot in a specific area, and if it is successful, it will be applyed by other franchisees. So, franchisees are the source of new ideas and innovation for new product/ service development (Cox & Mason, 2007). The motivation for franchisee's entrepreneurial behavior is to generate more business which leads to generation of more revenue. Therefore, franchisee's entrepreneurial behavior has a positive impact on the business performance of franchising system (Dada, Watson & Kirby, 2010).

5. CONCLUSION

Franchising concepts were originally referred to the replication of standardized business concepts. In conditions of more intense competition, the importance of entrepreneurial behavior of participants in franchise systems is emphasized. Surveys on franchising are actually surveys on entrepreneurial cooperation between the two different types of entrepreneurs: franchisors and franchisees. Entrepreneurship and franchising overlap in a number of segments, so definitions of these two terms are related. Based on the review of definitions of entrepreneurship and its application to franchising it can be concluded that they are almost compatible concepts. We have identified two different approaches that can cause a dilemma: franchising as the antithesis of entrepreneurship and franchising as an entrepreneurial model. The first approach is explained by the fact that the stimulation of entrepreneurial behavior in franchise units is inconsistent with the requirements for the uniformity of the franchise system. The second approach is supported by the fact that franchisees play an important role in innovative and entrepreneurial behavior that is necessary for the functioning of the franchise system in modern conditions. The solution to the dilemma is "controlled entrepreneurship", which should provide control of franchisees' behavior in order to maintain uniformity of the system, while providing entrepreneurial autonomy. This can be achieved by using formal networks that enable interaction between franchisees (forums, working groups and regional and national meetings). Franchisee networks contribute to the maximization of entrepreneurial behavior through: acquisition of relational and informational capital, promotion of competition within the system and facilitation franchisee learning through the generation of new knowledge. The culmination of franchisee entrepreneurial behavior is reflected in business growth, adaptability of the franchise system, market leadership, innovation

and solving business problems. Future research can be focused on the analysis the impact of franchise system's size on the entrepreneurial model of franchising. Also, global trends indicate growing importance of research of franchising systems involved in social entrepreneurship. Human resource management in entrepreneurial oriented franchising concepts is another topic which should be researched in the future.

REFERENCES

Aldrich, H., Martinez, M. (2007), "Many are Called, but Few are Chosen: An Evolutionary Perspective for the Study of Entrepreneurship", *Entrepreneurship*, pp. 293-311.

Amit, R.,Glosten, L., and Muller, E. (1993), "Challenges to theory development in entrepreneurship research", *Journal of Management Studies*, 30(5), pp. 815–834.

Antoncic, B., Hisrich, R. (2004), "Corporate entrepreneurship contingencies and organizational wealth creation", *Journal of Management Development*, 23(6), pp. 518–550.

Bradach, J. (1997) "Using the plural form in the management of restaurant chains", *Administrative Science Quarterly,* Vol. 42, pp. 276–303.

Burkle, T., Posselt, T. (2008), "Franchising as a plural system: A risk-based explanation", *Journal of Retailing*, 84(1), pp. 39–47.

Chirico, F., Ireland, D., Sirmon, D. (2011), "Franchising and the Family Firm: Creating Unique Sources of Advantage Through "Familiness", *Entrepreneurship Theory and Practice, Special Issue: New Directions in Franchising Research*, Volume 35, Issue 3, pp. 483–501.

Clarkin, J., Rosa, P. (2005), "Entrepreneurial Teams within Franchise Firms", *International Small Business Journal*, Vol. 23, No. 3, pp. 303–334.

Cochet, O., Ehrmann, T. (2007), "Preliminary evidence on the appointment of institutional solutions to franchisor moral hazard – The case of franchisee councils", *Managerial and Decision Economics*, Vol. 28, pp. 41–55.

Cole, A. (1968), "Meso-economics: A contribution from entrepreneurial history", *Explorations in Entrepreneurial History*, 6(1), pp. 3–33.

Combs, J., Ketchen, D., Shook, C., Short, J. (2011), "Antecedents and Consequences of Franchising: Past Accomplishments and Future Challenges", *Journal of Management*, Vol. 37 No. 1, pp. 99-126.

Cox, J., Mason, C. (2007), "Standardization versus adaptation: Geographical pressures to deviate from franchise formats", *Service Industries Journal,* 27(8), pp. 1053–1072.

Dada, O., Watson, A., Kirby, D. (2010), "Toward a model of franchisee entrepreneurship", *International Small Business Journal,* 30(5), pp. 559–583.

Dant, R. (1995), "Motivation for franchising: Rhetoric versus reality", *International Small Business Journal*, 14(1), pp.10–32.

Elango, B., Fried, V. (1997), "Franchising Research: A Literature Review and Synthesis", *Journal of Small Business Management*, Vol. 35, No. 3, pp. 68-81.

Gartner, W. (1985), "A conceptual framework for describing the phenomenon of new venture creation", *Academy of Management Review,* 10(4), pp. 696–706.

Gilson, L., Mathieu, J., Shalley, C., Ruddy, T. (2005), "Creativity and standardization: Complementary or conflicting drivers of team effectiveness?", *Academy of Management Journal,* 48(3), pp. 521–531.

Griffith, D., Lusch, R. (2007), "Getting marketers to invest in firm-specific capital", *Journal of Marketing,* Vol. 71: 129–145

Grunhagen, M., Mittelstaedt, R. (2005), "Entrepreneurs or Investors: Do Multi-unit Franchisees Have Different Philosophical Orientations?", *Journal of Small Business Management,* 43(3), pp. 207-225.

Harrison, R., Leitch, C. (2005), "Entrepreneurial learning: Researching the interface between learning and the entrepreneurial context*", Entrepreneurship Theory and Practice,* Vol. 29, Issue 4, pp. 351–371.

Holt, D., Rutherford, M., Clohessy, G. (2007), "Corporate entrepreneurship: An empirical look at individual characteristics, context, and process", *Journal of Leadership and Organizational Studies,* 13(4), pp. 40–54.

Hoy, F. (2008), "Organizational learning at the marketing/entrepreneurship interface", *Journal of Small Business Management*, 46(1), pp. 152–158.

Hoy, F., Shane, S. (1998), "Franchising as an Entrepreneurial Venture Form", *Journal of Business Venturing*, Vol.13, No. 2, pp. 91-94.

Ireland, R., Covin, J., Kuratko, D. (2009), "Conceptualizing corporate entrepreneurship strategy", *Entrepreneurship Theory and Practice* January, Vol. 33, Issue 1, pp. 19–46.

Johannisson, B., Ramírez-Pasillas, M., Karlsson, G. (2002), "The institutional embeddedness of local interfirm networks: A leverage for business creation" *Entrepreneurship and Regional Development*, Vol. 14, pp. 297–315.

Kaufmann, P., Dant, R. (1999), “Franchising and the domain of entrepreneurship research”, *Journal of Business Venturing*, Vol. 14, pp. 5–16.
Kaufmann, P., Eroglu, S. (1998), “Standardization and adaptation in business format franchising”, *Journal of Business Venturing*, Vol. 14, pp. 69–85.
Kaufmann, P., Stanworth, J. (1995), “The decision to purchase a franchise: A study of prospective franchisees”, *Journal of Small Business Management*, 33(4), pp. 22–33.
Kelley, D., Peters, L., O’Connor, G. (2009), “Intra-organizational networking for innovation-based corporate entrepreneurship”, *Journal of Business Venturing*, Vol. 24, pp. 221–235.
Ketchen, D., Short, J., Combs, J. (2011), “Is Franchising Entrepreneurship? Yes, No, and Maybe So”, *Entrepreneurship Theory and Practice,* Vol. 35, Issue 3, pp. 583–593.
Kirzner, I. (1985), *Discovery and the Capitalist Process*. Chicago, IL: University of Chicago Press
Knight, F. (1921), *Risk, Uncertainty, and Profit*, Boston, MA: Houghton-Mifflin
Leibenstein, H. (1968), “Entrepreneurship and development”, *American Economic Review*, 38(2), pp. 72–83.
Michael, S., Combs, J. (2008), „Entrepreneurial failure: The case of franchisees”, *Journal of Small Business Management*, 46(1), pp. 73–90.
Morgan, G. (1997), *Images of Organization*, Thousand Oaks, CA: Sage Publications
Morrison, A., Lashley, C. (2003), “A franchise: A resource-rich small service firm?”, *Service Industries Journal*, Vol. 23, pp. 135–149.
Muzyka, D., De Koning, A., Churchill, N. (1995), “On transformation and adaptation: Building the entrepreneurial corporation”, *European Management Journal,* 13(4), pp. 346–362.
Phan, P., Butler, J., Lee, S. (1996), “Crossing Mother: Entrepreneur - Franchisees’ Attempts to Reduce Franchisor Influence”, *Journal of Business Venturing,* 11(5), pp. 379–402.
Pizanti, I., Lerner, M. (2003), “Examining control and autonomy in the franchisor - franchisee relationship”, *International Small Business Journal,* Vol. 21, pp. 131–159.
Schumpeter, J. (1942), *Capitalism, Socialism, and Democracy*, New York: Harper and Brothers
Shane, S. (1996) “Hybrid Organizational Arrangements and Their Implications for Firm Growth and Survival: A Study of New Franchisors”, *Academy of Management Journal,* 39(1), pp. 216–34.
Stefanović, S., Stanković, M. (2013) “Comparative analysis of the development of franchising in Serbia and worldwide”, *Marketing*, vol. 44, iss. 2, pp. 115-127.
Watson, A., Kirby, D. (2004) "Public perceptions of franchising in Britain: releasing the potential", *Journal of Small Business and Enterprise Development*, Vol. 11, Iss. 1, pp. 75-83.

FINANCIAL MANAGEMENT

ALTERNATIVE SOURCES OF FINANCING OF THE SMALL AND MEDIUM SIZE ENTERPRISES IN THE REPUBLIC OF MACEDONIA

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Abstract: *The effective managing with a company, to a large extent, depends on the sources of financing of its business activities. The decisions that the entrepreneurs make for financing of the business activities are rather complex and are related to the planning, providing and using of the finances. The establishment and the continuity of the work of the small and/or medium sized enterprises, mainly depends on approachability to the finances that can be obtained from different sources and under different financing conditions.*

The main goal of this paper is to point out the alternative sources of financing that can help the Macedonian small and medium sized enterprises to provide enough capital for improving and enlarging the scale of their productivity, competence, as well as the development of new products and innovations.

In this paper, a theoretical research is presented concerned with the financing of the small and/or medium sized enterprises through analytic description and a synthesis method that will be applied after the content analysis.

The expected results of the research are actually the answers to the following questions:

- *How important are the small and/or medium sized enterprises in the development and the stability of the Macedonian economy?*
- *Which are the additional sources of financing available for the Macedonian small and medium sized enterprises?*

Key words: *small and medium enterprise, alternative financial sources, commercial banks, economic development, economic stability.*

1. INTRODUCTION

Many analysts and policymakers (Albert Berry, 2007, OECD, USAID) recognize the importance of SMEs in economic development, especially for the developing countries. According to USAID (2009) small and medium enterprises (SMEs) are critical because they account for large shares of the total output and employment and are thus a key to the strategic objective of overcoming the poverty.

Risteska (2012) concludes that SMEs have by far big part in the development of the national economy, because of which the governments take different measures, using different instruments and strategies to support them in their development. According to Dickins and Feels (2005) many SMEs are facing difficulties in finding sustainable finances such as long-term loans just because of the high risk connected with the enterprises with small assets. The commercial banks do not want to finance the SMEs because of the risk. On the other hand, the SMEs being considered as with higher risk than the big ones, the SMEs have to pay higher interest rates for the loans from the commercial banks.

Many researchers, amongst whom, Jovanova (2012) say that in the conditions of crisis when the commercial banks are more rigorous in approving the loans, it is necessary to find new ways of financing of the Macedonian enterprises.

The scope of research is covering the explanation of the mentioned objective and will depend on the knowledge and past research made by different authors in the field of entrepreneurship and management of small business, as well as, from analysis of the economic development strategies provided by home and foreign institutions.

This paper contributes to the exciting literature by familiarizing the SMEs with additional sources of funding for their ongoing development and business activities. This is very important to ensure the survival and sustainability of SMEs, something that a country's economy growth and development depend on.

2. IMPORTANCE OF SMEs IN COUNTRY'S ECONOMY DEVELOPMENT

Before we start analyzing the importance of the SMEs within an economy, it is important to define SMEs as a classified group. In most cases the European Commission's definition is the one that is widely accepted.

According to the European Commission an enterprise is concerned to be entity engaged in an economic activity, irrespective of its legal form. This includes, in particular, self-employed persons and family businesses engaged in craft or other activities, and partnership or associations regularly engaged in economic activity.[1] Main criteria to define the SMEs are: number of employees, turnover or Balance sheet total.

Table 1: Company category classification

Company category	Employees	Turnover	or	Balance sheet total
Medium-sized	< 250	≤ € 50 m		≤ € 43 m
Small	< 50	≤ € 10 m		≤ € 10 m
Micro	< 10	≤ € 2 m		≤ € 2 m

Source: http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/index_en.htm

According to the data from the table above, the SMEs can be divided into three categories: middle sized with less than 250 employees, small with less than 50 employees and micro with less than 10 employees. In the Republic of Macedonia the classification of micro, small and middle sized enterprises is regulated by the Trade Companies Law[2] according to which:

- Middle sized enterprises either have up to 250 employees or annual income less than 10 million euros and average assets value less than 11 million euros,
- Small enterprises either have up to 50 employees, annual income less than 2 million euros and average assets value less than 2 million euros,
- Micro enterprises are the ones that have up to 10 employees and less than 50.000 euros annual income.

It can be seen that according to the number of employees, the criteria are as same as the European ones when it comes to the classification of the SMEs, the difference is in the average assets value and the annual income. However, most often is the number of employees that is used as a standard definition when classifying the SMEs.

The level of importance of the SMEs can be measured according to the number of employees and to which extent they take part in the creation of new values in the economy. The small enterprises are considered to be the moving force of the changes in the economy as well as, sources of significant innovations. The research made by Edinburgh Group[3] shows that more than 95% of the total number of enterprises in the world is in the category of SMEs, which employs approximately 60% of the employees in the private sector work. The SMEs play a key role in the employment not only in the developed countries but also in the developing and in the countries with low incomes. The data for the employment between 2002 and 2010 saying that in average MSEs are with 85% of the total number of employees just proves the previously stated. In figure 1 the contribution of the SMEs to the employment in different countries can be seen.

[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:124:0036:0041:EN:PDF
[2] Trade Companies Law article 470 Official Gazette of Republic of Macedonia, number 28/04 (change number 84/05;25/07)
[3] Edinburgh Group (2013): Growing the global economy through SMEs, p.8.

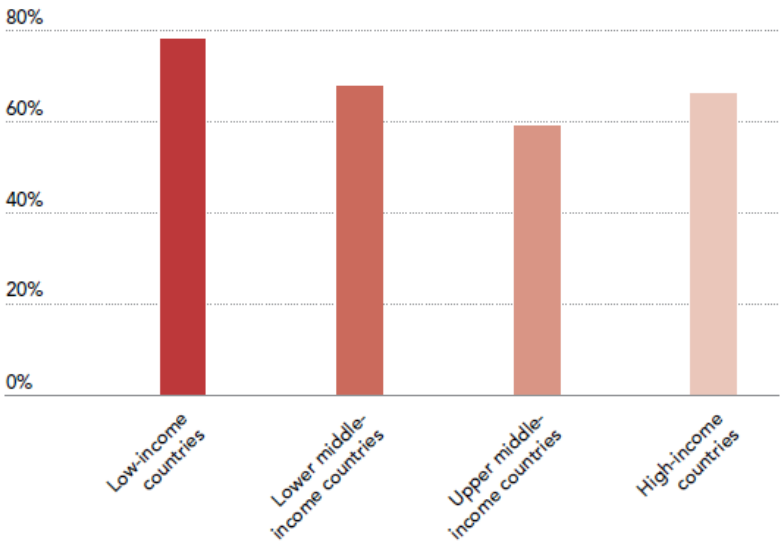

Figure 1: Contribution of SMEs to employment (median values)

Source: Edinburgh Group (2013): "Growing the global economy through SMEs, p.8.

According to the data of the National Office of Statistics of Republic of Macedonia, there were 71290 active business entities in 2013. Enterprises with 1 to 9 employees took 85% of that number. On the second place were the enterprises with no or unknown number of employees (6.2%),then the enterprises with 10 to 19 employees follow with 4.2%,after them were the enterprises with 20 to 49 employees-2.5%; 1.8% of the enterprises with 50 to 249 employees and only 0.3% have more than 250 employees[44]. The number of active business entities in Macedonia for 2013 is presented in Table 2.

Table 2: Number of business entities by number of employees

Total						
	0[1)]	1-9	10-19	20-49	50-249	250 +
71 290	**4 415**	**60 599**	**2 989**	**1 787**	**1 291**	**209**

1) Including business entities with unascertained number of persons employed

Source: www.stat.gov.mk

According to Stojanovska (2014) the sector of small and medium enterprises plays a major role in the Macedonian economy which is shown by the fact that the percentage of employees in SMEs is higher than the one of the big companies, reaching its peak in 2007 with 83%. The percentage of 63% of the SMEs in the GDP shows that SMEs are carriers of the economic growth of Macedonia. This means that SMEs have major impact on the range and the dynamics of the economical development of our country and also they maintain the economical and social stability. We would like to point out here that there is a two-way connection between the SMEs and the economic development. In other words as SMEs influence the level

[4] www.stat.gov.mk. March 2014.

of economic development so the higher level of development stimulates establishing new SMEs as well as strengthening and development of the existing ones.

The small and medium enterprises are the moving force of the development of every national economy. The positive impact of the SMEs is evident through the following: decreasing of the unemployment rate, bigger GDP, higher level of exports and higher level of innovations of the certain country. This is the reason why the government creates such polices to push forward the development of the SMEs sector and to solve many other different problems in this sector.

3. THE PROBLEM OF FINANCING THE SMALL AND MEDIUM ENTERPRISES

Analyzing the problem of financing the SMEs the fact that Macedonian economy is open and it was not immune to the economic crises in 2008, must be taken into consideration. Namely, during the crisis when the businessmen hesitate to invest and when the demand for the SMEs's products drops, they face the problem of collecting their charges which has impact on their liability. In the situation presented before, the enterprises, especially the start-up ones, can hardly find the necessary finances. Being very hard to access financing schemes, made it difficult for the SMEs to plan their long-term development, and postponed the process of establishing new ones-as mentioned previously-which are the carriers of the economic development of Macedonia.

Talking about the sources of financing of the SMEs in Republic of Macedonia, we must say that the commercial banks, as a center of the finance market, are the ones that provide the SMEs with different kinds of loans and thus the banks are the most often and biggest finance supplier. Nevertheless, the banks decide to give loans to highly liable and stable enterprises (lower risk), rather than to start-up, new enterprises (higher risk) just because of the not yet so stable conditions of the global economy. The commercial banks give loans to start-up enterprises if only they are ensured that the business in question brings enough money, so that the loan installments can be paid and the loan as a total can be paid off.

Dimovska and her research that she did back in 2012 in five banks in Macedonia can only prove the previously stated. The research gave answer to the following question: What is the impact of the global financial crisis on SMEs lending in your bank? All of the banks involved in the research gave the same answer, that the global financial crisis makes giving loans to SMEs highly risky as a result of the macroeconomic instability.[5]

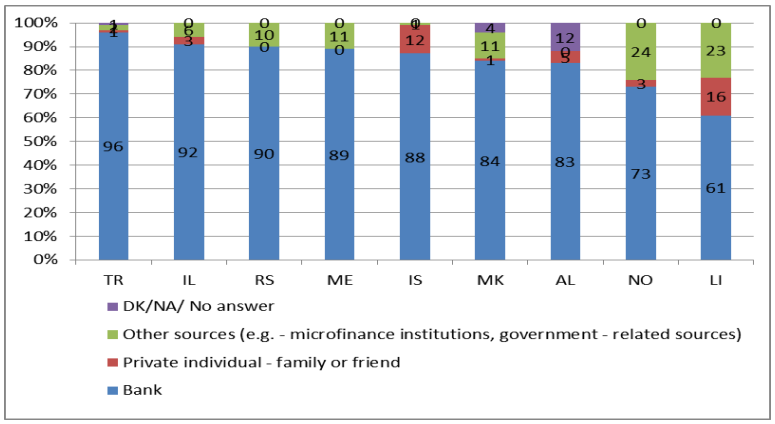

Figure 2: Provider of the most recent loan
Source: European Commission (2013): 2013 SMEs' Access to Finance survey, Analytic Report, Brussels. p.45.

Researching about this question further, the European Commission says that although the Macedonian banks are more rigorous when approving loans, they are still the biggest part of the finance source for the SMEs sector. Namely, in 2011 and in 2013 a very high percentage of the total loans, 84%, were given by the banking sector (Figure 2).

[5] Dimovska, Efimija. (2013).Evaluation of SMEs financing in Macedonia from the "supply side" perspective, CEA Journal of Economics, Vol.8, issue 1, Skopje,p.11.

The fact stands that the entrepreneurs first ask the banks for loans-but the banks are not the sole creditors at the finance market. Further on, an analysis of several alternative sources is presented, sources that have been available to the businesses in Macedonia recently.

4. KINDS OF ALTERNATIVE SOURCES OF FINANCING THE BUSINESSES

The European Commission in the progress report for Republic of Macedonia for 2013, points out that the development of SMEs is obstructed because the SMEs can hardly approach finances and that is actually their biggest challenge. Although there is a certain progress of the Government made by lowering the administrative and legislative barriers, still there are a lot of challenges for the SMEs in providing the support, the innovation and in approaching the finances.[6]

Having into consideration the situation with financing of SMEs in Republic of Macedonia, SMEs should do further research in where and under what conditions they can access the much needed capital. Here, we would like to mention again that finding new sources other than the commercial banks was imposed to the SMEs because of the global financial crisis.

In the recent years the finance sources have diversified and their numbers have enlarged. Thus, for the Macedonian entrepreneurs there are many different sources, such as[7]:

- Business angels' network
- European Bank for Reconstruction and Development (EBRD)
- SEAF1 Macedonia
- Technological development and innovation fund
- Development Foundation "Crimson Capital"
- Sortis Invest

- **Business angels' network -** Business angels are successful entrepreneurs, owners, managers who have capital, knowledge and skills and are ready to invest in sustainable business projects that can make profit fast. The goal is for the business angels to help the start-up businesses financially and in return get either shares of that certain company or a percentage of the profit.
I2BAN is the first official Business angels' network in Macedonia established in 2011 and its goals are:

  - Grouping and gathering the most successful Macedonian businessmen to connect them with the best investing opportunities amongst the new companies,
  - Creating more finance sources for the new companies.

I2BAN puts together the entrepreneurs with the richest people in the country and the region, something that makes the additional finance sources more approachable especially for those entrepreneurs with innovative projects.

In the developed countries business angels are very real and an excellent opportunity for start-up businesses. In the USA $20 billion is invested by the "business angels, while in Europe the number is lower-some $4 billion per year[8]. The Macedonian business angels' network is comprised of 15 home investors that have capital of 40million €.

- **European Bank for Reconstruction and Development (EBRD)** is one of the biggest investors in our region, playing a major role in attracting FDI. So far, the EBRD, s target has been the financing of the private sector and projects that will create employment. EBRD made a strategy for Republic of Macedonia for the 2013-2016 period with priorities such as: attracting FDI, local economic development, efficiency in energetics, sustainability of the integration within the region. Within that framework, EBRD realized successfully two projects: BAS-Business Advisory Services and ECD-Enterprise Growth Program, obtaining help for the home companies to improve their business performances, as well as, developing new managerial skills. Both projects previously mentioned, definitely improve the competence of the home companies[9].

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[6] European Commission (2013): Report on the Macedonian progress in 2013, page 49, Brussels.
[7] http://www.amcham.com.mk/WBStorage/Files/BusinessAngelsINFO.pdf
[8] http://biznis101.com/osnovaj-biznis/pocetno-finansiranje/93-veruvate-li-vo-angeli.html.
[9] http://www.economy.gov.mk/ministerstvo/3740.html, March 2014.

The owners of the small and/or medium enterprises in Republic of Macedonia should have in mind the fact that EBRD improved the financial support for them by making contracts with the commercial banks. EBRD, so far, has made contract with Ohridska Banka - Societe Generale for on-lending to local companies. A loan up to 6 million € will be used to finance energy efficiency investments and a second loan of 1 million € will be provided for competitiveness improvement of SMEs.[10]This credit line project is available for: private enterprises, trading enterprises, as well as for public and/or private companies-providers of local services. The maximum amount allowed for private sector project is 2 million € and for the public sector 2.5 million €.

Also the contract made between EBRD and NLB Tutunska Banka is for 4 million € that will help to improve the economic efficiency of the Macedonian companies. The advantage of this credit line (mentioned previously) for the potential applicants is that the successful projects do not pay out 15% of the loan they got.

- **SEAF 1 Macedonia** is an investment fund that provides not only finance but also business help for the SMEs. 80% of the money in this fund is supposed to be obtained by successful Macedonian entrepreneurs-working in foreign countries, from the international SEAF, as well as from capital and pension funds. This fund is particularly for highly risky investments in the Macedonian companies. But still, time is needed to find potential investors willing to invest part of their capital in Macedonian economy.

- **Technology development and innovation fund (TDIF)[11]** has a goal to: promote and provoke innovations, improve the approachability to finance services and innovations, develop the infrastructure which will lead to innovations and technological development, as well as to establish a strong partnership between universities and research centers on one side and the private sector on the other in Macedonia. This fund provides finances through four financial instruments:

- Co-financing grants for start-up, spin-of companies and innovations,
- Co-financing grants and conditional loans for commercialization of the innovations,
- Co-financing grants for transferring technologies,
- Technical help with business-technology accelerators.

This fund is established and enhances the development of innovative projects that will enlarge the competence and the quality among the small businesses.

- **Crimson Capital** is an international lender in emerging market development by stimulating trade, finance, investments and sales. The services that it provides are as follows[12]:

- Finance for SMEs (debt, equity, trade finance, leasing, factoring)
- SME Development
- Trade, Export and Investment Promotion
- Competitiveness and Restructuring (manufacturing, agribusiness, technology
- services)
- Capacity Building of managers, Consultants and business associations
- Agriculture and Agribusiness (including food processing)
- Loan workouts and Financial Restructuring
- Enterprise restructuring and improvement
- Industrial and manufacturing operations improvement
- Marketing and sales
- Training and train-the-trainer programs

Crimson Capital-Macedonia informs that the foundation is financing projects or companies that have an American partner with at least 25% ownership.

- **Sortis Invest** is a Bulgarian investing and consulting agency for financing projects that mean enlarging the existing business, finding and approaching new market etc. Together with financing concrete/real projects, the Agency offers consulting services concerned with corporate financing, merging and acquisitions.

All these mentioned above sources of financing are only a part of the additional ways of the SMEs in Macedonia to find capital to develop and strengthen the existing businesses or to start a new one.

[10] http://www.ebrd.com/pages/news/press/2013/131218b.shtml March 2014.
[11] http://www.mon.gov.mk/index.php/dokumentimon/formularimon/1676, February 2014.
[12] www.crimsoncapital.org, January 2014.

The entrepreneurs should know that before applying for finance help they have to make a profitable and sustainable business plan, then get informed and analyze the positive and negative effects of each and every possible and available source of finance help. As we mentioned before, in this still fragile and sensitive global finance situation, this is the only way that the entrepreneurs can get the capital they need.

Regardless what type of finance help they choose, the SMEs' owners should have all the necessary information concerning the different kinds and opportunities for financing. They should also be aware of the level of risk-meaning whether the company can or cannot generate income that will pay out the loan in due time. Otherwise the SME can come to apposition of non-liability, not being able to develop as planned, not being able to pay the obligatory installments and eventually lose the business completely.

5. CONCLUSION

The small and medium enterprises play a key role in the economies of all the countries in the world, regardless the level of their development. The importance of the SMEs can be seen in:

- The biggest percentage of employees in the country goes to this sector,
- They have a big share of the GDP,
- High level of innovations and technological development.

Although the SMEs play a major role in the economic development in many countries, they still face problems. If we regard the administrative and legislative procedures as one of their problems, the second one would certainly be the approachability to appropriate sources of financing. Thus this is what the SMEs are facing in Macedonia, too. In order to overcome this problem, efforts are made toward awareness and being better informed about what and how can Macedonian companies choose as a source of financing that are actually available to finance and support the development of investments.

The high risk level that exists among the SMEs is the cause of the entrepreneurs to face difficulties when asking for finance for their businesses. The reality in Republic of Macedonia is that SMEs mainly seek for financing in the commercial banks and they are still dependent on the banks.

Macedonian companies are getting more and more aware of the fact that their own assets and the loans from the commercial banks are simply not enough for developing the technology and investments. So, in order to enlarge the list of possibilities of how to get the financial help, Macedonian entrepreneurs should be better informed and understand the variety of financing sources available now. The alternative financing sources such as: Business angels' network, European Bank for Reconstruction and Development (EBRD), SEAF1 Macedonia, Technological development and innovation fund, Development Foundation "Crimson Capital", Sortis Invest are a good instrument for the start-up businesses as well as for the sustainable development of the existing SMEs.

REFERENCES

Association of Economic chambers of Macedonia (2012). Strategy for economic growth through the development of SMEs. Skopje, Macedonia.

Berry, Albert (2007). The Importance of SMEs in the Economy Paper presented at ITD Global Conference in Taxation of Small and Medium Enterprises, Argentina.

Company Law, Article 470, published in the "Official Gazette of Republic of Macedonia" No.28/04 (modification No.84/05, 25/07).

Deakins, David & Freel, M. (2005). Entrepreneurship and small firms, 4Ed. McGraw – Hill International UK.

Dimovska, Efimija. (2013). Evaluation of SMEs financing in Macedonia from the "supply side" perspective, CEA Journal of Economics, Vol.8, issue 1, Skopje.

EBRD. (2013). Strategy for Republic of Macedonia.

Edinburgh Group (2013). Growing the global economy through SMEs.

European Commission (2013). 2013 SMEs' Access to Finance survey. Analytic Report, Brussels.
http://eurex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:124:0036:0041:EN:PDF

Jovanova, Sonja (2012): How to get money for business development?
www.kapital.com.mk/mk/magazin/83554/kako_do_pari_za_razvoj_na_biznisot_.aspx

Ministry of Labor and Social Policy (2011). National Employment Strategy of the Republic of Macedonia 2015. Skopje.

Risteska, Aneta. (2012). The impact of SMEs on economic development, with special emphasis on Republic of Macedonia, PhD thesis, Faculty of Economics - Prilep.

Scarbough, Norman & Thomas W.Zimmerer. (1996). Effective Small Business Management. 5th Edition, Prentice Hall.

Stojcevska – Zdravkovska, Biljana. (2012). The rescue is in opening new small firms. www.kapital.mk/mk/magazin.aspx/84624/spasot_e_vo_otvoranje_novi_mali_firmi!.aspx?iId=2761.

www.amcham.com.mk/WBStorage/Files/BusinessAngelsINFO.pdf

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www.ebrd.com

www.economy.gov.mk

www.mon.gov.mk

BEHAVIORAL FINANCE AND INVESTMENT DECISIONS

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Abstract: *Investment decisions are made in accordance with the situation in the financial markets, the level of portfolio diversification, the results of technical and fundamental analysis, as well as in line with the expectations and preferences of investors and managers. This paper discusses the role of risk in decision-making, and gives the basic concept of behavioral finance and its applications. Adequate management of investment portfolios provides a harmonized relationship between risk and return, and considering the fact that all decisions in the financial markets are made based on predictions and expectations, it is clear that the influence of the irrational should not be underestimated. Empirical evidences proved that there are number of situations in investments and capital market transactions when market participants often act very unpredictably. Behavioral finance is supplement to the standard finance theories by bringing in behavioral aspect into decision-making process This paper represents a theoretical basis for future empirical research on the subject of behavioral finance.*

Keywords*: Behavioral finance, decision-making process, market efficiency, risk,*

1. INTRODUCTION

Global financial markets are influenced by a number of factors: economic processes related to different countries of the world, institutional and political constraints, lack of transparency in operations, information asymmetry etc. However, one of the most important factors refers to the perceptions and reactions of participants in the financial markets. For each investor, doing business in the financial markets is a constant process of decision making. The aim of this paper is to briefly describe the emotional factors that have an influence on the price changes in the market, i.e. on making investment decisions. The analysis of the rational and irrational investment decisions could partly be explained by considering the psychological effects of an investment activity. As Bikas et al. (2013) states in their work, the main difference between traditional and behavioral finance is the fact that traditional finance does not address the question of "why" investors make one or another decision.

Bikas et al. (2013) suggest that investment in financial markets instruments in recent decades is becoming increasingly popular in the circles of individual investors. Communication with people on the other side of the world is no longer a problem, so the information is spread very quickly, and decisions are made in a relatively tense atmosphere. Undoubtedly, investment decisions depend on the type of investment and expectations that are linked to it. However, very often short-term investment decisions are not based on logical arguments, and are more often made on the basis of your current mood or just received information.

In an attempt to explain the decisions and actions of financial investors, a completely new theory has been suggested in the literature which is based on the concept of behavioral finance. Some authors like Bikas and Jurevičienė (2009) and Jurevičienė et al. (2012) have used this theory in order to explain the decisions regarding personal finances and the way in which clients of financial institutions decide on savings.

Behavioral finance is the result of connecting the various sciences (Ricciardi & Simon, 2000): **Psychology** – through which the behavior and thinking is analyzed, i.e. how human behavior is conditioned by the physical and psychological characteristics and the external environment; **Finance** – which explain ways to define the optimal structure of assets and resources; and **Sociology** – which analyzes the impact of sociological factors on people's attitudes and values.

In their research, Jurevičienė et al. (2012) classified behavioral finance as macro and micro-finance. Macro aspect refers to the analysis of defects of market efficiency hypothesis and micro aspect focuses on the behavior and inconsistencies in decision-making of individual market participants. Both approaches separate finance from strictly rational decisions, as well as from mathematical and statistical models, thanks to which, a large number of procedures were explained in the past.

Financial experts have been trying to make an empirical model that will show which factors influence the investor's competence. Graham et al. (2009) have concluded that investors who trade frequently have a more diversified portfolio of those investors who are characterized by passive strategies. In addition, investors with a strong self-confidence feel strongly that their decisions are more accurate, and portfolio of securities better structured.

2. DECISION-MAKING AND RISK

In everyday life, people often find themselves in a situation to make a choice among a range of options and make different decisions, from the mundane, which are not very important, to those of vital importance. Making individual and group decisions is the subject of decision theory which was created in the mid-twentieth century through contributions from different scientific disciplines, economics, statistics, psychology, political science, sociology, philosophy (Hansson, 2005). In the framework of decision theory two perspectives have been developed, normative and descriptive (behavioral) decision theory. Normative theory was formed to meet the needs of the economy and is concerned with how decisions should be made. It describes the behavior of an idealized, fully rational and informed decision maker who is governed by the principle of maximizing their benefit and offers a variety of methods of making good decisions adequate for different circumstances. In contrast to the normative, descriptive decision theory has been developed primarily in the field of psychology and focuses on the question of how decisions are really made. The role of the decision maker is given to a man with a natural cognitive limitations and psychological factors which lead to deviations from the ideal, rational decision-making (Pavličić, 2007).

Decision is the selection of one from a set of at least two options which can achieve the desired objective. Decision theory assumes that the set of possibilities is closed, i.e. their number is limited and they are mutually exclusive. Also, all possible events have to be fully understood and mutually exclusive (Hansson, 2005).

Depending on whether the circumstances in which decisions are made (the state of nature, events) are predictable or not, it is possible to talk about decision-making under three types of conditions - certainty, uncertainty and risk (Peterson, 2009). For all three types of situations normative theory offers models which lead to making rational decisions. It is understood that perfectly rational decision maker always knows what he wants and strives to achieve it governed by the principle of maximizing personal benefit. Decision-making under conditions of certainty refers to the cases when only one state of nature occurs in the implementation of a specific action, and it is known in advance. In this case, the outcome of each selected alternative is known in advance. Based on personal preferences, each option is assigned a number which expresses its importance, utility for the decision makers and it is usually expressed in money. In the event that the probability of occurrence of each outcome is unknown, the decision is made in terms of (total) uncertainty. If the probability of the possible outcomes when choosing certain options is known, the decision is made in terms of measurable uncertainty, that is, in terms of risk. In such conditions, the utility of each outcome is weighted by the probability of its occurrence resulting in a number that represents the expected value of the outcome. Rational decision involves selection of option with maximal total expected value. However, for making specific, individual decisions which are not repeated, the expected value is not a reliable basis for selection. This has been shown by the **St. Petersburg Paradox** which reveals that in terms of risk the values function of money is not always a linear relation with subjective utility, which is attributed to it. This finding implies the use of selection methods based on the maximization of mentioned subjective expected utilities (EU designation of Expected Utility). To calculate its value, the procedure of standard game is used, and it requires ranking the options on the basis of individual preferences, and choosing numerical interval in whose range the values assigned to individual options will be able to move.

In his paper, Virlics (2013) states that if the utility function is linear, it means that the indifference to risk is present, that is, it does not matter whether we choose a certain outcome or a risky action of the same expected value, one outcome of which is better than the certain one, and the other worse. Only in this case there is a linear relationship between the value of money and the expected utility attributed to it. However, in reality, the other two forms of function are much more common. A function that is convex downward reveals an individual who shows aversion to risk and will always prefer a certain outcome to the risky option. Although the majority of people in everyday life act like this, there are people and situations which are dominated by the tendency towards risk. In this case, the utility function is convex upward showing preference to the risky option. Principles of normative theory show how a perfectly rational individual should make decisions in the circumstances of certainty, uncertainty and risk.

However, in everyday life, one often does not have access to all the necessary information related to the set of possible alternatives, states of nature and outcomes. The criteria of normative theory are too strict even when it comes to preferences of real decision makers. The preferences are often time unstable, logically

inconsistent and thereby mutually conflicting. Since the 1970s different studies have been conducted aiming to explain the actual process of decision making. The empirical findings that have emerged from these studies were the basis for the creation of behavioral theory. In addition, it has been found that decision-making is not always defined by utility maximization, but is affected by a number of factors which, among other things, are of emotional nature. Kahneman and Tversky (1979) have defined one of the most important theories explaining the causes of deviations from rational choice under the conditions of risk. Based on a series of conducted experiments, the aforementioned authors have concluded that in humans there is a tendency to overestimate the chances of unlikely events occurring and underestimate the chances of medium and highly likely events occurring. Kahneman and Tversky (1979) assume that in assessing the utility of the outcome there is a value that represents a standard, a reference point. Each outcome is compared to it and is therefore seen either as a profit, which is assigned a positive value, or a loss, which is assigned a negative value. In this way, a function value is formed and is the basis for decision making. It has been shown that the function has the shape of the letter S, and it reveals two important phenomena. First, it seems that people are more sensitive to identical differences in values of outcomes if they are close to the reference point than when they are significantly distant from it. For example, an increase in funding from 1000 to 2000 dinars is perceived as greater than the increase from 10 000 to 11 000 dinars. Another important feature of the value function reveals the existence of the phenomenon of loss aversion – the losses and gains of the same value are not evaluated in the same way, as the losses are viewed as larger. The loss of 10 000 dinars is experienced more intensely than a gain of 10 000 dinars (Kahneman and Tversky, 1979).

Normative decision theory is based on the concept of statistical probability, while in the process of making individual decisions it does not make much sense to rely on statistical probabilities. A solution is offered in the form of the concept of subjective probability, which is distinctive only to a particular decision maker. In order to determine the numerical subjective probability, the lottery method is used (Pavličić, 2007).

Analysis of the decision-making process in economic theory shows that the decision-making process is based on an objective analysis of the investment and the possible outcomes, as well as on the subjective perspective of investors. Neuroeconomics shows that the psychological and emotional impact on the decision-making process can have an informative and very useful role. The analysis of investment risk in terms of behavioral finance explains some of the decisions made irrationally, and the fact that the perception of risk greatly affects the optimistic or pessimistic attitude of the investor opens the door for new research on this topic.

3. BEHAVIORAL FINANCE CHARACTERISTICS

When analyzing investment process, there are studies whish emphasis that investors spend too much time studying investment behavior and not enough time focusing on investor behavior. In spite of what an investment does, it is the decisions of the investor to buy or sell that finally determines success or failure. This fact is the fundamental premise in behavioral finance.

It might be said that the most valuable contribution of behavioral finance can be perceived in better understanding of how investors value assets they would invest in. Asset valuation performed by investors and academics relies on evident factors but, on the other hand, experience has showed that human side is very influential during the investment decision process. Connecting the knowledge of how people make decision with investment process would hopefully enhance portfolio performance.

For a long period theoretical and empirical evidence suggest that capital asset pricing model (CAPM), efficient market hypothesis and other rational financial theories were successful in predicting and explaining events and processes in financial markets. But, in time, more and more anomalies and behaviors has occurred that could not be explained by existing theories at that time. Empirical evidences proved that there are number of situations in investments and capital market transactions when market participants often act very unpredictably. Behavioral finance is supplement to the standard finance theories by bringing in behavioral aspect into decision-making process. Contrary to Markowitz and Sharp, behavioral finance deals with individuals and ways of gathering and using information. Behavioral finance is particularly in evidence in stock market anomalies, share valuation, acquisitions and loss-making projects (Pike and Neale, 2006).

The traditional understanding of EMH is illustrated in the following diagram. The key idea is that in an efficient market, all available information is reflected in the market price of securities.

A critical assumption in the traditional framework is that this information, no matter which form of it is being observed, leads directly to the investment decision. These decisions relate to the purchase, sale, issue of securities, or a decision to continue with keeping the securities in the portfolio.

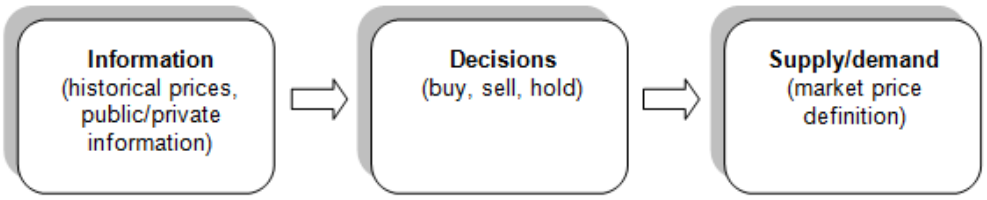

Diagram 1: Traditional model of investment decision-making process

In an efficient market, the market price fully reflects the available information. The only goal of the behavior in this model is the maximization of profits. Buyers and sellers can and do make decisions to optimize their expected return tailored to a particular level of risk.

Diagram 2: Behavioral model of investment decision-making process

In this model there is an additional phase which is located between the available information and the decision to invest. Relevant information, including historical rates, accounting ratios or plans to take over a corporation etc., is inevitably processed by the investors whose behavior is the subject matter of behavioral finance.

Errors in processing affect the investment decisions and, therefore, affect the price in the market. Market prices, defined by supply and demand, can fully reflect the available information, as well as the errors in processing the information.

Nobel Prize laureate in economics for 2002, Daniel Kahneman and Amos Tversky have integrated economy and psychology, and in the process, laid the foundations of behavioral finance. Their work is focused on the process of decision-making under conditions of uncertainty.

They have proven that human decisions are systematically different from those predicted by rational models of decision-making, which is the assumption of traditional economics. Their alternative model, the theory of loss aversion (Prospect theory), provides new insights into the perceived behavior of decision makers. Kahneman and Tversky (1979) have also shown that, by using heuristic shortcuts, decision makers systematically deviate from the principles of probability.

Their work represents a revolution in the field of finance because it has shown that behavioral biases, and in particular the theory of loss aversion, generally gives a better indication of how decisions are made in risky situations.

During the processing of information by investors, there are a few distinctive mistakes (Bodie et al. 2009):

- **Prediction mistakes**: According to the research conducted by Kahneman and Tversky, people attach great significance to recent experiences at the expense of previous convictions (memory bias). According to them, if a company has announced good business results and if a great profit is predicted, the expectations of future price growth are generally too optimistic in relation to the real business of the company. This is manifested in the growth of share prices and a higher P/E ratio, which later leads to a drop in prices and the ratio when investors realize their bad judgment.
- **Overconfidence**: People have it in their character to overly trust in their abilities and the correctness of their beliefs and decisions, and they take actions in the financial markets with too much confidence. This compares to a phrase that there are no bad drivers because they all think they drive perfectly. Excessive self-confidence usually results in more active trading, although according to Barber and Odean's research (2000), it has been determined that 20% of investment accounts with the largest turnover have seven percent lower average returns than 20% of the accounts with the lowest turnover.

- **Being conservative:** Being inert in processing the new information related to the market or companies usually results in overly slow responses to new evidence, causing a delay in trading.
- **The size and representativeness of the sample:** Investors often make decisions on a small sample of information, trying to determine the trend of price movements on the basis of a small amount of information in a short period of time. For example, if a company has published good results in a several quarterly reports, it can be considered as a sufficient signal for investment and can lead to an excessive price growth, although there is a large discrepancy between the market value and intrinsic value of shares. After a certain period, this leads to a shift in the trend since the initial investors' expectations about the company's business trends are usually not met.

And if there was a case in which information is process perfectly, it does not necessarily mean that fully rational decisions would be made. Irrational behavior has a significant influence on investment decisions and the perception of risk and return.
One of the factors that affects rational decision-making is **formulation**, i.e. the way in which relationship between risk and profit, or loss, is formulated. People usually behave differently to risk if it is presented to them with the option of gain, or an option of loss (e.g. tossing a coin and the possibility of gain if the right side is called, or loss if you choose the wrong side of the coin).

Mental accounting is a special type of formulation, which implies that people separate certain decisions in investment, according to the degree of risk. It is very often the case that an investor holds a portion of his portfolio in very high-risk stocks, while having a separate savings account with minimal risk, as a balance. This behavior is manifested in easier decisions to spend the dividend income, which is not the case when it is needed to sell the stocks which have brought the same rate of return, to hold the shares which are making losses (reluctance to realize losses, because at the time of sale they becomes real), as well as to take a greater risk with the realized profit from trade, because it is the earned money and does not mean spending the investor's substance.

Safe decision-making, i.e. investing in well-known large companies, provides an alibi in trade losses, because those investments are considered "safer" than if the money was invested in young and lesser known companies. In this way, loss regret has its justification in the absence of happiness, not in a bad estimate in investments. Furthermore, investing in young companies, through mental accounting, is recorded as the expected and higher return because they carry higher risk.

If rational investors could take full advantage of the irrational investors' errors, then the irrational behavior would have no impact whatsoever on the price movements of stocks, because the rational investors would use any deviation to invest and, in doing so, return the rates to the appropriate level. However, in the behavioral theory there are several factors which limit this possibility:

- **Fundamental risk**: Even if a share is undervalued, it does not mean that the purchase of these shares at the appropriate time is the right choice, because it can happen that the price of the stock continues to fall. It may happen that the purchase of undervalued stocks at the wrong time leads to further losses (even though they are short-term) which can cause a margin call (if it is traded with margin) or that the investors leave the fund which has poor short-term results and has invested in this way.
- **Trading costs**: They are especially conspicuous in the sale of overvalued stocks, the so-called short selling. Some funds or investors do not have the opportunity to trade like this, or can do so only if, in a short time, they buy shares to cover this position, but it carries a high risk of loss.
- **Model risk**: There is always a risk that a wrong model is being used in estimating the value of shares, which gives the illusion that a share is undervalued, but it might actually be its real value. This constant risk limits the trading activity and makes it less attractive.

According to Bikas at al. (2013) traditional finances lies on basic paradigms that portfolio is based on the expected return and risk and is subject to risk based capital asset pricing models, such as CAPM etc. On the other hand traditional finance does not respond to the questions like: why does an investor trades, how does an investor trades, and how does an investor composes portfolios, questions on which behavioral finance tries to give the answers.

4. BEHAVIORAL FINANCE AND THEIR APPLICATION

The emergence of behavioral finance and behavioral economics occurs primarily as a response to those circumstances in making economic decisions which cannot be explained by the postulates of the traditional economy. Postulates of the traditional economy are based on the rationality of market participants when making financial decisions, as well as on the efficiency of the market. A typical feature of behavioral finance is that it uses the findings of social sciences, especially psychology. Psychological studies are based on

limited human rationality, the evident differences found between individuals when it comes to experience, education and expectations, which is a direct consequence of the social and economic status of the individual. Todorovic (2011) points out that behavioral finance, based on the observation and study of the behavior of investors and managers, seeks to add cognitive psychological elements to sophisticated mathematical and statistical models of modern corporate finance.

Behavioral economics can be applied in a variety of areas, especially in modern finance which can no longer be explained only in terms of basic economic principles. Other areas in which behavioral economics is applicable include: organizational economics, public finance and neuroeconomics, and there is also an emerging need for the application of behavioral finance in new areas of psychology.

Behavioral finance is largely successful in explaining the ways in which certain groups of investors behave, especially what kind of portfolio structure they select, and the way in which they trade (Jo and Kim, 2008). Some studies (Grinblatt and Keloharju, 2001; Huberman, 2001; Benartzi, 2001) have shown that ambiguity and familiarity of decisions are the reasons for the insufficient diversification of the investment portfolio. In addition, it often takes fewer resources to investigate local firms than the foreign ones. Guided by this fact, managers prefer local companies' stocks, choosing those with a high expected return. Rationally speaking, the number of transactions should be low because of the high transaction costs. However, the volume of trade on stock exchanges worldwide is extremely high. Best behaviorist explanation for this contradiction is the overconfidence that the investors and portfolio managers have. The hypothesis automatically predicts that people who are more confident will trade more and, consequently, because of transaction costs get lower returns. Several studies (e.g. Shefrin and Statman, 1995) have shown that investors are reluctant to sell assets if, by doing so, they realize a loss or a price which is lower than that at which the assets were purchased. There are two behavioral explanations for this situation. The first explanation implies that investors have an irrational belief when it comes to refunding, while the second one refers to the aversion to loss.

Odean (1999) argues that the attention effect has a great influence on the decision to purchase the shares. It has been shown that individual investors are more inclined to purchase the shares which are designated as "high-attention stock" than to sell them. Barber and Odean (2002) have also come to the conclusion that individual investors typically purchase only a smaller number of shares which have attracted their attention. They create "portfolios of attention" on the basis of several criteria: stocks with above average trading volume, stocks with returns which are well below and above the average, and stocks which are published in the newspapers. Jo (2003) has examined whether managers are considering the psychology and investor's interests when planning the issues of shares. The results of his research have shown that investors prefer companies which are considered to act in a socially responsible way and which attract public attention through marketing campaigns.

Shefrin and Statman (1999) offer numerous behavioral explanations of the fact that investors expect regular dividend payments. The first reason relates to the concept of self-control. Another rational reason for preferring dividends refers to the so-called mental accounting. Shefrin and Statman claim that, by paying the dividends, companies allow investors to avoid regrets for buying a particular stock and for investing their money for those purposes. Baker and Vurgler (2002) argue that changes in dividend payment policies may have a negative effect on the investor's opinion of the company whose shares they have in their portfolio. In addition, their study has shown that it is easier to control the irrational investors than the irrational managers. Heaton (2002) analyzes the consequences of manager's excessive optimism, or a situation in which managers overestimate the likelihood that their company's future performances will be good. Knyazeva (2007) and Yu (2007) have focused on the role of financial analysts in the process of monitoring. They find that the control mechanisms improve the level of connection between managers and shareholders, and give managers an incentive to conduct proper corporate policies. Jo and Kim (2007) argue that the improved transparency in a corporation will reduce the information asymmetry between the different stakeholders, discourage managers to seek self-interest and increase the company's value. In their work, these authors have concluded that the transparency of information is negatively correlated with unethical manipulation and profits, and positively correlated with long-term performances of the company.

The application of behavioral theories has brought about the need to define investment portfolios based on personality and gender. Pompian and Longo (2004) have conducted a study on this topic and came to the following conclusion. Classifying the investors by type, personality and gender, enables the advisors to create programs that mitigate individual bias, encouraging investors to consider long-term strategic directions. Only a few studies have examined the relationship between gender and bias in behavioral finance, and the authors Barber and Odean (2002) have dealt with this phenomenon the most. The conclusion of their study is related to the fact that men have more confidence than women and that it is

reflected in the trading behavior. These authors have found that, over a period of six years, men traded on average 45% more than women. In addition, single men traded 67% more than single women.

Research in the field of behavioral corporate finance is heading in two directions. The first emphasizes that the investors are not fully rational and the markets are not fully efficient, and, therefore, stock prices deviate from their fundamental values. This means that financial managers need to shape the financial and investment decisions taking into account the irrationality of investors. The second approach emphasizes that the managers are not fully rational. Behaviorists in corporate finance consider a postulate in which managers believe that, when making financial and investment decisions, they are working to maximize the fundamental value of the company, but, in reality, they are not doing so because of the psychological traps. Generally speaking, behavioral finance tends to contribute to the reduction of market irregularities, the rational behavior of managers and investors, and the improvement of the quality of investment decisions.

5. CONCLUSION

Although the standard financial theory advocates that investors should have more diversified portfolio, empirical research has shown that very often decisions are made intuitively and according to investors' personal preferences. Real investment strategy should not rely on market efficiency since it is clear that not all the information is publicly available. Furthermore, it often happens that investors direct their attention and expectations to only one type of investment or to specific market instruments. Behavioral finance seeks to explain the way in which market participants make decisions, and to justify the consequences caused by them, aiming to defining a successful investment strategy. The premise of behavioral finance is that conventional financial theory does not take into account the way in which people make complex decisions when having limited information. The proponents believe that one of the reasons for this drawback is the fact that it is relatively easy to acquire data on prices and returns, but it is much harder to study behavior. The aim of this paper is to stimulate discussion and further research in this area, particularly in the context of improving market strategies and proper understanding of the decision-making process in the field of finance.

REFERENCES

Barber, B. M., & Odean T. (2000). Trading Is Hazardous to Your Wealth: The Common Stock Investment Performance of Individual Investors. The Journal of Finance, 55(2), 773-806.

Bikas, E., & Jurevičiene, D. (2009). Approach to personal behaviour finance. Research Papers of Wroclaw University of Economics, 59, 75 – 88.

Bikas, E., Jurevičiene, D., Dubinskas, P., & Novickyte, L. (2013). Behavioural Finance: The Emergence and Development Trends. Social and Behavioral Sciences, 82, 870–876. doi:10.1016/j.sbspro.2013.06.363

Bodie, Z., Kane, A. &Marcus, A. (2009). Osnovi Investicija, Data status, Beograd.

Graham, J. R., Harvey, C. R., & Huang, H. (2009). Investor competence, trading frequency and home bias. Management Science, 55(7), 1094 - 1106.

Grinblatt, M., & Keloharju, M. (2001). How distance, language, and culture influence stockholdings and trades. Journal of Finance, 56, 1053-73.

Hansson, S. O. (2005). Decision theory. A brief introduction. Stockholm: Department of Philosophy and the History of Technology, Royal Institute of Technology (KTH).

Heaton, J. (2002). Managerial optimism and corporate finance. Financial Management, 31, 33-45.

Huberman, G. (2001). Familiarity breeds investment. Review of Financial Studies, 14, 659-680.

Jo, H. & Kim, Y. (2007), Disclosure frequency and earnings management. Journal of Financial Economics, 84, 561-590.

Jo, H. (2003), Financial analysts, firm quality, and social responsibility. Journal of Behavioral Finance, 4, 172-183.

Jo, H., Kim, D.M. (2008). Recent Development of Behavioral Finance. International Journal of Business Research, 8(2), Retrieved from http://www.freepatentsonline.com/article/International-Journal-Business-Research/190463116.html

Jurevičiene, D., Bikas, E., & Gausiene, E. (2012). Behavioural finance during economic downturn in Lithuania. The 7th International scientific Conference „Business and Management 2012", Vilnius Gediminas Technical University. doi: 10.3846/bm.2012.011.

Knyazeva, D. (2007). Corporate governance, analyst following, and firm behavior. Working paper, New York University.

Odean, T. (1999). Do investors trade too much? American Economic Review, 89, 1279-1298.

Pavličić, D. (2007): Teorija odlučivanja. Beograd: Ekonomski fakultet, Centar za izdavačku delatnost

Peterson, M. (2009). An introduction to decision theory, Cambridge University Press, USA

Pike, R. & Neale B. (2006). Corporate Finance and Investment: Decisions and Strategies, Prentice Hall.

Pompian, M. M., Longo, J. M. (2004). “A New Paradigm for Practical Application of Behavioral Finance: Creating Investment Programs Based on Personality Type and Gender to Produce Better Investment Outcomes”, The Journal of Wealth Management
Ricciardi, V., & Simon, H. K. (2000). What is behavioural finance? Business, Education and Technology Journal, 2(2), 1-9.
Shefrin, H. & Statman, M. (1995), Making sense of beat, size, and book-to-market. Journal of Portfolio Management, 21, 26-34.
Shefrin, H. & Statman, M. (1999), Behavioral portfolio theory. Working paper. Santa Clara University.
Todorović M. (2011). Psihologija i finansijski menadžment – Bihevioralne korporativne finansije, Ekonomski fakultet Univerziteta u Beogradu
Tversky, A., & Kahneman, D. (1979). Prospect theory: an analysis of decision under risk. Econometrica, 47(2), 263-292.
Virlics, A. (2013). Investment Decision Making and Risk. Economics and Finance, 6, 169-177. doi: 10.1016/S2212-5671(13)00129-9
Yu, F. (2008). Analyst coverage and earnings management. Journal of Financial Economics, 8, 245–271.

BUDGET CONTROL AND FUND ACCOUNTING

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Abstract: *In this paper the authors analyse implementation of the fund accounting concept in the process of managing non-profit organisations. Control of budget, that is, funds can be ensured by implementing various concepts, including, inter alia, the fund accounting concept. Although its implementation has a long history in the USA and other developed countries, developing countries start paying more attention to the use of public funds and other resources in non-profit organisations only in later stages of development. The paper will highlight the main advantages and disadvantages of this concept, with a view to considering possible introduction of the concept into official or unofficial financial reporting of non-profit organisations in the Republic of Serbia.*

Keywords*: non-profit organizations, funds, control, accounting.*

1. INTRODUCTION

In the circumstances of crisis, control of utilisation and spending of funds in companies is gaining importance. Increasing efficiency of spending and elimination of spending of funds that do not have long-term effect on productivity and profitability of a company should allow survival of operations of businesses in those circumstances. Companies would thus be able to create profit, which represents the key objective of their foundation. On the other hand, non-profit organisations, being business entities whose main objective is not creation of profit, may very easily get bad publicity of the general public and critics if they do not ensure efficient spending in the challenging economic circumstances. These business entities are established for the purpose of conducting activities, the results of which should meet the needs of general public. Alternatively, the entire social community of a certain country should have benefit from the operations of those entities.

Therefore, unlike companies where utilisation of funds should generate income, preferably much higher, in order to ensure higher business result, non-profit organisations use funds to conduct certain activities that are not supposed to generate income and ultimately profit. Non-profit organisations do not need extended reproduction, as it is the case with business entities, to continue operations because the funds they are spending should not be generated by conducting an activity, but they obtain those funds otherwise. In the challenging economic conditions, financial resources raised by these entities are more limited than in regular economic circumstances, therefore control of utilisation of these funds is more important. In such situations, all government authorities are faced with above constraints, not only economies of developing countries. Accounting of non-profit organisations (fund accounting) is one of the concepts used in the process of control of utilisation and spending of funds in non-profit organisations. In the first part of this paper, the authors will analyse how drawing up the budget can be used in the process of managing the spending in non-profit organisations, while in the second part of the paper the authors will focus on the fund accounting concept in non-profit organisations, its advantages and disadvantages in practice.

2. NONPROFIT ORGANIZATIONS, BUDGET AND CONTROL

Non-profit organisations can be financed by governments and therefore they are called governmental non-profit organisations, or can be financed from other sources, in which case they are called non-governmental non-profit organisations. Examples for non-profit organisations can be: governmental units, universities, hospitals, professional organizations, museums, theatres, voluntary organizations... For instance, in 1989 in the USA, out of 7,000 hospitals in the USA, approximately 90% were non-profit organisations (Forgione & Giroux , 1989). Today, out of 5,273 hospitals, about 73% are non-profit hospitals (Health Forum LLC, 2014). As we can notice, activities and/or business conducted by non-profit organisations depend on the needs of the society, not on the possibility to earn profit, although that intention is changing over time due to introduction of corporate governance in all areas of functioning of one country. Legal and physical entities investing funds in these organisations will not be granted share in the equity of the organisations, as it would

be a case with business entities. On the contrary, these entities will not receive any reward in the form of money; therefore assessment of quality of performance of these entities may not take profit as a basis of assessment. It is also the reason why financial reporting and financial reports of these entities are different from companies. With the above in mind, absence of profit in these organisations does not represent certain form of penalisation or control of funds utilisation, as it is a case with corporate entities; therefore, it is necessary to establish control over managing spending of financial resources otherwise. For instance, limitations in utilisation and control of funds utilisation can be established by persons donating funds, because they wish the invested funds to be used for achieving a specific target, for example, construction of buildings, care of people or granting scholarships to certain individuals, etc. On the other hand, in case of governmental non-profit organisations, control over utilisation of funds is achieved by drawing up the budget.

Considering that public revenues represent all revenues generated through mandatory payments by taxpayers – legal entities and natural persons using certain public goods or public service, as well as all other revenues earned by the beneficiaries of budgetary funds and funds of organisations for mandatory social insurance, it is very important to ensure their transparent monitoring. That is the purpose of the national budget. A budget is a one-year or three-year plan in case of capital expenditures, which shows how the collected public funds will be spent over the observed time period. Beneficiaries of the budget funds can be direct and indirect. For example, in the Republic of Serbia, direct beneficiaries of the budget funds are government authorities and organisations, that is local government authorities and organisations, whereas indirect beneficiaries of the budget funds are judiciary bodies, budget funds, local communities, public enterprises, funds and agencies established by the local government which are financed from public revenues, the purpose of which is defined according to special law, institutions established by the government of local government which are controlled by the founder through direct beneficiaries of the budget funds according to the law regulating rights in terms of management and financing. Furthermore, organisations for mandatory social insurance and beneficiaries of Health Insurance Fund (health and pharmaceutical institutions founded by the government or local government) are also seen as beneficiaries of public funds.

The budget foresees how much money will be collected from citizens and corporate sector during the observed period. It is adopted by the highest representative body, the parliament of a country, province or local self-government. Structure of revenues shows who is responsible for creation of revenues, while structure of expenditures shows economic, social and other goals. The legal act according to which the legislative power, that is, the Parliament, approves expenditures and other expenses, and/or revenues and other income, borrowing and other financial transactions for every year is the Law on the Budget of the Republic of Serbia. This Law also contains stipulations relevant for its implementation. In the event when the budget is adopted for the period of three years, revenues and income and/or expenditures and expenses are disclosed for each year separately. On the other hand, decision on the budget is adopted at the local level. It is the most important local political document, that is, legal act by which revenues and expenditures are foreseen at the level of local community for the period of one year. Moreover, direct or indirect beneficiaries of the budget funds are obliged to prepare a financial plan in line with the guidelines for budget preparation and the guidelines for preparation of mid-term plans and projections within the mid-term framework of expenditures provided for by the Fiscal Strategy. Utilisation of funds of non-profit organisations is naturally controlled through financial reporting and preparation of financial reports which may be official and unofficial.

3. FUND ACCOUNTING AND GOVERNMENTAL ACCOUNTING

As mentioned above, financial reporting related to non-profit organisations is different from financial reporting intended for business entities. For long time professional organisations show intention to unify the global accounting standards which are used by companies, whereas the difference in standards of non-profit organisations is considerably larger. There is also a difference in the financial reporting between government and non-governmental on-profit organisations. The first organisations usually have dual financial reporting, that is, they prepare both mandatory and official financial reports in compliance with the accepted accounting standards (e.g. IPSAS - International Public Sector Accounting Standards) and internal or unofficial financial reports, which allow better control over the utilisation of funds.

On the other hand, non-governmental non-profit organisations commonly only organise unofficial financial reporting, except in special cases. Governmental accounting is usually understood as official financial reporting of governmental non-profit organisations, whereas fund accounting represents a concept which usually refers to internal financial reporting of both governmental and non-governmental non-profit organisations, although it can also be applied to governmental accounting, if regulated so by state regulations. It is commonly considered that this concept cannot serve as the basis for quality control of spending by governmental non-profit organisations, if it is independently used as a concept.

The concept of fund accounting is based on the term “fund” which has been since 1900 referred to as the account in which money is collected for specific ultimate purpose (James, 1950). This concept has been used in governmental accounting in the USA for an entire century (Ingram, 1986). Implementation of the fund accounting concept is usually recommended for expendable fund entities, because other two types of funds (proprietary and fiduciary fund entities) also require implementation of other financial reporting concepts (Jeter & Chaney, 2011). In case of expendable fund entities all collected funds will be spent over certain period, one year or during some other specific period. The purpose of spending these funds must be pre-defined and the funds must be spent exclusively for that purpose. An example for these organisations can be a fund intended for implementation of capital projects, such as construction of a highway or debt service fund created to account for interest and principal payments on long-term debt (Jeter & Chaney, 2011). In addition, debt service fund can have a separate principal account and interest account in which funds can be used only for that particular purpose.

In case of fund accounting there are no revenues, expenses and financial result as measures of successful functioning, but fund resources (inflows), decreases in fund resources (outflows) and change in fund balance. Term “expenses” is not commonly used in fund accounting, because this term is mainly used in the context of revenue generation, that is, in financial reporting of companies each expenditure and revenue must be presented against each other. Bearing in mind that in non-profit organisations revenue does not represent a goal and as such cannot be found, in fund accounting we commonly use the term “expenditures”. This term shows spending of funds which will not lead, as a result, to creating certain production outcome – service or product and it will not be opposed to revenue. However, fund accounting is often used in combination with concepts of accrual accounting and budgetary accounting, in order to ensure better and more efficient funds utilisation control.

4. ADVANTAGES AND DISADVANTAGES OF FUND ACCOUNTING

Advantages and disadvantages of fund accounting are usually classified in four categories (Hoek, 1996):

- economic (efficient allocation of funds),
- financial governance (considering the state apparatus performs different activities, one concept may not meet all requirements),
- political and administrative.

What is frequently mentioned as a drawback of the fund accounting concept is spending of the funds for the particular purpose for which they are earmarked, but to an unnecessary extent. IRS (Internal Revenue Service) in the USA is an organisation which has been criticised for excessive spending. According to Chubin (2013), an official appearing before Congress testified that the disputed conference in California would have cost $ 1million less if it had been held in another city. However, the funds planned for the conference reached the amount of $4.1 million because the funds were simply available and allowed numerous benefits for the conference participants, such as tickets for baseball match and the like (Urbanski, 2013). According to the same source, IRS spent in the period 2010-2012 approximately $50 million for organising about 220 conferences for employees.

Although at first glance misappropriation (inefficient allocation) of funds by non-profit organisations includes use of cash, in practice that misuse very often, almost always, refers first to utilisation of fixed assets. The reason for that is use of cash basis accounting concept which does not see acquisition of fixed assets as acquisition of assets that can be used over longer period, but as outflow of cash funds incurred by acquisition of fixed assets. The above practice would not be the case in financial reporting of companies where outflow of funds would be recognised as purchase of assets that would be later depreciated. Therefore, non-profit organisations need not justify utilisation of fixed assets because those assets technically do not exist in the records (Tanzi & Prakash, 2000). This is the reason why it often happens that state schools and similar institutions in the city centre or at attractive locations are sometimes no longer used or half-empty, because governments simply do not have records how public assets are opportunistically used for present purposes. It is often the case that certain ministries in the government do not even keep track of the fixed assets managed by its organisations.

According to Chubin (2013), the fund accounting concept should no longer be used as it leads to excessive spending and lower control of spending by employees in the U.S. government. The author points out that it is necessary to stop comparing the budgeted inflows of money with the actual inflows and the budgeted with the actual expenditures and start using revenues and expenditures as companies do and, in other words, introduce corporate spirit into these organisations. From the aspect of allocation of funds, it is assumed that beneficiaries of funds will spend all allocated funds as the following year they would otherwise receive lower

amount of available funds. Another reason for spending funds is a possibility that beneficiaries will not later be able to justify the funds allocated. The above practice causes surplus of employees who are still employed, surplus of public procurement or replacement of still functional and usable assets. It is assumed that implementation of the corporate financial reporting would reduce expenditures and number of employees, whereas introducing the reward system for employees for efficient utilisation of funds would increase employees" motivation to use funds economically (Chubin, 2013).

Among arguments in favour of implementation of this concept may include that the problem is not comparing of the budgeted with the actual inflows of funds and expenditures, but inadequate determination of marginal values of available funds. In other words, maybe the problem lies in the budgeting process. After all, fund accounting, as we have proved, refers to the organisations where, as a rule, spending is not continuous (which would be the budgetary accounting concept), but it is time-bound. Accordingly, as it is noted (Reiffe, 2013), the purpose of the fund accounting concept is to separate funds with limited use from the funds where there are no such limitations and to monitor the use of those funds for pre-defined purpose and therefore it is not connected with the determination of the budget amount. Furthermore, implementation of the corporate financial reporting may not automatically cause reduction of expenditures and lead to more efficient utilisation of funds, as it is intended, but might lead to increased revenue, in this case inflow of available funds, in order to enable inefficient spending of funds.

Those criticising this concept stress that it leads to reduced comprehensibility of the information it produces. It is considered that the main stakeholders do not obtain information that would be relevant to them for making business decisions. Further, they state that the concept is much more focused on harmonisation with legal regulations than on estimation of efficiency of funds utilisation and it may conceal unjustified use of funds.

Bearing in mind that the fund accounting concept has long been implemented, objections to this concept have also followed it throughout its use. For instance, in the 1970s, financial problems of New York City became more notable through considerable fall in the sales of city"s bonds in 1974, but it did not affect the rating of the city"s bonds until 1976 (Herzlinger & Sherman, 1980). Many market analysts pointed out at that time to inadequacy of the financial reporting concept because it did not timely warn investors of possible worsening of the bond rating until it became obvious. It was later confirmed that the reasons for worsening of the city"s financial standing resulted from poor internal control and inadequate accounting system organisation.

The research conducted by Ingram (1986) confirmed similar findings, indicating that there is no evidence that governments deliberately apply this method in order to make financial reporting more incomprehensible. The research results show that this concept produces useful information for key stakeholders in situations when investors wish to invest in municipal bonds (Ingram, 1986). Ironically, despite all disadvantages and advantages of the fund accounting implementation, the most important change in relation to improving comprehensibility of financial reports in international, but also local practices would actually be to make these reports more publicly available These organisations are commonly exempt from tax payments, therefore all stakeholders paying tax should be allowed access to the financial reports of non-profit organisations and be able to analyse them. Although according to the law non-profit organisations are obliged to make their financial statements publicly available in almost all countries worldwide, as it is done by companies, they rarely comply with that stipulation so that users of these reports are short of information relevant for business decision-making. (Herzlinger & Sherman, 1980).

5. CONCLUSION

The aim of creation and development of the fund accounting concept is to increase comprehensibility and fair presentation of transactions which are typical for non-profit organisations. Importance of applying this concept is manifested in clear monitoring of funds earmarked for specific purposes, how much funds has been spent and for which purpose and how much is available for achieving the main goal of these organisations. Irrespective of their non-profit nature, financial reporting of these organisations still needs to be economical. Although one of key disadvantages of the fund accounting concept is complexity of information it produces, which is also related to high costs for obtaining such information, use of this concept is justified if the benefits exceed costs. Considering the economic conditions in developing countries, stricter control of spending public funds is highly important. The aforementioned also refers to non-governmental non-profit organisations which are operating based on investment from funds of individuals or organisations because it is important for the owners of allocated funds that funds are used for performing pre-defined activities. We believe that it necessary to apply different concepts in financial reporting in order to ensure that their main functions are met.

6. REFERENCES

Chubin, H. (2013). Time to Abandon Fund Accounting in Government. Accounting Today, 27 (8), p. 11.

Forgione, D., & Giroux , G. (1989). Fund Accounting in Nonprofit Hospitals: A Lobbying Perspective. Financial Accountability & Management, 5 (4), pp. 233-245.

Health Forum LLC. (2014, January 2). Fast Facts on US Hospitals. Retrieved February 2014, 23, from American Hospital Association: http://www.aha.org/research/rc/stat-studies/fast-facts.shtml.

Herzlinger, R., & Sherman, D. (1980). Advantages of Fund Accounting in Nonprofits. Harvard Business Review, pp. 94-105.

Hoek, P. (1996). Fund Accounting and Capital Budgeting: European Experiences. Public Budgeting and Financial Management, 8 (1), pp. 26-46.

Ingram, R. (1986). Tests of the Fund Accounting Model for Local Governments. Conemporary Accounting Research, 3 (1), pp. 200-21.

James, R. (1950). Three Major Concepts in Governmental Accounting Theory. Accounting Review, 25 (3), pp. 307-315.

Jeter, D., & Chaney, P. (2011). Advanced Accounting. New Jork: John Wiley & Sons (Asia) Pte Ltd.

Reiffe, A. (2013). In Defense of Fund Accounting. Accounting Today, 27 (10), p. 8.

Tanzi, V., & Prakash, T. (2000, November). The Cost of Government and the Misuse of Public Assets. Retrieved February 2014, 24, from Social Science Research Network: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=880249&download=yes.

Urbanski, D. (2013, Jun 2). IRS Spent $50 Million for Conferences, Report Finds; „Expensive Presidential Suites," „Free Drinks". Retrieved February 23, 2014, from The Blaze: http://www.theblaze.com/stories/2013/06/02/irs-spent-50-million-for-conferences-report-finds-expensive-presidential-suites-free-drinks/.

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THE CRITIQUE OF INTEGRAL BUSINESS PERFORMANCE MEASUREMENT SYSTEMS

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Abstract: *Integral performance measurement systems have been in a focal point of both scholars and practitioners for more than three decades. In today's business environment which is characterized by tremendous competitiveness and globalization of business, performance measurement becomes a critical success factor. In spite of the fact that performance measurement systems receive significant attention, studies focused on critical perspectives are still at the infantile phase. This paper aims to provide a theoretical overview of upsides and downsides of currently used integral performance measurement systems.*

Keywords*: business performance, performance measurement systems, financial indicators*

1. INTRODUCTION

Integral performance measurement systems have been in a focal point of both scholars and practitioners for more than three decades. Many authors have argued that performance measurement is a key success factor for decision making. From the qualitative point of view, aforementioned statement can be viewed from the prism of paradigmatic maxims such as "what can not be measured can not be managed" or "you get what you inspect, not what you expect."[1] However, the quantitative confirmation to the statement is not easy to provide, regarding the fact that the term – integral performance measurement systems – has been ambivalently interpreted by various scholars (Franco-Santos et al., 2012). The same term is used by Bititci et al (1997). On the other side, scholars simultaneously use the term comprehensive performance measurement system (Hall, 2008; Franco-Santos et al., 2012), business performance measurement (McAdam and Bailie, 2002), and strategic performance measures (Atkinson, 1998; Ittner et al, 2003; Bourney and Widener, 2007).

In spite of the fact that performance measurement systems receive significant attention, studies focused on critical perspectives are still at the infantile phase. This paper aims to provide a theoretical overview of upsides and downsides of currently used integral performance measurement systems. Specific objectives of the study aim to contribute to the current body of knowledge in the area by emphasizing critical points of common integral performance measurement systems. More precisely, the study will address the issues of performance measurement normalization, information optimization, adequate structures of relations among particular performance measures within the system, a synthetic of performance measurement and the issues of design, implementation and development of performance measurement systems.

To the best of author"s knowledge a study of this kind has never been conducted before. The study is a part of the comprehensive study which addresses the issues of design, implementation and usage of integral performance measurement systems.

The remainder of the paper is organized as follows: the second section elaborates on the role and importance of business performance measurement systems, thus emphasizing the potentials of appropriate design and usage. The third section presents a review of most commonly cited integral performance measurement systems both from the point of view of the practical usage and citations in the academic literature. The fourth section provides the set of critiques to aforementioned systems. The fifth, and the last chapter provides concluding remarks, managerial implication and recommendations for further research in the area of business performance measurement systems.

[1] The first one is bind to a management guru Peter Drucker, whereas the second one is attributed to the consultant, Oliver Wright.

2. THE ROLE OF INTEGRAL PERFORMANCE MEASUREMENT SYSTEMS

Modern business environment characterized by ubiquitous competitiveness and globalization, performance measurement becomes a critical success factor. Business performance measurement systems aim to align a variety of organizational activities, processes and resources with overall and specific business objectives and strategy. Simmons (1991) indicates that these systems can support the formulation and communication of business strategy. Determining, structuring and adequate emphasizing of particular performance measures and comparing them to predefined management ambitions makes strategy more specific. Thus, business performance measurement systems enable the lower level of management structures (supervisors) to comprehend business objectives (Drew and Kaye, 2007; Mooraj et al, 1999). Thus, business performance measurement systems are useful to both higher-level (Ittner and Larcker, 2003; Kaplan and Norton, 2006) and lower-level management (Wouters, 2009). Nevertheless, empirical studies are not unanimous regarding the statement that effective measurement system necessarily leads to the achievement of strategic objectives, which is confirmed in the study conducted by Verbeeten and Boons (2009).

Business performance measurement systems also have a controlling function. In its rudimental form, this function was primal and was consisted of diagnostic control, where employees knew exactly what had to be improved in order to increase overall efficiency (Simmons, 1995). Furthermore, each performance measurement system has to connect long-term strategic organizational objectives with comprehensible and measurable determinants, creating the basis for comparison with both external and internal elements. Business performance measurement systems have to facilitate the establishment of standards for inter-organizational and intra-organizational comparison. This function can be defined as diagnostic, as it indicates the degree of the achievement of organisational objectives. Business performance measurement systems set the reliable basis for business decision making process, and subsequent performance management (Bisbe and Malagueño, 2012). A systematic and comprehensive measurement of performance should indicate whether efforts within an organization have effects on the achievement of preset objectives. If these efforts are compatible to predefined objectives, they will be rewarded. Therefore, business performance measurement systems also have the role of evaluating and rewarding employees (Van Veen-Dirks, 2010). An adequate business performance measurement system facilitates proper and rational communication of predefined strategy through an organization as a whole. This function was discussed in a myriad of different studies (Atkinson, 2006; Murby and Gould, 2005; Braam and Nijssen, 2004; Kaplan and Norton, 2004; Kaplan and Norton, 2000). Performance measurement drives asymptotical communication of the vision and mission of an organization. Additionally, performance measurement systems should prevent the appearance of information overload (Großwiele et al, 2012). A proper system has to refine data in order to provide management with the filtrated set of information useful for the decision making process. Effective communication, as a result of proper functioning of performance measurement system, should enable a successful coordination of activities and processes within an organization. Thus, performance measurement system has a communicating and coordinating function in an organization. This is why performance measurement systems have been recognized as an important management tool not only in managerial accounting and financial management, but also in other functional areas of management, such as marketing (Löning and Besson, 2002), operations management (Evans, 2004; Andrews et al, 2001), and human resource management (Bontis et al, 1999).

Scholars and practitioners are currently focused on the usage of integral performance measurement systems, meaning both the implementation and creation of the strategy (Gimbert et al, 2010; Kaplan and Norton, 2008; Bourne et al, 2000). This is especially important noting that 85% managers spend more time considering operational measures of realization than strategic ones. Nevertheless, this function of performance management systems has not been sufficiently investigated, so it will not be a topic of a further discussion in this paper. Performance measurement represents a connection between organizational objectives and results, which leads to business operations optimization. This shifts the focus of activities towards results, supports communication between organizational departments and individuals and creates information feedback regarding objectives achievement. Recent studies indicate the significance of performance measurement systems for formulating and reformulating strategy using “bottom-up” approach (Widener, 2007; Henry, 2006; Tuomela, 2005; Bisbe and Otley, 2004). Performance measurement system enables the creation of an information feedback which limits the communication constraints and determines the base for continuous strategy implementation. Consequently, this leads to long-term approach to objectives achievement and elimination of potential short-term sub-optimizations.

Finally, educational function of performance measurement has to be mentioned (Melnyk et al, 2004). Employees identify measured elements as something of importance for their organization. If something is identified as important, more efforts will be put in a realization of such measures. Naturally, this should stimulate professional training in related areas by continuous improvement and education.

3. A REVIEW OF INTEGRAL PERFORMANCE MEASUREMENT SYSTEMS

The field of measuring business performance still lacks the standardization which affects non-cohesiveness in defining performance measurement systems. Marr and Schiuma (2003) emphasize that there is no single body which would gather and systematize an immense body of knowledge. The diversity and non-cohesive approaches in defining performance measurement systems are also evident. Depending on observed criteria, different authors have given their own definitions of integral performance measurement systems. For instance, Ittner et al. (2003) suggest that performance measurement systems provide information which might advance their chosen strategies and demonstrate a cause-and-effect link between non-financial areas and cash flow, profit, or stock price. This definition indicates strategic nature of the system and the necessity of determining chronological sequence of managerial actions which are based on previously defined performance measures. On the other side, Hall (2008) points out that "comprehensive performance measurement systems include a more diverse set of performance measures, and performance measures that are linked to the strategy of the firm and provide information about parts of the value chain. A combination of various indicators in a functional system is in a focal point of this definition. Both aforementioned definitions are related to a function of performance measurement systems."

Nevertheless, definitions where features of performance measurement system can be also found in literature. Cheng et al. (2007) assert that performance management systems "supports using a wide set of financial and non-financial performance measures". Hence, defined function of integral systems is to provide management with information for strategic decision making by combining financial and non-financial data.

With regards to the typology of integral performance measurement systems, the most influential ones are (similar typology was given by: Garengo et al, 2005; Jamil and Mohamed, 2011; Yildiz et al, 2011):

(1) Performance measurement matrix (Keegan et al, 1989; Fitzgerald et al, 1991),
(2) Performance pyramid (Lynch and Cross, 1991),
(3) Balanced scorecard (Kaplan and Norton, 1996),
(4) Performance prism (Neely et al, 2002),
(5) Performance measurement based on assessment of business excellence (EFQM, 2012) and
(6) Integral performance measurement model for SMEs (Laitinen, 2002).

All the aforementioned systems share similar features. For instance, the base performance indicators are financial indicators, and none of the systems is complete regarding the functional business performance areas.

4. THE CRITIQUE OF INTEGRAL PERFORMANCE MEASUREMENT SYSTEMS

The initial disadvantages of business performance measurement systems were related to selection of one performance measure which is believed to be the best reflection of state and success of organization as a whole or its particular component. This is especially related to aggregate financial indicators, such as profitability (Chenhall and Langfield-Smith, 2007). This phenomenon is defined as a performance measure mono-dimensionality. The advantages of this mono-dimensional approach are its relative simplicity and potentially high inter-entity comparability of achieved results, where financial indicators are still having a stronghold in modern literature as the most relevant measure (Atrill, 2006; Hagos and Pal, 2010; Shim, 2008). In a relatively simple manner, decision makers are able to perform corrective actions based on abovementioned business parameters in order to improve business performance. Nevertheless, the overall performance can not be expressed with single indicator, no matter how well it represents organizational success or failure. This is the reason why organization has to be observed from multiple perspectives, and to make a balance between performance indicators (Bourne et al, 2000)

Further, as a response to performance measurement system based on single indicator or small group of indicators, concepts of multiple measures of performance were developed. Many authors point out that users of such business performance measurement systems are facing the effect of "information overload" (Iselin et al, 2010; Nudurupati et al, 2011). Meyer and Gupta (1994) note that inclusion of additional indicators is not always correlated to previously implemented performance measures, which leads to inconsistent usage of different indicators. The consequence of such management policy is loss of relevance of business performance measurement system (Kennerly and Neely, 2003). Due to lack of unique and developed methodology for their integration and utilization, the practice of unarticulated use of various business performance measures can not be considered a business performance measurement system. Additionally, Lebas and Euske (2007) emphasize that the aim of business performance measurement system is simplification and abstraction of reality, but not the opposite.

Furthermore, the opinion that improving performance of organizational components leads to improving performance of organization as a whole was widely accepted. This set the thesis that efficient work of

individuals and departments inevitably leads to organizational success (Fry and Cox, 1989). The thesis of hierarchical compatibility of performance measures implies that organizational performance measures can be optimized by optimization of local performances. Such approach eliminates the importance of organizational structure complexity as a factor. Nevertheless, this approach is not universal and can not be applied in practice due to fact that optimization of global performance can not always be achieved by optimization of local performance.

Finally, managers are frequently facing unorganized data and information regarding business performance. Current business performance measurement systems have not created mechanism for integrating all relevant information or reliable basis for creating functional relations between particular performance measures. Possible difficulty in establishment of such systems is related to potential suboptimization, meaning that individual performance are partially optimized, without considering their cause-effect relations. Hence, optimal partial performance do not necessarily lead to optimal global performance of an organization.

Despite decades of efforts of academics and practitioners, discussed integral business performance measurement systems show several disadvantages and inconsistencies. The major criticisms of aforementioned systems are based on the following issues:

(1) Performance measure normalization,
(2) Information overload,
(3) Relationships among performance measures,
(4) Integration of performance measures,
(5) Design, construction and implementation of integral performance measurement systems.

Performance measure normalization. In order to create integral performance measurement system, each performance measure has to be uniformly expressed, and normalized. This is very challenging task due to fact that some performance measures are quantitatively expressed, while the others are qualitatively expressed. Even in the case of quantitative performance measures, normalization is not necessarily simple. For instance, some scales are continual, while other can be discrete. Depending on the level of measurement, theory suggests classification of scales into nominal, ordinal, interval and ratio scales. Likewise, data or measures can be classified into nominal, ordinal, interval and ratio data. There are a few papers which investigate performance measure normalization. Even the authors who are making an effort to explain the normalization methodology base their interpretation on logic and common sense rather than on particular findings. Lohman et al. (2004) suggest the normalization methodology which is based on linear scale from 0 to 10. They justify this methodology by high readability and relatively simple interpretation of aforementioned scale.

Information overload. The recent study conducted by Groβwielle et al. (2013) indicates at least two significant aspects of this problem. The first aspect is related to the efficiency of collecting too much information. In particular management has to consider which economically optimal amount of information will be collected, considering the fact that information are not free. Except for a few studies, cost of collecting performance measures information has not been thoroughly investigated so far (Johnston et al, 2002). The second and probably more significant aspect of this problem is cognitive by a nature. This is related to a managers' ability to process the large amount of information. These issues have been in a focal point of both psychologists and human resource managers. For instance, Marois and Ivanoff (2005) point out that human brain, no matter how complex, has a strictly limited capacity for information processing. This also applies to decision makers in companies and other organizations. Information overload causes confusion of managers and can result with a stress or other disorders in decision making process (Bawden and Robinson, 2009). In accordance to the joint effect of aforementioned factors, the objective of integral performance measurement systems should be providing decision makers with optimal quantum (volume) of information.

Relationships among performance measures. Performance measurement science distinguish three types of relationships between performance indicators (Norreklitt et al, 2000; Malina et al, 2007), which can be logical, empirical or hierarchical. According to Groβwiele et al. (2013), logical relationships arise from definitions and mathematical transformations. Theoretically, profit represents mathematical difference between income and expenses which is a striking example of the definition-based relationship. Furthermore, profitability is an incremental mathematical transformation, as it represents the relation between profit and business assets. Empirical relationships are based on reality observations and establish either deterministic or stochastic relationships between performance measures. Deterministic relationships are quite rare in managerial sciences, which is the reason why academics and practitioners are focused on identifying stochastic relationships. For instance, it is stated that the asset turnover is directly negatively correlated to the sales margin. This may not always be the case, but most often it will. Finally, hierarchical relationships are being established in the case of the ranked order of performance measures. Ranking is usually based on the objective relations, although subjectively defined ranking also appears in the practice. The most evident

example of financial hierarchical performance measurement system is DuPont analysis or Economic Value Added™, where all performance measures are hierarchically classified.

Integration of performance measures. Information overload problem solving requires identification of a few synthetic indicators which will represent the actual financial position and earning power of an organization. The solution of aforementioned problem can directly or indirectly lead to new issues and discussion topics, known in literature as the problem of synthesizing performance measure. Synthesizing performance measure can be achieved by various operational techniques. For instance, Franceschini et al. (2007) suggest three approaches:

(1) The concept of relative importance,
(2) The concept of the minimum set of coverage and
(3) The concept of indicator correlation level.

Design, construction and implementation of integral performance measurement systems. Creation of performance measurement system is not one-time process, but the process that should be continually adjusted, in line with changes in external and internal business environment (Beamon and Ware, 1998; Medori and Steeple, 2000). Performance measurement system design, construction and implementation methodology is not uniform. This is why various steps and procedures are needed in order to achieve full functionality of the system. Folan and Browne (2005) stress out that modern design of performance measurement systems requires establishment of documented mechanism for selecting performance measures into integral system. Aforementioned mechanism uses brainstorming for selecting performance measures. Due to subjective nature of this method, Kaplan and Norton (1993) suggest series of workshops and interviews in order to make selection of performance measures more objective. On the other side, Neely et al. (2000) described a pilot process of performance measurement system construction. They suggest incremental changes in aforementioned procedure, which can be described as "the nine steps to performance measurement system implementation" (Neely et al, 1995).

5. CONCLUSION

This paper discusses the role and functionality of the modern integral performance measurement systems. Performance measurement represents a connection between the organizational objectives and results, which leads to business operations optimization. This shifts the focus of activities towards results, supports communication between SBUs and individuals and creates information feedback regarding objectives achievement.

The study finds that modern integral performance measurement systems have weaknesses regarding some of the important criteria for integration, design or functionality of the system. The most important issues are weak possibility of normalizing indicators used within the systems, the information overload and myopia of the system, poor base for demonstration of cause-and-effect relationship between the measures and among the measures and strategic objectives, the lack of a sound base for the integration of financial and non-financial performance measures, and the lack of procedures for the unified design, construction, and implementation of the system. This conclusions sum up the main recommendations for further research in the area. Performance measurement systems have advanced in last three decades, particularly in the area of moving towards the less introvert measures. However, they still lack in the field of uncritical adoption of boilerplate mechanisms which are not applicable in each and every organization.

REFERENCES

Andrews, B. H., Carpenter, J. J., & Gowen, T. L. (2001). A new approach to performance measurement and goals setting. Interfaces, 31(3), 44–54.

Atkinson, A. A. (1998). Strategic performance measurement and incentive compensation. European Management Journal, 16(5), 552-561.

Atkinson, H. (2006). Strategy implementation: a role for the balanced scorecard? Management Decision, 44(10), 1441–1460.

Atrill, P. (2006). Financial management for decision makers. Essex, UK: Pearsons Education Limited.

Bawden, D., & Robinson, L. (2009). The dark side of information: overload, anxiety and other paradoxes and pathologies. Journal of Information Science, 2, 180–191.

Beamon, B. M., & Ware, T. M. (1998). A process quality model for the analysis, improvement and control of supply chain systems. Logistics Information Management, 11(2), 105–113.

Bisbe, J., & Malagueño, R. (2012). Using strategic performance measurement systems for strategy formulation: does it work in dynamic environments? Management Accounting Research, 23(4), 296-311.

Bisbe, J., & Otley, D. (2004). The effects of the interactive use of management control systems on product innovation. Accounting, Organizations and Society, 29(8), 709–737.

Bititici, U. S., Carrie, A. S., & McDevitt, L. (1997). Integrated performance measurement systems: a development guide. International Journal of Operations and Production Management, 17(5-6), 522-534.

Bontis, N., Dragonetti, N.C, Jacobsen, K., & Roos, G. (1999). The knowledge toolbox: a review of the tools available to measure and manage intangible resources. European Management Journal, 17(4), 391–402..

Bourne, M., Mills, J., Wilcox, M., Neely, A., & Platts, K. (2000). Designing, implementing and updating performance measurement systems. International Journal of Operations and Production Management, 20(7), 754-771

Bourney, L., & Widener, S. K. (2007). Strategic performance measurement systems, job-relevant information and managerial behavioral responses-role stress and performance. Behavioral Research in Accounting, 19, 43-69.

Braam, G. J. M., & Nijssen, E. J. (2004). Performance effects of using the balanced scorecard: a note on the dutch experience. Long Range Planning, 37(4), 335–349.

Cheng, M. M, Luckett, P. F., & Mahama, H. (2007). Effect on perceived conflict among mulitple performance goals and goal difficulty on task perforomance. Accounting and Finance, 47(2), 221-242.

Chenhall, R. H., & Langfield-Smith K. (2007). Multiple perspectives on performance measures. European Management Journal, 25(4), 266-282.

Drew, S. A. & Kaye, R. (2007). Engaging boards in corporate direction-setting: strategic scorecards. European Management Journal, 25(5), 359–369.

EFQM (2012). The EFQM Excellence Model. Retrieved from www.efqm.org/en/tabid/132/default.aspx

Evans, J. R. (2004). An exploratory study of performance measurement systems and relationships with performance results. Journal of Operations Management, 22, 219–232.

Fitzgerald, L., Johnston, R., Brignall, S., Silvestro, R., & Voss, C. (1991). Performance measurement in service business. London, UK: CIMA.

Folan, P., & Browne, J. (2005). A review of performance measurement: Towards performance management. Computers in Industry, 56(7), 663–680.

Franceschini, F., Galetto, M., & Maisano, D. (2007). Management by measurement: designing key indicators and performance measurement systems. Berlin: Springer-Verlag.

Franco-Santos, M., Kennerley, M., Micheli P., Martinez, V., Mason, S., Marr B, Gray, D., & Neely, A., (2007). Towards a definition of a business performance measurement system. *International Journal of Operations and Production Management,* 27(8), 784-801.

Franco-Santos, M., Lucianetti, L., & Bourne, M. (2012). Contemporary performance measurement systems: A review of their consequences and a framework for research. Management Accounting Research, 23, 79-119.

Fry, T. D., & Cox, J. F. (1989). Manufactoring performance: local versus global measures. Production and Inventory Management Journal, 30(2), 52-56.

Garengo, P., Biazzo, S., & Bititci, U. (2005). Performance measurement systems in SMEs: a review for a research agenda. International Journal of Management Reviews, 7(1), 25-47.

Gimbert, X., Bisbe, J., & Mendoza, X. (2010). The role of performance measurement systems in strategy formulation processes. Long Range Planning, 43, 477–497.

Großwiele, L., Röglinger, M., & Friedl, B.(2013). A decision framework for the consolidation of performance measurement systems. Decision Support Sytems, 54 (12), 1016-1029.

Hagos, T., & Pal, G. (2010). The means of analysis and evaluation for corporate performances. Annales Universitatis Apulensis Series Oeconomica, 12(1), 438-449.

Hall, M. (2008). The effects of comprehensive performance measurements systems on role clarity, psychological empowerment and managerial performance. Accounting Organizations and Society, 33(2-3), 141-163.

Henry, J. F. (2006). Management control systems and strategy: a resource-based perspective. Accounting, Organizations and Society, 31, 529–558.

Iselin, E. R, Mia, L., & Sands, J. (2010). Multi-perspective performance and organisational performance: the impact of information, data and redundant cue load. International Journal of Accounting, Auditing and Performance Evaluation, 1, 1-27.

Ittner, C., & Larcker, D. (2003). Coming up short on nonfinancial perfomance measurement. Harvard Business Review, 81(11), 88-95.

Jamil, C. Z. M., & Mohamed, R. (2011). Performance measurement system in small medium entreprises: a practical modified approach. World Journal of Social Sciences, 1(3), 200-212.

Johnston, R., Brignall, S., & Fitzgerald, L. (2002). „Good enough" performance measurement: a trade-off between activity and action. Journal of the Operational Research Society, 3, 256–262.

Kaplan, R. S. and Norton D. P. (2008). Mastering the management system. Harvard Business Review, 86(1): 63-77.

Kaplan, R. S., & Norton, D. (1993). Putting the balanced scorecard to work. Harvard Business Review, 71(5), 134–147.

Kaplan, R. S., & Norton, D. P. (1996). Linking the Balanced Scorecard to strategy. California Management Review, 39(1), 53-79.
Kaplan, R. S., & Norton, D. P. (2000). The strategy-focused organization. Boston, USA: Harvard Business Publishing.
Kaplan, R. S., & Norton, D. P. (2004). Strategy maps. Boston: Harvard Business Publishing.
Kaplan, R. S., & Norton, D. P. (2006). How to implement a new strategy without disrupting your organization. Harvard Business Review, 84(3), 100–109.
Keegan, D. P., Eiler, R. G., & Jones, C. R. (1989). Are your performance measures obsolete? Management Accounting, 70(12), 45-50.
Kennerley, M., & Neely, A. (2003). Measuring performance in a changing business environment. International Journal of Operations and Production Management, 23(2), 213-229.
Laitinen, E. K. (2002). A dynamic performance measurement system: evidence from small Finnish technology companies. Scandinavian Journal of Management, 18(1), 65-99.
Lebas, M. J., & Euske, K. (2007). A conceptual and operational delineation of performance, in Neely A. (ed.) Business performance measurement: unifying theories and integration practice. Cambridge, UK: Cambridge University Press, 125-139.
Lohman, C., Fortuin, L., & Wouters, M. (2004). Designing a performance measurement system: A case study. European Journal of Operational Research, 156(2), 267–286.
Löning, H., & Besson, M. (2002). Can distribution channels explain differences in marketing and sales performance measurement systems? European Management Journal, 20(6), 597–609.
Lynch, R. L., & Cross, K. F. (1991). Measure up - the essential guide to measuring business performance. London, UK: Mandarin.
Malina, M., Norreklit, H., & Selto, F. (2007). Relations among measures, climate of control, and performance measurement models. Contemporary Accounting Research, 3, 935–982.
Marois, R., & Ivanoff, J. (2005). Capacity limits of information processing in the brain. Trends in Cognitive Sciences, 9(6), 296–305.
Marr, B., & Schiuma, G. (2003). Business performance measurement – past, present and future. Management Decision, 41(8), 680-687.
McAdam, R., & Bailie, B. (2002). Business performance measures and alignment impact on strategy – the role of business improvement models. International Journal of Operations and Production Management, 22(9-10), 972-996.
Medori, D., & Steeple, D. (2000). A framework for auditing and enhancing performance measurement systems. International Journal of Operations and Production Management, 20(5), 520–533.
Melnyk, S. A., Stewart, D. M., & Swink, M. (2004). Metrics and performance measurement in operations management: dealing with the metrics maze. Journal of Operations Management, 22(3), 209–218.
Meyer, M. W., & Gupta, V. (1994). The Performance Paradox, in Straw B.M. and Cummings L.L. (eds.) Research in Organizational Behavior, 16. Greenwich, UK: JAI Press
Mooraj, S., Oyon, D., & Hostettler, D. (1999). The balanced scorecard: a necessary good or an unnecessary evil? European Management Journal, 17(5), 481–491.
Murby, L., & Gould, S. (2005). Effective performance management with the Balanced Scorecard. Technical Report CIMA/INSEAD.
Neely, A., Gregory, M., & Platts, K. (1995). Performance measurement system design: a literature review and research agenda. International Journal of Operations and Production Management,15(4), 80-116.
Neely, A., Mills, J., Platts, K., Richards, H., Gregory, M., Bourne, M., & Kennerley, M. (2000). Performance measurement system design: developing and testing a process-based approach. International Journal of Operations and Production Management, 20(10), 1119–1145.
Neely, A. D., Adams, C., & Kennerley, M. (2002). The Performance Prism: the scorecard for measuring and managing stakeholder relationships. London: Prentice Hall.
Norreklit, H. (2000). The balance on the balanced scorecard: a critical analysis of some of its assumptions. Management Accounting Research, 11(1), 65–88.
Nudurupati, S. S, Bititci, U. S, Kumar, V., & Chan, F. T. S. (2011). State of the art literature review on performance measurement. Computers and Industrial Engineering, 2, 290.
Paladino, B. (2007). Five key principles of corporate performance management. New York, USA: John Wiley and Sons.
Shim, J. K. (2008). Analysis and uses of financial statement. London: Global Professional Publishing Limited.
Simons, R. (1991). Strategic orientation and top management attention to control systems. Strategic Management Journal, 12(1), 49–62.
Simons, R. (1995). Control in an age of empowerment. Harvard Business Review, 73(2), 80–88.
Tuomela, T. S. (2005). The interplay of different levers of control: a case study of introducing a new performance measurement system. Management Accounting Research, 16, 293-320.
Van Veen-Dirks, P. (2010). Different uses of performance measures: the evaluation versus reward of production managers. Accounting, Organizations and Society, 35, 141-164.

Verbeeten, F., & Boons, A. (2009). Strategic priorities, performance measures and performance: an empirical analysis in Dutch firms. European Management Journal, 27, 113-128.
Widener, S. K. (2007). An empirical analysis of the levers of control framework. Accounting, Organizations and Society, 32(7–8), 757–788.
Wouters, M. (2009). A developmental approach to performance measures – results from a longitudinal case study. European Management Journal, 27, 64-78.
Yildiz, F., Hotamişli, M., & Eleren, A. (2011). Construction of multidimensional performance measurement model in business organizations: an empirical study. Journal of Economic and Social Studies, 1(1), 33-51.

SOVEREIGN CREDIT RATING PREDICTION USING FUZZY LOGIC

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Abstract: *In this paper, we have used the fuzzy logic approach to predict future credit ratings for countries. The proposed fuzzy model is implemented in MATLAB software. As model inputs we have taken data from the World Bank for 14 countries around the world, for the period from 1996 to 2013. The model is built using historical data and expert knowledge, and then tested for randomly chosen years. Results that are obtained in this way are then compared to the real sovereign credit rating grades.*

Keywords*: credit rating, prediction, fuzzy logic.*

1. INTRODUCTION

Credit rating represents forward-looking opinions about risk due to unexpected changes in counterparty's credit quality. The sovereign credit rating is a credit rating assigned to a national government or another sovereign entity. A credit rating of a country represents its political, social and economic stability. This rating should reflect some basic information about an observed country like riskiness of investment in a particular country, probability of bond issuer default, the ability of a government to reconcile its obligations, Central bank's borrowing cost and similar vital characteristics of a county's creditworthiness. Nowadays, financial markets are unstable and hard to keep track of, so in this study we seek to predict future credit rating assigned to a country by using some basic county's indicators, historical rating grade changes and probability of credit quality change.

When determining which predicting technique to use, analysts look for forecasting method that minimizes forecast errors. Fuzzy logic turns to be one of a new ways for predicting movements of different factors in the economies. It is designed to solve problems in the same way that humans do: by considering all available information and making the best possible decision given the input. It assumes that we have advanced knowledge about entities and movements we are trying to predict.

Data used in this study are explained in Section 2. The same section gives detailed explanations concerning input data selection criteria and data transformation process. Section 3 presents the proposed fuzzy logic model with detailed specification of inputs, outputs, fuzzy rules and overall model structure. The results of the proposed model are presented in Section 4. Finally, Section 5 concludes the paper.

2. DATA

In this study dataset of fourteen countries are taken into account. These counties are mainly chosen by the criteria of the frequent sovereign credit rating grade changes over time. These grades are published by some leading rating agencies like Moody's, Standard and Poor's, Fitch and other. Each of them use their own model based on public and non-public data to determine agency's opinion on government creditworthiness. The analyzed countries are: Argentina, Brazil, Dominican Republic, Estonia, Greece, Hungary, South Korea, Romania, Russia, Slovakia, Slovenia, Turkey, Uruguay, Venezuela. Data sets cover the period from 1996 to 2013.

2.1. History of credit rating grades

Historical credit rating time series used in this paper are published by Fitch rating agency. According to qualitative ordinal scale that Fitch publishes (Fitch Inc., 2011): "AAA" ratings denote the lowest expectation of credit risk. They are assigned only in cases of exceptionally strong capacity for payment of financial commitments. This capacity is highly unlikely to be adversely affected by foreseeable events, "AA" ratings denote expectations of very low credit risk, etc. These ratings are followed by sovereign categories which are considered to be increasingly riskier to invest in. Rating category "D" indicates that a country is in a state of default.

These series of data contain rating of sovereign debt in chronological order. However, they need to be slightly modified to suit to the country-year data format convenient for further manipulation.

For targeted countries that for single year have more than one credit rating grade, provided by Fitch as an opinion on risk of loss due to credit risk, arithmetic mean rounded by fewer is taken as a grade for the observed year. What is meant here by the credit rating mean? If we assume that, each credit rating category can be expressed as a unique integer value instead of a combination of letters, then we can introduce a presumption that the average value of this rank ordered values assigned to letters can be a suitable estimation of credit rating grade. Missing observations of country's rating for some years are handled in such manner that the average value of the credit rating grade between two observations we are familiar with is assumed for observed year.

2.2. Transition matrix

Since Fitch sovereign rating history is used for obtaining necessary data about historical rating grade changes, therefore Fitch's transition matrix is selected as a next very important input parameter further in this process. Transition matrix consists of migration probabilities from one to another credit rating category over the given horizon. It also reflects different trends in the credit quality change across the major credit categories. For the purpose of this study, Fitch's one-year transition matrix is used, with the intention to these migrations match the one-year interval of already mentioned historical rating observations.

2.3. Country indicators

In order to explain the variability of sovereign credit rating some basic financial, health, economy and growth country indicators are taken into account. All of the indicators are mostly official-source data from the World Bank. They were selected in such order that in some way can affect and be related to the country's credit rating grade. In this model are included following indicators:

- Unemployment rate refers to percent of the total labor force that is unemployed. It represents the share of the labor force that is without work but available for and seeking employment. It is assumed that this rate is inverse to credit rating grade.

- Gross Domestic Product Growth (GDP growth) represents the annual percentage growth rate of gross domestic product at market prices based on constant local currency. Here, we suppose that the growth of GDP will raise observed country's ability to meet its obligations.

- Central Government Debt expressed as percentage of GDP. Debt is the entire stock of direct government fixed-term contractual obligations to others outstanding on a particular date. It includes domestic and foreign liabilities such as currency and money deposits, securities other than shares, and loans. It is the gross amount of government liabilities reduced by the amount of equity and financial derivatives held by the government. (World Bank Source, 2013) The bigger the debt in percents of GDP is, the country's financial situation is considered to be worse.

- Under-five mortality rate is the probability per 1,000 that a newborn baby will die before reaching age five, if subject to current age-specific mortality rates. Estimates developed by the UN Inter-agency Group for Child Mortality Estimation. (World Bank Source, 2013) It is believed that countries with lower mortality rates of children and thus probably more developed health system will have healthier economy as well.

- Lending Interest Rate is the bank rate that usually meets the short- and medium-term financing needs of the private sector. This rate is normally differentiated according to creditworthiness of borrowers and objectives of financing. (World Bank Source, 2013) Higher interest rates compensate higher risk of losing money and these high risks are associated with uncertainty of the country's overall economic situation and its creditworthiness.

- Inflation is measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used. (World Bank Source, 2013) High inflation may signal country's inability to settle its obligations without inserting the new banknotes into the system.

2.4. Data transformation

After all necessary time series are provided, in order to bring all of the variables into proper proportion, data is normalized. In this study, data standardization or z-score method is used to scale all the variables appropriately. To adjust values in such manner, the mean of the sample mean is subtracted from the raw observed value and divided by its standard deviation:

$$z = \frac{x - \bar{x}}{s} \qquad (1)$$

Bearing in mind the nature of the selected indicators there was a possibility that some of them are correlated. To remove this correlation and thus redundancy present in the input data, Principal Component Analysis is used. Although this procedure will reduce our data set into fewer principal components, some losses concerning described variance in the data will be suffered. A principal component represents the weighted sum of the initial variables and accounts for the share of observed variable's variance.

3. FUZZY LOGIC MODEL

It turns to be that in finance and economics, many phenomena are fuzzy, but are treated as if they were crisp. Fuzzy logic is built on a mathematical logic that attempts to solve problems by assigning values to an imprecise spectrum of data in order to arrive at the most accurate conclusion possible. Knowledge can come from experts, from historical data or from some other source. Fuzzy logic is also often applied by advanced trading models/systems that are designed to react to changing markets. It is already widely applied in finance which led us to decide to use it for predicting future movements of countries' credit ratings.

With the help of fuzzy logic, we can define terms such as "high/low risk of bankruptcy" and "high/low probability of credit rating goes up/down" which will help us define rules and predict future credit ratings more accurately.

The fuzzy model is implemented using the Fuzzy logic toolbox in MATLAB. First, we defined inputs, transfer functions, rules and outputs. Then, output is generated using inputs and rules. The structure of our model is shown on the picture below (Fig. 1).

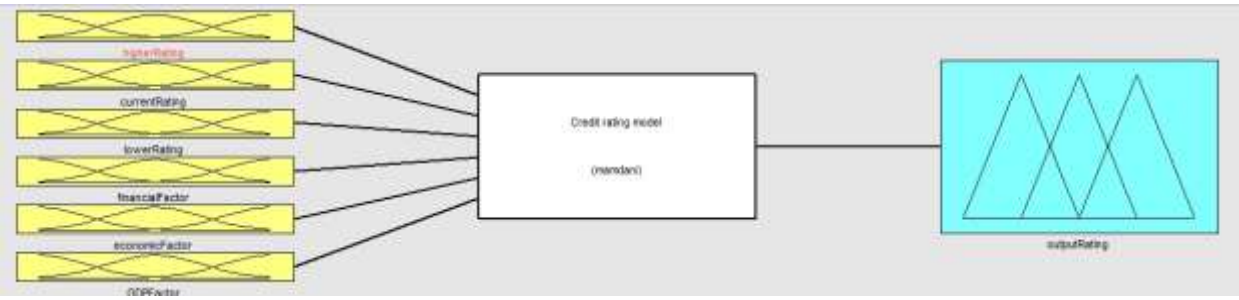

Figure 1: Fuzzy model structure

3.1. Model inputs

We have six input variables in our fuzzy model divided into two major groups. Groups are determined by direct or indirect influence of inputs on the future credit rating of countries.

Inputs that directly influence future credit rating grade are the following:

- Probability of credit rating upgrade (credit rating grade goes up),
- Probability of credit rating downgrade (credit rating grade goes down),
- The probability that credit rating stays the same.

These probabilities are obtained from credit rating transition matrix and depend on possible country's credit rating grade. For each grade, probability that a country's creditworthiness within the credit group will move up, down or stay the same, differs.

Inputs that indirectly influence future credit rating are country's indicators transformed by using statistical tool – Principal Component Analysis. Initial number of indicator variables are reduced on the three linearly interrelated factors that together explain 67.8 percent of the total variance. First of them mostly consists of

two variables – mortality rate and inflation, second is mostly constructed using unemployment rate and central government debt, while third consists of GDP growth rate only. These factors are respectively named:

- Financial factor
- Economic factor
- GDP factor

Every input, in both of these groups, has a numerical value that in general can be considered low, average or high. For each input, we have three membership functions that have a Gaussian shape which role is to map crisp input values into these fuzzy values. As a result of this mapping, initial crisp values are transformed into the degrees of membership to the membership functions. The shape of the functions is same for each of the three functions within the group. The tolerance for these functions overlap here is twenty percent. Minimum and maximum in the input domain are minimum and maximum in our time series data, which are different for every input.

A domain for functions which maps crisp value of an input variable into the value that is considered low is defined using following formula:

$$D_{low} = [a, \quad a + 0.3 \times D + 0.2 \times (a + 0.3 \times D)] \quad (2)$$

where:

$$D - input\ domain$$
$$a = minimum(D)$$
$$b = maximum(D)$$

A domain for functions which maps crisp value of an input variable into the value that is considered average is defined using following formula:

$$D_{avg} = [a + 0.3 \times D - 0.2 \times (a + 0.3 \times D), \quad 0.7 \times D + 0.2 \times (b - 0.7 \times D)] \quad (3)$$

A domain for functions which maps crisp value of an input variable into the value that is considered high is defined using following formula:

$$D_{high} = [0.7 \times D - 0.2 \times (b - 0.7 \times D), \quad b] \quad (4)$$

In the first input group, i.e. group with direct influence, to each of the inputs are assigned three membership functions that represent low, average and high probabilities that a certain outcome presented by that input will occur (Fig. 2). Simplified example may be that if a value of an input variable named probability of credit rating downgrades mostly belongs to the high probability membership function, we can conclude that it is very probable that in next year credit rating for the observed country will go down. Values that correspond to every possible credit rating, and in this model represent values on x-axis, are provided from one-year Fitch transition matrix. On y-axis are degrees of membership to the function i.e. probabilities that the credit rating will indeed go up/down or stay the same, depending on the value on x-axis. Domains for this group of inputs are shown in Table 1.

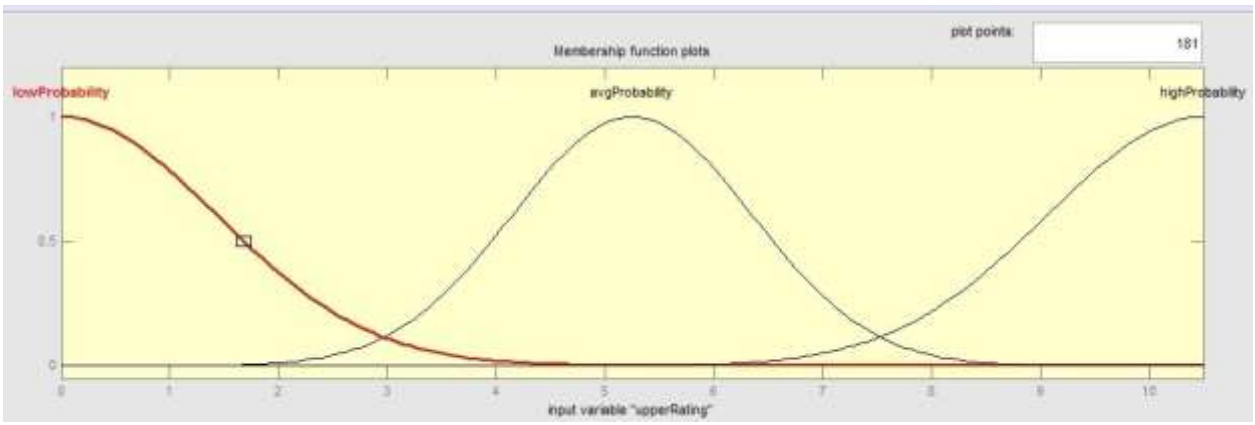

Figure 2: Membership function for rating upgrade

Table 1: Domains for first group of inputs

Name of the input	Domain	Low probability	Average probability	High probability
Higher rating	0 - 10.5	0 - 4.6	1.7 - 8.8	6.2 - 10.5
Current rating	79 - 98.52	79 - 88.1	82.2 - 94.9	89.9 - 98.52
Lower rating	2.19 - 10.5	0 - 5.9	3.7 - 8.8	6.95- 10.5

For the second group of inputs, i.e. group with indirect influence, membership functions represent values that are considered low, average and high values of factors (Fig. 3). Values on the x-axis are observed values of the factors. On y-axis is the degree of which these observed values are low, average or high. Domains for this group of inputs are shown in Table 2. An example, specific for our data set, may be that if value of financial factor is sixty-eight we consider that factor value is high.

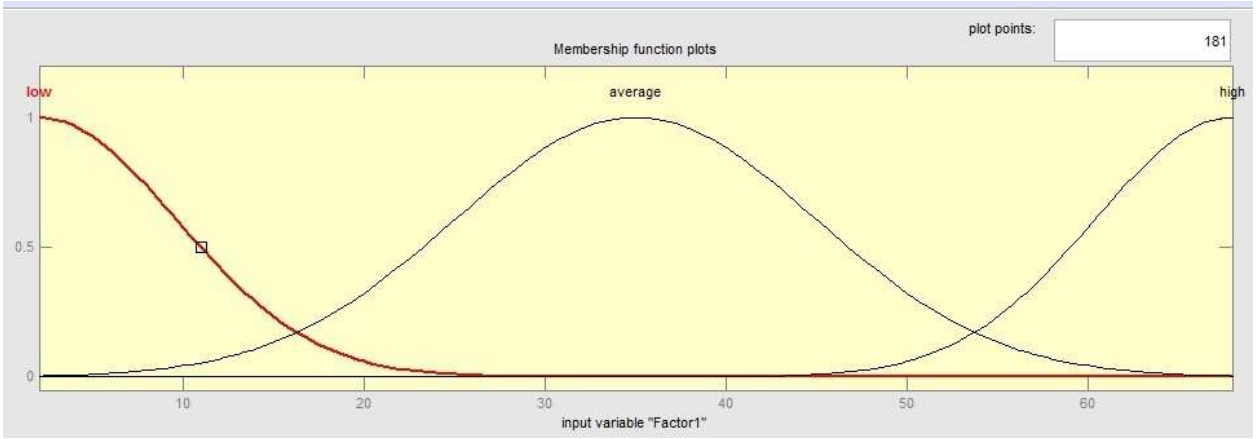

Figure 3: Membership function for financial factor

Table 2: Domains for second group of inputs

Name of the input	Domain	Low value	Average value	High value
Financial factor	2 - 68	2 - 26.9	1 - 59	43.9 - 68
Economic factor	3.2 - 66.4	3.2 - 27.9	1 - 65.4	41 - 66.4
GDP factor	(-10.9) - 18.3	(-10.9) - (-1.1)	(-10) - 17	7.6 - 18.3

3.2. Model rules

Rules are in simple "IF - THEN" shape. "IF" part of the rule consists of several conditions connected with operator "AND". In every rule, for IF part of the rule, we take one out of three possible values for each factor (low, average, high). "THEN" part consists of output taking value that indicates whether credit rating in the next year will go up, down or maintain its current value. Each rule has specific weight. Weights go from 0 to 1, where 0 is no priority and 1 is highest priority, in case that overlaps happens. The model consists of thirty-two rules (Fig. 4). An example of rules that we used is:

IF (upperRating is highProbability) AND (currentRating is averageProbability) AND (lowerRating is lowProbability) AND (Factor1 is low) AND (Factor2 is average) AND (Factor3 is high)
THEN (outputRating is higher) (0.7)

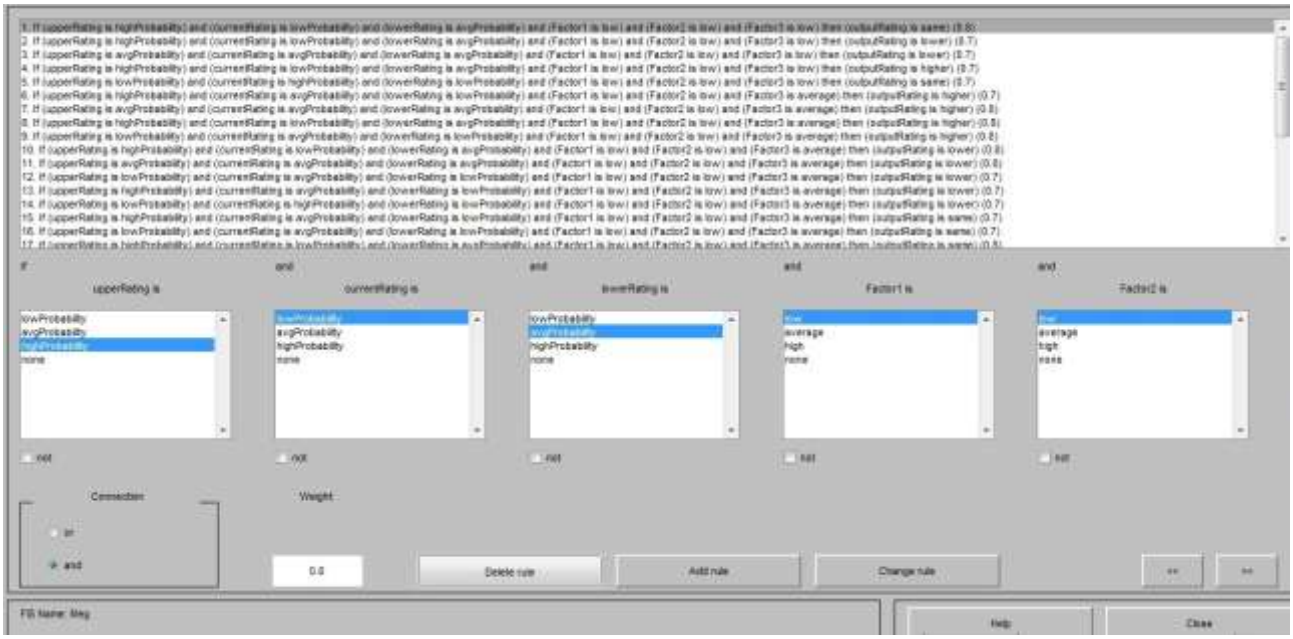

Figure 4: Rules

3.3. Model outputs

We made one output, which represents the future movement of credit rating. The future value of credit rating can be lower, higher or same as a credit rating for the country today. For output, we have three membership functions that have a triangular shape (Fig. 5). Membership functions are not overlapping because we want to achieve crisp output, which will tell us if credit rating will go up, down or stay the same. We also present domain of our output variable (Table 3). We use the centroid method for defuzzyification of output.

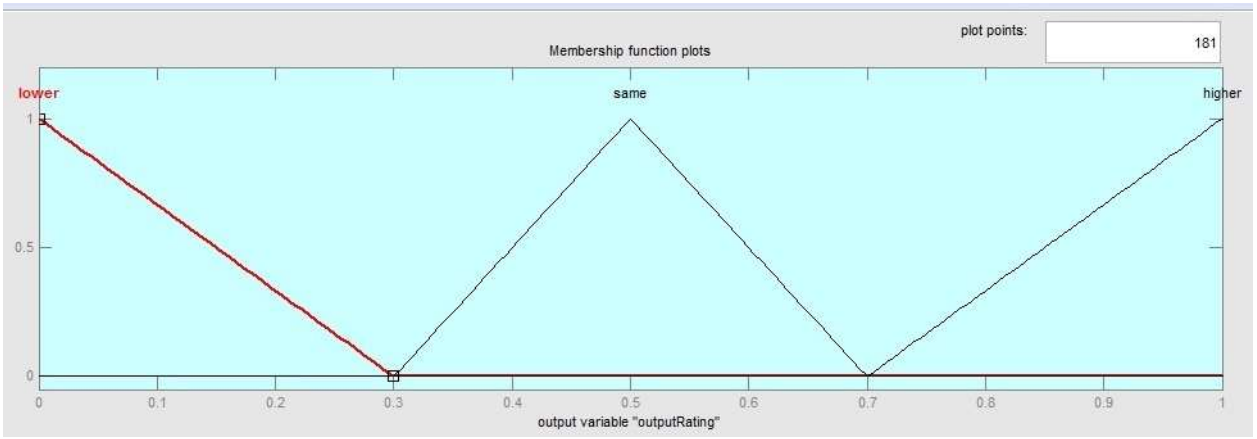

Figure 5: Output

Table 3: Domain for output

Name of the output	Domain	Lower (downgrade)	Same (without change)	Higher (upgrade)
Output rating	0 - 1	0 - 0.3	0.3 - 0.7	0.7 - 1

4. RESULTS

For each country in our survey, we semi-randomly have chosen 3 years within the period from 1996 to 2012. These three years are picked in such manner that in the next year credit rating went up, down or stayed at the same level for each observed country. We took one occurrence of each of these possible outcomes, if such an example existed in the dataset. Then we calculated our prediction for credit ratings for those years, and compared it with real results. We present all of the input values along with the obtained results (Table 4). The last 3 columns of the table are results that we obtained, real results and column which indicates whether we successfully guessed following credit rating grade or not.

Table 4: Results

Country	Year	Upper rating prob. [%]	Same rating prob. [%]	Lower rating prob. [%]	Financial factor	Economic factor	GDP factor	Current credit rating	Our prediction	Real results	Correct / Incorrect
Argentina	1998	8.37	85.02	6.61	9.32	16.34	3.85	BB	Same	Same	Correct
Argentina	2000	8.37	85.02	6.61	8.54	20	-0.78	BB	Same	Lower	Incorrect
Argentina	2009	10.5	79	10.5	10.04	23.28	8.46	CC	Higher	Higher	Correct
Brazil	2001	8.37	85.02	6.61	24.46	25.75	1.31	BB	Same	Lower	Incorrect
Brazil	2003	9.52	86.9	3.58	27.54	30.44	1.14	B	Same	Higher	Incorrect
Brazil	2009	6.99	88.71	4.3	16.71	24.53	-0.32	BBB	Same	Same	Correct
Dominican Republic	2005	10.5	79	10.5	16.85	17.9	9.26	C	Higher	Higher	Correct
Dominican Republic	2008	9.52	86.9	3.58	15.9	16.7	5.25	B	Same	Same	Correct
Estonia	2001	2.98	92.86	4.17	6.48	6.07	6.28	BBB	Same	Higher	Incorrect
Estonia	2004	2.98	92.86	4.17	4.39	5.4	6.34	A	Same	Same	Correct
Estonia	2005	2.98	92.86	4.17	4.3	4.73	8.85	A	Same	Same	Correct
Greece	1999	6.99	88.71	4.3	6.6	40	3.41	BBB	Same	Higher	Incorrect
Greece	2002	2.98	92.86	4.17	4.57	46.48	3.43	A	Same	Same	Correct
Greece	2009	2.98	92.86	4.17	3.32	48.85	-8.76	A	Same	Lower	Incorrect
Hungary	1999	6.99	88.71	4.3	10.02	25.26	3.19	BBB	Same	Higher	Incorrect
Hungary	2001	2.98	92.86	4.17	8.28	22.07	3.17	A	Same	Same	Correct
Hungary	2007	6.99	88.71	4.3	6.48	26.24	0.11	BBB	Same	Same	Correct
Korea	1997	6.99	88.71	4.3	5.44	3.5	4.6	BBB	Same	Lower	Incorrect
Korea	1998	8.37	85.02	6.61	7.23	5.99	-6.85	BB	Same	Higher	Incorrect
Korea	2001	6.99	88.71	4.3	4.74	6.94	3.97	BBB	Same	Same	Correct
Romania	1997	8.37	85.02	6.61	68	9.27	-6.1	BB	Lower	Lower	Correct
Romania	2002	9.52	86.9	3.58	21.94	11.82	5.1	B	Same	Higher	Incorrect
Romania	2008	8.37	85.02	6.61	10.45	6.42	7.93	BB	Same	Same	Correct
Russia	1997	8.37	85.02	6.61	19.23	24.36	1.4	BB	Same	Same	Correct
Russia	1999	8.37	85.02	6.61	39.84	30.38	6.4	BB	Lower	Lower	Correct
Russia	2003	8.37	85.02	6.61	12.7	16.55	7.29	BB	Same	Higher	Incorrect
Slovakia	2004	6.99	88.71	4.3	7.18	20.8	5.06	BB	Same	Higher	Incorrect
Slovakia	2005	2.98	92.86	4.17	5.08	19.61	6.65	A	Same	Same	Correct
Slovenia	2003	2.98	92.86	4.17	5.08	19.61	6.65	A	Same	Higher	Incorrect
Slovenia	2008	3.54	93.43	3.04	3.87	8.86	3.59	AA	Same	Same	Correct
Slovenia	2011	3.54	93.43	3.04	2.5	15.49	0.7	AA	Same	Lower	Incorrect
Turkey	1996	8.37	85.02	6.61	42.61	12.51	7.37	BB	Lower	Lower	Correct
Turkey	2002	9.52	86.9	3.58	27.12	30.07	6.16	B	Same	Same	Correct
Turkey	2004	9.52	86.9	3.58	15.67	26.82	9.36	B	Higher	Higher	Correct
Uruguay	2002	9.52	86.9	3.58	35.68	38.34	-7.73	B	Same	Lower	Incorrect
Uruguay	2006	9.52	86.9	3.58	8.5	27.19	4.1	B	Higher	Higher	Correct
Uruguay	2007	8.37	85.02	6.61	42.61	12.51	7.37	BB	Same	Same	Correct
Venezuela	1999	8.37	85.02	6.61	20.07	17.85	-5.97	BB	Same	Same	Correct
Venezuela	2002	9.52	86.9	3.58	20.19	17.8	-8.86	B	Same	Lower	Incorrect
Venezuela	2004	9.52	86.9	3.58	15.82	22.27	18.28	B	Higher	Higher	Correct

The final performance of the model is shown in the last column of Table 4. We can see that we correctly predicted 25 out of 42 samples. That is 59.52%. We conclude that we have predicted correctly all samples where credit rating is not changing, 18 out 18, with percentage of 100%. Samples where credit rating goes up are predicted correctly 4 out of 14, with percentage of 28.57%. Samples where credit rating goes down are predicted correctly 3 out of 10, with percentage of 30.00%. Therefore, changes in credit rating are harder to predict. This may happen because for each credit rating category the highest probability is that the country will keep its current rating in the next year.

5. CONCLUSION

The importance of a credit rating assigned to a country, as a major indicator of its creditworthiness, is constantly growing. The ongoing economic crisis heightens the need for reducing uncertainty in financial markets.

In this paper, we proposed and tested new fuzzy logic model to be used as a tool for preventing this uncertainty. The leading idea was to approach to the problem from nonstandard angle that uses fuzzy logic as a main tool in our work. Fuzzy logic is relatively young scientific method, and therefore, there is room for

trying to exploit its specific characteristics to our advantage. Since finance itself nowadays is much more fuzzy than crisp, there is a reason more for trying to implement fuzzy logic methodology.

From numerous data sources we obtained some vital country's indicators which variations we suspected can cause credit rating migrations in the time period from 1996 to 2013. We also provided probabilities with which these migrations, according to the transition matrix, may occur for each credit quality class. Finally, historical changes of rating grades are taken into account. After standardization and principal component analysis, all of these input data are transformed into input variables of a fuzzy model. These input values are processed using fuzzy rules based on common sense deduction, expert knowledge and advanced understanding of modeled movements. After the defuzzification process crisp, output rating prediction is obtained.

On a given sample, we managed to predict nearly sixty percent of one-year credit quality migrations. We had more success in predicting situations when credit ratings do not change, but less with predicting changes. Obtained percentage of successful predictions are satisfying, having in mind that there are high probabilities that credit rating will not change in period over one-year, and yet, it does, much more than it is assumed in the beginning with transition matrices. These findings may be of a great interest to investors interested in placement of funds in international market. It provides an opportunity to assess possible future credit risk associated with a country by using publicly available data as a model inputs.

After completing the research, we draw the opinion that this model can be improved in several ways, and that it should be one of the leading goals of our next research on this subject. We suspect the following ways to make the performances of the proposed model better:

- Including more countries and longer time period in our research,
- Changing the rules so they catch more variability in the data (credit rating changes),
- Including more factors in our model,
- Having more strict rules for boundaries of membership functions and domain,
- Changing shape of membership functions.

REFERENCES

Bojadziev G., Bojadziev M. (1997, July). Fuzzy Logic for Business, Finance, and Management, Advances in Fuzzy Systems - Applications and Theory.

Cantor R., Packer F. (1996, October). Determinants and Impact of Sovereign Credit Ratings, FRBNY Economic Policy Review.

Dadios, P. E. (2012, March). Fuzzy Logic - Emerging Technologies and Applications, InTech, doi: 10.5772/2337

Dostál P., Brož Z., (2011). Fuzzy logic investment support on the financial market, Brno University of Technology, Faculty of Business and Management

Fitch, Inc. (2011). Form NRSRO Annual Certification, Application for registration as a nationally recognized statistical rating organization. Retrieved from https://www.fitchratings.com.

Matlab tutorials (n.d.), from http://www.mathworks.com

SAS Institute Inc. (n.d.). Principal Component Analysis. Retrieved from: http://www.support.sas.com

Sivanandam S. N., Sumathi S., Deepa S. N. (2007). Introduction to Fuzzy Logic using MATLAB, Springer

World Bank Source (2013). International Monetary Fund, Government Finance Statistics Yearbook and data files, and World Bank and OECD GDP estimates. Retrieved from http://www.worldbank.org

ACCOUNTING INFORMATION SYSTEM AS THE SOURCE OF CORPORATE COMPETITIVE ADVANTAGE

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Abstract: *Accounting information systems feature as vital segments of the organisational structure of any corporate entity. Only a well-organised accounting information system can produce financial reports meeting the needs of numerous users of accounting information contained in them. High-quality financial reports serve as crucial sources of any corporate entity's competitive advantage, given that they contain high-quality information that a corporate entity can use in its operation with the aim of gaining competitive advantage, and are a product of a well-organised and devised information system. This article will look into the issue of organising an accounting information system, quality of financial reports and the information it produces, factors affecting the quality of financial reports and the confidence of the users of financial reports in their contents, and also the consequences of decisions made based on thus produced financial reports, competitive advantage based on financial reports, and its significance for companies' future business operations.*

Key words: *accounting information system, quality of financial reports, accounting information, users of financial reports, business decisions, competitive advantage.*

1. INTRODUCTION

As a part of a corporate subject's organizational structure, accounting function can exist in various forms. It can exist as an independent organisational unit, or a constituent of another organisational unit. Regardless of how the accounting function is organised, it should be set up so as to produce high-quality information that will meet the needs of all users, both internal and external. Accounting staff constituting the accounting function is the vital factor of its successful work, for the human factor plays the dominant role in the quality of any performance, including accounting tasks. The final objective of it all is financial reporting that should meet the needs of numerous accounting information users.

As products of the accounting function, financial reports are not intended only for the needs of the accounting staff, but also of all the stakeholders both within and outside a corporate entity. Information contained in financial reports is used by both accounting staff and other human resources and services of the corporate entity, tax authorities, inspectors and other public bodies. They are particularly significant for meeting the needs of the management, as the foundation of their decisions, and the prerequisite of the corporate entity's successful operation. The given financial reports also contain the sources of a corporate entity's competitive advantage, which create a stable basis of its future development, and are the result of a well organised and conceived accounting information system.

The accounting function and accounting profession in general have often been neglected in domestic business conditions without plausible reason. In numerous situations, accounting staff have faced disdain, the effort they invested has been underrated, and the significance of the information produced by account misunderstood. This is a consequence of inadequate accounting knowledge and the opportunities provided by the accounting information system. Lately, however, this area has seen significant advances, primarily as the outcome of the contemporary market environment where modern corporate entities operate, characterised by expressed instability, dynamic developments and high levels of risk that corporate entities face on a daily basis. The accounting function and staff are likely to get a much more significant role, resulting from contemporary market trends where corporate entities exist.

2. THE ACCOUNTING FUNCTION AS THE DATABASE OF BUSINESS ENTITIES

Operation of contemporary business entities is inconceivable without a well-organised accounting function. Its significance stems from the broad range of data it receives, transformed into information, and distributed to numerous users. The accounting function's role is reflected in accounting, registering and disclosing all the relevant transactions numerically expressible in terms of value within the corporate entity. Accounting is often erroneously identified with bookkeeping (by those inadequately familiar with accountancy), which is, in fact, wrong, as bookkeeping is only a segment of accounting. The view that accounting and bookkeeping are synonymous therefore represents a wrong approach to consideration of accountancy. Accounting is a much broader concept, and, apart from bookkeeping, it also includes (Dmitrović Šaponja, Petkovič and Jakšić, 2011, 10):

1. **accounting planning** – enables presenting the future business operations of corporate entities using monetary units, unlike bookkeeping, which is past oriented;
2. **accounting supervision or control** – aimed at protecting the integrity of a business entity's assets, and providing reliable and timely accounting information to numerous financial report users;
3. **accounting analysis** – a segment of the corporate entity's overall business analysis; and
4. **disclosure** – producing accounting information with the aim to meet the needs of numerous financial report users.

Each corporate entity can be regarded as a business system, with the accounting system as one of the constituents. To enable the corporate entity to function smoothly, all its subsystems must be well connected and mutually compatible. Operating functions are mutually reliant and connected.

As regards the organisational aspect of accounting in a corporate entity, the following two organisational forms of the accounting function can be identified in the corporate entity:

- independent organisational unit and
- constituent of another organisational unit, mostly the Finance Department.

Depending on the size of the corporate entity, the accounting function can be organised as centralised or decentralised. In current business condition, when the national economic system comprises a large number of small and medium sized corporate entities, they often do not organise this function within, but rather outsource service of professional accounting agencies, which they entrust with keeping accounting records for a certain remuneration.

The modern-day business and economic practice has seen the emergence of new forms of organisation in accounting, based primarily on cost-effectiveness in the organisation of accounting, these new forms being (http://www.vikrevizija.hr/usluge/organizacija-racunovodstva.html, accessed April 10, 2014):

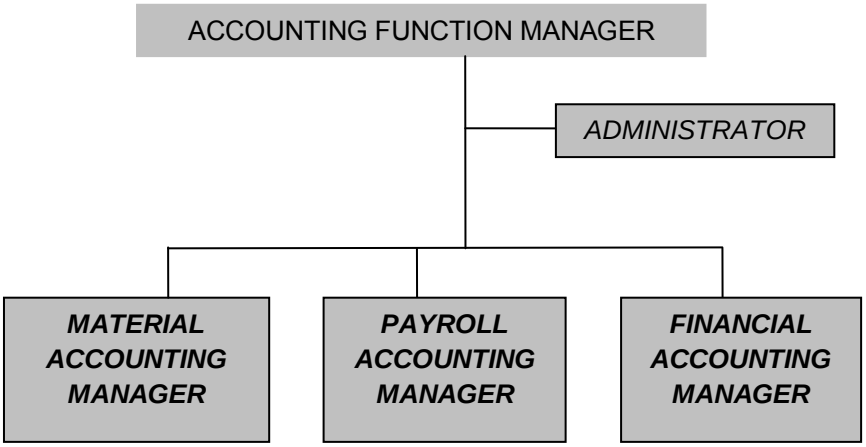
> in-house accounting service,
> outsourcing the services of accounting agencies,
> combination through outsourcing third persons and part-time work.

The in-house model of organising the accounting function means that the accounting function is within the corporate entity itself, performing all the tasks as required by the corporate entity, employing qualified staff, and featuring as a constituent of the corporate entity's organisational structure. The outsourcing-based organisational model of organising the accounting function is almost dominant nowadays, in view of the increasing number of small and medium-sized corporate entities, who would find it cost-ineffective to organise their own accounting service, and therefore use the services of professional accounting agencies, who keep records of their operations and perform all the accounting operations for them, charging appropriate fees. The third model of approach to organising the accounting function includes hiring accountants who are retired, or employed in another corporate entity, to perform the accounting tasks.

In order to fully accomplish all the tasks set before it, the accounting function must employ appropriate human resources. The staff are the core and essence of the accounting function. Professionally trained and educated staff can perform the tasks set before them with high-quality performance. An additional requirement is constant additional training of the current staff, which is an indispensable prerequisite for successful performance and functioning of the accounting function. At this point, it must be stressed that the

accounting staff are the foundation for successful performance of the tasks set before the accounting function. When performing tasks set before them, accountants should adhere to strict ethical requirements of professionalism, effectiveness and efficiency. This will contribute to the reputation of the entire profession, which has been somewhat compromised over the past period.

One of the forms of organising the accounting function within a corporate subject may be:



Graph 1: A model of organising the accounting function (www.vus.hr/Nastavni%20materijali/Osnove%20menadzmenta/12.%20Poslovne%20i%20procesne%20funkcije%20u%20poduzecu.pdf, accessed April 15, 2014)

Graph 1 shows only the core, or the basic organisational structure of the accounting function. Each corporate entity, in accordance with its needs, divides this structure so that the accounting function can fully perform the set tasks.

The prerequisite for successful operation of every corporate entity is good cooperation between all three above mentioned systems of the business entity. Their close cooperation results in the fulfilling the corporate entity's objectives. As a constituent element of these three systems, the accounting function monitors the movement of the total assets at the corporate entity level, and performs the accounting control of operations of all the organisational units in a corporate entity. This requires the accounting function to cooperate closely with other functions that it provides with necessary data on the other hand, while drawing the necessary data on the other. A well organised accounting function should provide data that are a prerequisite for economic and cost-effective operation of the corporate entity. Such an accounting function will supply information required by the management for successful operation, that is, provide the management of a corporate entity with the following information, which are not only prerequisite for high-quality business decision making, but also a prerequisite for the corporate entity's survival (http://web.efzg.hr/dok/OIM/inacinovic/PRED%20Organizacija%20poslovnih%20funkcija.pdf, accessed April 25, 2014)

- periodic performance in production;
- movement of assets
- sources of finance
- results of annual operation.

All the aspects of considering the accounting information are supposed to enable accomplishing the overall objective of this system, which is to establish a connection between the users of accounting information and the effects of earlier made business decision. This is due to the fact that each business decision is made based on relevant information that should result in certain effects.

3. FINANCIAL REPORTS – THE FINAL PRODUCT OF THE ACCOUNTING FUNCTION

The main products of the accounting function are financial reports, which are to supply high-quality and relevant accounting information to numerous users of accounting information. To provide financial reports that will be a reliable representation of corporate entity's state, it is essential for information used for producing those reports to be reliable, relevant, and based on appropriate documentation.

These financial reports meet the needs of numerous users of financial reports. The most significant users of financial reports definitely include managers, who base all their business decisions based on these. Only reliable and high-quality accounting information can feature as a basis for making relevant business decisions. Based on data contained in financial reports, managers analyse operations, identify weaknesses, identify the level and dynamics of cost fluctuations, etc. Although these data are historical, they feature as basis for predicting the corporate entity's future operations. There are other users of accounting information, equally significant, who should be neglected, such as: the employees and trade unions, the in-house services, business partners, banks and other creditors, government bodies, etc. Information contained in financial reports must meet the required quality characteristics, for only such information serves as a reliable basis for business decision making.

To be qualitatively adequate, information contained in financial reports must possess the following characteristics (Dmitrović Šaponja, Petkovič and Jakšić, 2011, 17):

1. **truthfulness** – means obtaining information from reliable accounting documents, for only such information serves as a reliable basis for high-quality business decisions;
2. **usefulness** – which means that accounting information must be reliable, i.e. accurate and impartial on the one hand, and adequate on the other, meaning that they must meet the users' requirements and requests;
3. **comprehensibility** – this is information that do not require substantial time for interpretation, and are tailored to the user's level of knowledge; if accounting information is not adapted to users for whom it is intended, it is practically useless, which means that the same information will be presented in a certain way to the management, and differently to the corporate entity's expert services:
4. **cost-effectiveness** – all the information yielding benefits that exceed costs; to be useful, the use of accounting information must produce effects much higher than the costs of its production.

All information must be tailored to the user, i.e. that the same information will be presented differently to different users. Regarding the central tenet of this article, which is considering the role and significance of accounting information for the purpose of business decision making, the table below will show what kind of information is required by individual levels of management:

Table 1: Relation between accounting information system and various users

Management LEVEL	**Character of Accounting Information**
Top management	Accounting information tailored for the purpose of strategic planning
Middle-level management	Accounting information for management control
Operative management	Accounting information contained in analytical records

Source: Dmitrović Šaponja, Petkovič and Jakšić, 2011, 18

The domain of a corporate subject's top management includes strategic planning, which means decisions pertaining to the corporate subject's long-term business objectives, i.e. decisions of strategic importance for business operations, considering the effects of numerous business alternatives. The middle-level management uses accounting information aimed at management control, considering the achieved results and effects compared to the plan. The operative, or junior management uses analytic records, relying on data from bookkeeping to the greatest extent.

4. COMPETITIVE ADVANTAGE THROUGH THE PRISM OF THE ACCOUNTING INFORMATION SYSTEM

A corporate entity's competitive advantage stems from its ability to create value for its customers exceeding the expenditure that the corporate entity invested in the process of creating this value. The greater the difference between the created value and costs incurred in creating this value, the better the given corporate entity's competitive position. To reach this goal in the appropriate direction, it is necessary for products and services provided by the corporate entity to be completely adapted to buyers' demands and requirements, and to continuously research and monitor changes in the buyers', i.e. consumers' demands, and adapt on time through producing commodities in accordance with their needs, performing this task better than its competition.
When a business entity has gained a good market position and, consequently, achieved significant competitive advantage, it must constantly be ready to enhance and adapt its production and services to consumers' demands, as competitive advantage is not a permanent category, which, once achieved, remains in force forever. Actually, corporate entities should continuously improve their effectiveness and efficiency in order to maintain and retain their competitive position. To keep competitive advantage, it is necessary to take into account the impact of a whole range of factors: the essence of competition is managing financial, material and information resources, based on the knowledge and skill of innovating and preserving the distinctness of the achieved advantage; then, the choice of the appropriate market and products on which a corporate entity will capitalise its competitive advantages in the most acceptable manner, and finally, the choice of competitors in order to target the competing suppliers that will provide us with a great opportunity to demonstrate our advantages in the consumers eyes, and thus gain consumers' favour. If each of these factors is taken into account, we can literally expect a significant improvement in quality and retain competitive advantage.

In the context of the analysis of competitive advantage, we shall analyse Figure 1, which shows the correlation between financial performance and competitiveness:

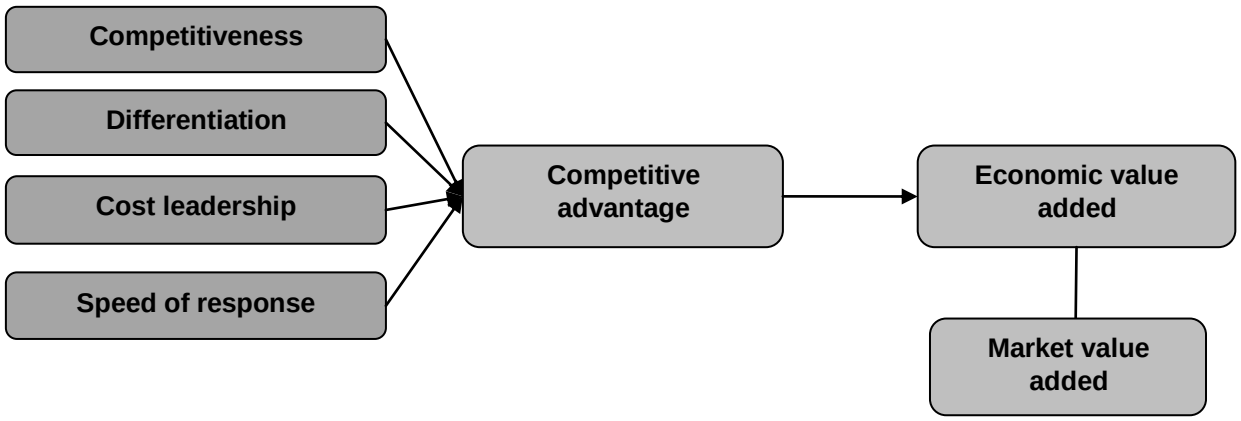


Figure 1: Financial performance and competitiveness
Source: Todorović, 2003, 486

Addressing the task of analysing competitiveness and sources of competitive advantage, Figure 1 shows that four factors are decisive for achieving competitive advantage: competitiveness, differentiation, cost leadership and speed of response. Based on achieving competitive advantage by means of these factors, economic value is gained, and very quickly transformed on the market into market value added. Thus, growth in market value creates prerequisites for the best and highest-quality competitive position possible.

To secure survival in the contemporary business environment, a corporate entity must work daily on creating and building its own competitiveness. The increasingly dynamic, complex and turbulent milieu requires making business decisions containing a growing strategic component, thus imposing the inevitable question: How to achieve it? Although the answer to this question is complex and requires further elaboration, it can be pointed out with a high dose of certainty that this is virtually impossible without a well-organised and constructed accounting information system.

Accounting-based planning primarily refers to choosing a corporate entity's business objectives and forecasting the avenues of achieving them. This indicates that planning permeates all the activities of a business entity – both those related to long-term objectives (of strategic character) and those of operative character. It is these decisions of strategic character that should support finding and achieving a corporate entity's competitive advantages. The aims of accounting-based planning are achieved through the business decision making process, coordination, direct management control, and staff motivation. In addition to strategic objectives, the account-based planning also defines the corporate entity's operative goals, viewed both on the level of the business entity and the level of individual organisational segments, which enables the management to maintain control of the achievement and take timely corrective actions in order to remove possible diversions from the planned goals. This indicates that and accounting information system provides information both on planned values and the current state, which shows the extent of realisation of the devised plan.

If the accounting information system is to enable the corporate subject to find and create competitive value and raise the efficiency of overall business operations, the information that it produces, as the platform for business decision making, must be true, timely, useful and cost-effective. This implies that account information contained in financial reports as the final product of the accounting information system is of high quality, meaning that they can meet their users' needs.

Besides financial information, an increasing significance for achieving competitive advantage in contemporary business environment is gained by non-financial information. This stems from the fact that the sources of competitive advantage in the contemporary corporate setting should increasingly be sought in knowledge and intellectual resources available to corporate entities, given that people are the asset in whose heads is stored the strongest source of competitive advantage. People, with their knowledge and experience, constitute the fundamental factors of a business entity's progress and development.

Another vital factor through which accounting information systems influence competitive advantage is the model of its organisation. The earlier mentioned modularly organised accounting information system is less efficient compared to integrated information systems. The essence of the integral accounting information system is reflected in the fact that once entered into the system, a piece of information is used in all further instances of processing. This is also its key advantage in relation to the modularly organised accounting information system, in addition to the possibility of online data entry. Thus constructed, interaction of accounting models enables the business activity of one cycle to initiate changes in other cycles automatically, which is the core advantage of thus devised accounting information system.

5. CONSLUSION

Appropriately organised and well systematised accounting policies should result in high-quality financial reports. This implies good internal organisation of the accounting function, its proper position in the organisational structure of the corporate entity, and well chosen and professional accounting staff. Only in cases when all these elements combine can a high-quality and reliable financial report be expected.

Through financial reports, the accounting function confirms and establishes its position as the main information system in a corporate entity, as it is the hub of information used by all the stakeholders interested in the performance of a given corporate entity. Financial reports produced by the accounting function are the chief source of information for all interested users, which requires a high quality of reports to be provided by the accounting function.

The existence of corporate entities in modern-day market conditions implies a well-organised and conceived accounting information system. Its good organisation and existence is what constitutes competitive advantage. Only the corporate subjects that manage to provide stable sources of competitive advantage can expect to survive in the forthcoming period. This indicates that competitive advantage is a *conditio sine qua non* of market existence and survival of corporate subjects in the global corporate setting.

REFERENCES

Bahtijarević, Šiber, F., Sikavica, P., & Pološki, Vokić, N. (2008). Suvremeni menadţment – vještine, sustavi i izazovi. Zagreb: Školska knjiga.

Certo, Samuel, C., Certo, Trevis, S. (2008). Moderni menadţment – 10 izdanje. Zagreb: Zagrebačka škola ekonomije i menadţmenta.

Dmitrović Šaponja, Lj., Petkovič, Đ., & Jakšić, D. (2011). Računovodstvo. Subotica: Faculty of Economics Subotica.

Dmitrović Šaponja, Lj., Gravorac, S., & Milutinović S. (2013). Accountancy as an Important Information Source for Corporate Management. The Annals of the Faculty of Economics Subotica, Vol. 49, 29/2013, 383 – 398.

Mamić, Sačer, I., Ţager, K. (2008). Računovodstveni informacijski sustavi. Zagreb: Croation Association of Accountants and Financial Professionals

The official website of the Vik Auditing. (2014). Retrieved from http://www.vikrevizija.

The official website of the Polytechnic in Šibenik. (2014). Retrieved from http:// www.vus.hr.

The official website of the Faculty of economics Zagreb. (2014). Retrieved from http://web.efzg.hr

Todorović, J. (2003). Strategijski i operativni menadţment. Belgrade: Conzit

FINANCIAL REPORTING IN CONTEMPORARY BUSINESS CONDITIONS

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Abstract: *Dynamic changes embodied in globalization and development of information technology, as well as a loss of confidence caused by the global financial crisis significantly affect the accounting information system, ie. the accounting profession, and therefore on financial reporting. International Accounting Standards / International Financial Reporting Standards as the language of business should facilitate the harmonization of financial reporting of companies around the world. The emergence of the web as a result of acceleration of the transactions, and thus increasing the volume of information. Changes in the field of documentation and reporting procedures on the one hand and the growing expectations of stakeholders for appropriate financial reporting in the contemporary conditions, on the other hand. Without standards for the exchange of information through web accounting profession has long been burdened by inefficient reporting process based on a variety of different software applications (pdf, xls, html, doc) which are usually incompatible with each other. At the end of the nineties appeared XBRL - extensible business reporting language for the exchange of structured business information that is widely accepted. XBRL is the financial reporting led to the Internet and facilitate communication with information from the financial statements to numerous users.*

Keywords*:* accounting information system, financial reporting, information, International Accounting Standards / International Financial Reporting Standards, XBRL standard

1. INTRODUCTION

Accounting information system if it is well organized should present the relevant information from the financial statements of financial position, asset and profitable position, ie. on the effects of activities of the company. In the twenty-first century, it faces with many challenges and opportunities. Financial statements establish communication between the information generated within the accounting information system and the many different users of the information. Conceptual Framework and International Accounting Standard 1 (as it provides the core structural elements of financial statements that are required for all companies when creating financial reports throughout the world) are very important elements in the function of harmonizing financial reporting. The effects of management decisions are looked at from the point of impact to moving the performance and value of companies, periodically are reviewed and evaluated through the financial statements and the specific economic analysis. Mentioned was made much easier due to the application of modern information technology. Online exchange of information is carried out with the XBRL standard based on XML - standardized business language for transmitting data over the Internet. This paper will discuss the importance of professional legal regulation in the financial reporting and business intelligence within the XBRL International Standards.

2. SIGNIFICANCE OF REGULATORY FRAMEWORK IN THE FINANCIAL REPORTING PROCESS

Throughout the world, many companies prepare and create financial statements for external users. Though these financial statements may look like similar from country to country, but there are diversities due to different social, legal and economic circumstances. Mentioned different circumstances have led to the use of different definitions of the constituent segments of the financial statements, such as the assets, liabilities, equity, income and expenses. They have resulted in the use of different criteria for the recognition and measurement in financial statements. That is why the International Accounting Standards Board has the task to reduce the differences with effort to harmonize regulations, accounting standards and procedures relating to the preparation and presentation of financial statements. The Board focuses on the harmonization of financial statements that are compiled to provide information relevant for decision making in the economic sphere.Thus prepared financial statements meet the common needs of most users. Economic decisions are made by almost all users, for example:
(Conceptual Framework for Financial Reporting (2014), p.3-4.),

- To decide when to buy, hold or sell a share in the capital,
- To assess the stewardship or responsibility of management,

- To assess the entity's ability to pay and provides other benefits to its employees,
- To assess the safety of the amount lent entity,
- To determine tax policy,
- To determine the profit and dividend distribution,
- To prepare and use national income statistics, and
- To regulate the activities of the entity.

Mentioned Board is aware that the state institutions of various countries for their own purposes may establish different or additional requirements. The above mentioned requirements should not affect the financial statements that are published in the interests of other users. In accordance with the accounting model based on recoverable historical cost and the maintenance concept of nominal financial capital financial statements are usually prepared. The conceptual framework is drawn up so as to be applicable to a range of accounting models and concepts of capital and its maintenance.

The purpose of the conceptual framework is:
- To assist the Board in the development of future IFRS as well as the review of existing IFRS,
- To assist the Board in promoting harmonization of regulations, accounting standards, procedures relating to the presentation of financial statements by providing a basis for reducing the number of alternative accounting treatments allowed by IFRS,
- To assist national bodies responsible for setting standards in the development of national standards,
- To assist persons who prepare financial statements in the application of IFRS, as well as in addressing issues that have yet to become the subject of IFRS,
- To assist auditors in forming an opinion about whether the financial statement in accordance with IFRS,
- To assist users of financial statements in interpreting the information contained in the financial statements prepared in accordance with IFRS, and
- To those who are interested in the work of the IASB with information about its approach to the formulation of IFRS. *(Conceptual Framework for Financial Reporting (2014), p.4.),*

Base of the conceptual framework makes the target of general-purpose financial reporting. Providing financial information about the company is a point of general purpose financial reporting. The information obtained from the reports are the benefits to all stakeholders ie. customer (lenders, existing and potential investors and other creditors).

Since the yield (dividend, the increase in the market price, the payments for principal and interest) that investors expect from investing in debt instruments or the purchase, sale and holding of equity instruments depend on the decisions of investors (both existing and potential). Expectations of lenders, investors and other creditors are depending on their assessment, dynamics, amount and perspective future net cash inflows to the company. As noted, investors need information on which they will be able to estimate the future cash flows of the company. Necessary information in good part they take in general purpose financial statements. They are actually the primary users of the information from mentioned financial statements.

The financial statements provide information in order to be able to assess the value of the company by investors, lenders and other creditors. General purpose financial statements do not provide the full necessary information to them. To make a proper business decision should be supplied with relevant information from other sources also, such as the perspectives of enterprises and the economy, the political climate, general economic conditions, etc.

In the process of developing standards of financial reporting The Board strives to provide the required information for the largest number of primary users. Information about financial position, ie. the economic resources of enterprises, the effects of transactions that change the company's resources are useful for decision making.This is so because they are the basis for identifying financial strength (liquidity, solvency, the need for additional financing) and weaknesses of the company. Information on the results of operations help many users to understand the yields that the company realized with its available resources. Also, this information shows how management do their activity of efficient and effective using of company resources.

For the evaluation of past and future capability of the company, for the accumulation of net cash inflows are important information about the result of the firm. Also, the company's ability to cumulate the future net cash flows provide information on the company's cash flow because from them we can see how the company spends cash, borrow, how pay off debts and other indicators that can affect both the liquidity and solvency. Assessment of financing activities and investing, liquidity and solvency provide information on cash flows (for more details see Conceptual Framework for Financial Reporting, Chapter 1).

Information from the general purpose financial statements to meet many users must be relevant, useful, credible, verifiable, comparable, timely and understandable. (for more details see Conceptual Framework for Financial Reporting, Chapter 3).

Accounting information system of the company has a duty to provide financial reporting for which quality and relevance is with management of the company directly responsible. The key assumption for making quality business decisions is the quality of information. This is why the need to improve the quality of financial reporting becomes more and more important.

International Accounting Standard 1 - Presentation of Financial Statements (IAS 1 below) provides the basis for presentation of general purpose financial statements, sets general requirements for the presentation, gives guidelines for their structure and makes minimum requirements for their content ie. prescribe the basis for presentation of financial statements that is it's main goal. It applies to all general purpose financial statements.

A complete set of financial statements under IAS 1 includes: a report on the financial position at the end of the period, a report on the profit or loss and other comprehensive income for the period, statement of changes in equity for the period, cash flow statement for the period, notes comprising a summary of significant accounting policies and other explanatory information, comparative information relating to the previous period and a report on the financial position at the beginning of the previous period when an entity applies an accounting policy retrospectively or makes a retrospective restatement of items in its financial statements or when it reclassifies items in its financial statements. (IAS 1, paragraph 10) The above-mentioned set of financial statements is otherwise called the Annual financial statement.

However, under the new Law on Accounting regular annual financial statement entities that apply IFRS include: balance sheet, income statement, statement of other results, statement of changes in equity, cash flow statement and notes to the financial statements. Micro-entities prepare a regular annual financial report that includes a balance sheet and income statement. Regular annual financial statements of other entities (political, trade union organizations, foundations, chambers, churches, etc.) includes a balance sheet, income statement and notes to the financial statements.

It is evident that the professional and legal regulations is in conflict as far as the name of mandatory annual financial statements. In Serbia, the prevailing is legislation. Association of Accountants and Auditors of Serbia as a member of the International Federation of Accountants (IFAC) has translated IAS / IFRS in 2009. provided that translated the five new IFRS which came into force on 2013th (four of them), and one will come in 2015th. Translation of these standards The Ministry of Finance published in the Official Gazette No. 35 until March 27th of 2014. (no sooner), and very important professional titles and certificates accountants are canceled and they are actually crucial, because only a true certified professionals should be involved in the accounting profession because of the objectivity of financial reporting.

For recognition, evaluation, presentation and disclosure of items in the financial statements big companies apply International Financial Reporting Standards. Medium-sized enterprises can use International Financial Reporting Standards or International Financial Reporting Standards for Small and Medium Enterprises. Small enterprises can use the International Financial Reporting Standards for Small and Medium Enterprises. Micro enterprises can use Regulation issued by the Minister of Finance or International Financial Reporting Standards for Small and Medium Enterprises.

In Serbia until July 2013. valid was the Law on Accounting and Auditing (Official Gazette 46/06, 111/09 and 99/11) who was sorting companies into three groups, to large, medium and small, according to the criteria: average number of employees, operating income and average value of commercial property, which is replaced by the new Accounting Act of 16th July 2013. (Official Gazette of RS, no. 62/2013). companies are divided into four groups, in large, medium, small and micro, which show the following table:

Table 1: Types of enterprises

Legal entities are classified according to size	Applying the criteria of the Law on Accounting and Auditing	Applying the criteria of the Law on Accounting
Large	1.163	552 (0,46%)
Medium	2.971	1.283 (1,07%)
Small	116.285	9.649 (8,01%)
Micro	-	108.935 (90,46%)
Total	120.419	120.419 (100%)

Source: IFRS and Current Regulations (2013)

From the table it is evident that Serbia has at the most micro enterprises (90,46%), at least large (0,46%).

3. FRAMEWORK FOR BUSINESS REPORTING BY INTERNATIONAL STANDARDS XBRL

The use of XBRL standards (eXtensible Business Reporting Language) is of great importance to the business of each company and the perspective of its use are very wide. Regulatory bodies (institutions that have the authority to prescribe certain standards of conduct in the collection of certain information, for example: Commission for securities, stock exchanges, tax authorities, insurance companies, banks, etc.) are commonly used until now classical methods of reporting based on a paper form or unstructured electronic methods of HTML (Hypertext Markup Language) or PDF (Portable Document Format) format. Each regulatory body ("a collector of business information") may prescribe the use of electronic and other structured methods in relation to XBRL (eg. Private electronic methods developed for their own use). In our business environment just mentioned is already present. In a particular required format regardless of whether the data is structured or unstructured single entity (or other applicant data) can transmit business information to data collector. The aforementioned diversity present in the world indicate a need of unification of business reporting.

Recent way of financial reporting is on the website, these are due to the presence of certain experiments in the implementation of possible variations in the development stages. By analyzing we got an answer that there are many different varieties of reporting that companies show on their web sites. Accordingly, interested parties can gain an impression at first glance that there are no clear rules in the presentation of financial statements on the Internet in terms of what exactly is allowed and what should not be allowed in the preparation and presentation of annual financial statements on the Internet. The SEC (Security Exchange Comity) in the United States specifically provides for uniform application of legal rules in the work process, regardless of whether it is implemented in hard copy or electronic technology, in his act that deals with working with securities of values.

The technology which allows precise setting and standardization of new features is based on the use of special software tools standard XML (Extensible Markup Language) - the language created by the W3C (World Wide Web Consortium). XML allows you to create web pages that include identifying information about the items on the Internet such as statements, currency, orders, invoices and similar. International standards, XBRL was also formed on the same model, based on XML language, the protocol developed by the General Accounting Board. The study of comparative financial web site in relation to paper reporting documentation showing that a number of companies on their web site show only the summary information, others do not want to present a complete financial statement.

There is the fact that new technologies, and therefore the implementation of the XBRL standard brings new challenges and new risks (Audit and Control Implications of XBRL, The Canadian Institute of Chartered Accountants, Information Technology Advisory Committee, Toronto, 2002).

Many accounting organizations are set reasonably question how big a business risk is if the business decisions use information from reports prepared using XBRL. The analyzes showed that the risk of errors related to the accuracy of the mappings balance sheet items and the appropriate uses of the related taxonomy.In case the information for the purposes of the financial statements in XBRL methodology are included, there is a need to apply additional controls to ensure that the data are of high quality, accurate and possess the required integrity. The use of XBRL technology does not mean that it will also be prepared and printed financial statements. Companies can choose that a method of financial reporting financial document that has been prepared in accordance with the taxonomy ISA (International Accounting Standards) to be published and posted, and only on the web site. Legislator allows mentioned in the world. From the aforementioned it follows that by analysts and others interested in business analysis can run their own analytical processes of such published data and prepare their comparative report, connect them with information obtained from other companies and shape within a new business report. With the technology of XBRL the mentioned process can be automated and used for retrieval of data from a variety of sources periodically for analysis management.

In the near future, XML will require control data transfer, which is based on the operations of the supply chain. Using the Internet in the process of automation of operations of exchange and transfer of data to be performed manually (including processing purchases, payments, invoicing, delivery, etc.) business environment is expected to adapt the XML standard needs of different activities to almost instantly reduce the total cost of operations.

Since XML exponentially affect the acceleration of business iterations and anyone who wants to start their own business should pay attention to this fact. Regular reporting in addition to shareholders at the same time provide information for decision-makers and others involved in the business chain. In this context, the decision making community (so-called XBRL) was established, which is an adaptation of XML technology for the chain of business information. It is believed that the business process designed to technological solution XBRL reporting has a key advantage over conventional current mode of reporting that is now compiled and distributed. XBRL allows the shortened time period of preparation and low cost of preparation, provides simplified access to information, the ability to cross information by expanding the analytical capabilities as well as better conditions for investment decisions.

In order to timely protect against possible shock of the financial markets it is necessary to examine developments in global business practices in recent years to conclude that measures should be taken. The most appropriate illustration can give us the case of Enron (big American energy giant was formed in 1985th, before all the gas, and then with electricity, which is the middle in 2001st had about 21,000 employees). Enron's was accounting fraud with poor corporate management and much more. The collapse of Enron implies a total systemic failure of American institutions of capitalism.

Enron's management misled the board of directors. Failed their tasks: internal audit function, external auditors, their lawyers, business printed reports. In other words, American institutions of capitalism that are being advertised and imposed all over the world as it should be operating all are easily betrayed at Enron. The greatest failure of American free-market capital and a direct failure of the SEC is actually Enron. SEC as a government "watchdog" was required to provide adequate and timely disclosure of relevant corporate information, he just not succeeded.

Bankruptcy of Enron and WorldCom accounting is concerned about the workers and small shareholders on the adequacy or inadequacy of GAAP (Generally Accepted Accounting Principles) and a GAAS (Generally Accepted Auditing Standards). The main problem and a potential cause of accounting scandals at opinion of a specialist after numerous analysis is reflected in the quality, or low-quality business disclosure of financial results and the quality of audit reports. Enron was applying the method to mark-to-market accounting for all aspects of their business while reporting to the SEC and public disclosure to analysts of securities. His reporting to the SEC was not objective.

After the accounting scandals of Enron and WorldCom, the U.S. Congress adopted a special law called the "Sarbanes-Oxley Act." This act introduces a new strict rules to protect investors by improving the accuracy and reliability of corporate disclosures. XBRL standard allows many customers to compare the financial performances of the company as opposed to a group of companies. Registered confidence of working with XBRL standard is fully in accordance with the requirements arising from the "Sarbanes-Oxley Act"-a.

The new system of trust should provide SEC with tools for checking to oversee corporate reporting and control their compliance with the criteria defined in the said Act. The tools that have been developed along with the XBRL standard facilitates comparison of the information obtained, and it is considered and expected to be able to eliminate fraud in a timely manner (early acceptance of income, inadequate capitalization of expenses, excessive reserves relating to income, inadequate management of income, etc..). XBRL is characterized by proliferation and the ability of their access to information.

Indicia including XML and XBRL will enable accounting systems to accumulate data from different databases in a concise reporting entities and translate the information needed to create all the elements in internal or external report. XML increases the speed of the internal and external shareholding reporting.

XBRL can optionally be used for that connection ie. linking of selected documents and reports back to the store such data on the disk of the new user, and the operation can be no security risk that should identify which management uses such information. Risk refers to the possibility that the link be exploited and compromised by hackers or others. In this case, additional security measures should be consider, and clear configuration used quality "firewall" with which network and server protect against unauthorized entry and measures such as the use of cryptography data from XBRL methodology. Clear attitude on the safety and security of financial settlements developed using XBRL has to have every accountant and auditor. Must remain the same as in the case of other traditional financial statements of the general a security approach and core control, only the protection technology to be adapted to new technological opportunities.

Application of new technology solutions can include the necessary accounting files that will be digitally signed or individual signed - such files within a document provided by the client by the auditor.

The first implementation of XBRL standards were achieved by the Commission for the Securities, the stock market, banks, tax and customs administration. The first implementation of the current conditions XBRL have accepted a variety of business organizations, auditing and accounting agencies, software for accounting and business intelligence, as well as individual analysts and investors.

At the global level, XBRL is implemented by the SEC (Security Exchange Commission), American Institute of Certified Public Accountants (AICPA), the Australian Prudential Regulations Authority (APRA) (first developed a program for the collection of regulatory data in XBRL). National Tax Administration of Japan leads the world in the application of the XBRL reporting standard and the Tokyo Stock Exchange (Tokyo Stock Exchange) in Asia. The current situation regarding the implementation of XBRL Europe show the following table.

Tabel 2: Progress in the implementation of XBRL standards in Europe

Country/Sector	Banking Sector	Business Sector	Tax sector	Sector of statistics	Regulators of securities markets	Insurance sector	Other: stock market, private sector
Belgium	Obligatory submission	Obligatory submission	Obligatory submission	Obligatory submission	A project with the mandatory filing in Spain, two projects are underway	Two projects are underway (EIOPA XBRL SOLVENCY II). Many projects are in the preparation	Ten projects ranging from reporting at the local level in Spain to water resources management projects in the Netherlands.
Cyprus	Obligatory submission	Voluntarily submission					
Denmark		Obligatory submission	Voluntarily submission	Voluntarily submission			
Finland	Voluntarily submission	Voluntarily submission					
France	Obligatory submission						
Germany	Voluntarily submission	Obligatory submission	Obligatory submission	Obligatory submission			
Ireland	Voluntarily submission	Voluntarily submission	Voluntarily submission				
Italy		Obligatory submission		Obligatory submission			
Lithuania	Obligatory submission						
Luksemburg	Obligatory submission			Voluntarily submission			
Nederland	Voluntarily submission	Voluntarily submission	Obligatory submission	Voluntarily submission			
Norway	Voluntarily submission						
Poland	Obligatory submission						
Spain	Obligatory submission	Obligatory submission					
Sweden	Voluntarily submission	Voluntarily submission					
Switzerland		Voluntarily submission					
Great Britain		Obligatory submission	Obligatory submission				
Estonia		Obligatory submission					

Source: *Gilles, M. (2012).*

Most European Union countries, as can be seen, permits or provides for the implementation of XBRL. There are between five and seven million of financial statements in this format in Europe. Regions of the world where the fastest developing XBRL are USA, Japan, Europe, China and Australia.

4. CONCLUSION

At the beginning of the twenty-first century is increasingly question whether the current system of financial reporting appropriate to the era of modern information technology. The globalization of business and accounting response to it have caused the development of global financial reporting tools, as well as global regulators that promote the development and improvement of the quality of financial reporting. The development of information and communication technology makes a major changes in the financial reporting process and the exchange of business information. The development of communication and information technology has enabled the relocation of financial reporting on the Internet. Thanks to the aforementioned business information is now available to everyone, anytime and anywhere. For this purpose, dominant is usage of the International standard for the exchange of business information XBRL.

Its application brings all participants in the financial reporting supply chain advantages such as cost savings for preparation, processing, disclosure and in time. XBRL does not require changes in existing accounting standards, or require companies to disclose more information. XBRL enables automated exchange of information between different business applications while dramatically reducing human involvement.

Benefits of XBRL reflect the savings in cost and time by automating the process. Completely redefine the accounting practice of applying XBRL, increasingly require a high level of analysis with a view to ensuring adequate informational support in decision making. XBRL is a relatively new and software support on which it relies, and may cause some problems of compatibility of software applications. XBRL as each standard has a limited life cycle, and probably will in future pass under appropriate changes. Because XBRL entirely relocated financial reporting on the Internet raises the question of information protection and security.

REFERENCES

Audit and Control Implications of XBRL, (2002) The Canadian Institute of Chartered Accountants, Information Technology Advisory Committee, Toronto,

Gilles, M. (2012). The Progress of XBRL in Europe, 10th XBRL Europe Day – Deutsche Bundesbank, Frankfurt.

Hoffman, C., Watson, L. (2010). XBRL for Dummies, Indianapolis, WILEY publishing.

Hoffman, C., Egmond, R. (2012). Digital Financial Reporting, Using an XBRL-based Model, Creative Commons License.

IFRS and Current Regulations (2013). XIV autumn seminar, SRRS, Zlatibor,

Konceptualni okvir za finansijsko izveštavanje, Službeni glasnik RS br. 35/2014. (Conceptual Framework for Financial Reporting, Official Gazette, Republic of Serbia, No. 35, March 27, 2014)

Polić, S. (2012). Digitalna ekonomija sa analizom podataka, primena međunarodnih standard i automatizovano poslovno izveštavanje kao potreba i izazov za Evropsku uniju (Digital economy with the analysis of data, the application of international standards and automated business reporting as a need and a challenge for the European Union), VII kongres računovođa i revizora Crne Gora: Razvoj finansijskog izveštavanja po svjetskim standardima kao podrška rastu ekonomije Crne Gore, ISRCG, Bečići.

Rešenje o utvrđivanju prevoda Konceptualnog okvira za finansijsko izveštavanje i osnovnih tekstova Međunarodnih računovodstvenih standarda, odnosno Međunarodnih standard finansijskog izveštavanja (2014), Službeni glasnik br. 35. (Solution on establishing the translation of the conceptual framework for financial reporting and basic texts of the International Accounting Standards of International Financial Reporting Standards)

Zakon o računovodstvu i reviziji, Službeni glasnik 46/06, 11/09, 99/11(Law on Accounting and Auditing)

Zakon o računovodstvu, Službeni glasnik RS 62/2013. (Law on Accounting)

RECOGNITION VERSUS DISCLOSURE IN FINANCIAL REPORTING

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Abstract: *Empirical evidence from the academic literature on capital market effects of recognition on the face of the primary financial statements versus disclosure in the notes to the financial statements is not straightforward. Therefore, the purpose of this paper is to contribute to the recognition versus required disclosure debate in the standard-setting context by exploring possible reasons for perceived differences between the recognised and disclosed amounts. Since in our opinion the preparers of the financial statements take less care about disclosures relative to recognised items, demonstrated auditors' greater tolerance for misstatement in disclosed amounts and allowed substantial non-compliance with disclosure requirements even in strong enforcement regimes, we believe that all these arguments strengthen the case for the general preference for recognition in the standard-setting context.*

Keywords*: disclosure, disclosure framework, efficient market theory, financial statements, notes, recognition*

1. INTRODUCTION

The question whether share prices reflect amounts disclosed in the notes to the financial statements and those recognised on the face of the primary financial statements similarly is of interest to standard-setters, regulators, financial statements preparers, auditors and hence also for academics.

Efficient market theory (EFM) suggests that the markets adopt a substance over form approach and incorporate all publicly available information, irrespective of the mode of disclosure, i.e. whether the amount is disclosed on the face of the primary financial statements or in the notes.[1]

But some (value relevance) empirical research suggests that under certain conditions note disclosures are less strongly associated with market values (of equity, i.e. share prices), as for example Bernard and Schipper (1994), Aboody (1996), Davis-Friday et al. (1999), Davis-Friday et al. (2004) and Ahmed et al. (2006). One of these conditions is if investors inappropriately undervalue disclosed amounts either through lack of expertise or due to the cost of processing note information. Secondly, recognition may imply greater relevance[2], in which users correctly assign lower weight to disclosed amounts (Jifri and Citron, 2009, p. 124).

On the other hand, some more recent empirical results of Jifri and Citron (2009)[3] suggest that, for particular classes of firms (firms engaged in R&D); the market perceives recognised and disclosed amounts equivalently, which is consistent with the efficient market hypothesis (EMH).

We can thus conclude that the empirical evidence from the academic literature on capital market effects of recognition versus disclosure in the notes to the financial statements is not straightforward. Therefore, the purpose of this paper is to contribute to the recognition versus required disclosure debate in the standard-setting context by exploring possible reasons for perceived differences between recognised and disclosed amounts. The paper has the following structure: it begins with recognition and disclosure as financial reporting concepts (Section 2); proceeds with limited attention and processing power (Section 3), explores auditor behaviour related to recognised and disclosed numbers (Section 4), while Section 5 concludes the paper.

[1] It is worth noting that some disclosed items in financial reports are not recognised—and likely never will be—because they cannot be expressed in numbers or, more narrowly, in currency units. Examples include the qualitative description of accounting policies, a summary of inputs to the calculation of a recognised number, and a sensitivity analysis (Schipper, 2007, p. 301).
[2] Relevant financial information is capable of making a difference in the decisions made by users. Information may be capable of making a difference in a decision even if some users choose not to take advantage of it or are already aware of it from other sources. Financial information is capable of making a difference in decisions if it has predictive value, confirmatory value or both (IASB, 2010, paragraphs QC6-7).
[3] Paper exploits the unique UK regulatory framework in which accounting for goodwill moved from note disclosure to balance sheet recognition. According to Jifri and Citron (2009, p. 125) paper adds to the literature in a number of ways. Firstly, it studies the recognition vs. disclosure issue in a new context, that of goodwill accounting. Secondly, it investigates whether the relative importance of recognised and disclosed amounts varies by type of firm, specifically whether or not firm engages in R&D.

2. RECOGNITION AND DISCLOSURE AS FINANCIAL REPORTING CONCEPTS

Although there is no extant academic theory of accounting or standard setting, both world's most important standard setters, namely the International Accounting Standards Board (henceforth IASB), which issues International Financial Reporting Standards (henceforth IFRS); and the Financial Accounting Standards Board (henceforth FASB), the accounting standard-setter from the USA; articulate their theory of accounting and standard-setting in their conceptual frameworks[4] (Barth et al., 2001, p. 78).

On the 28 September 2010 the IASB and the FASB announced the completion of the first phase of their joint project to develop an improved conceptual framework for IFRS and US generally accepted accounting practices (GAAP). That actually meant the issuance of Chapter 1 *The objective of financial reporting* and Chapter 3 *Qualitative characteristics of useful financial information* of the improved conceptual framework. Chapter 2 will deal with the reporting entity concept. Chapter 4 contains the remaining text of the IASB's *Framework for the Preparation and Presentation of Financial Statements* that was published in 1989.

The project's overall objective is to create a sound foundation for future accounting standards that are principles-based, internally consistent and internationally converged. The improved framework builds on existing IASB and FASB conceptual frameworks. Since this conceptual framework project is conducted in phases, as a chapter is finalised, the relevant paragraphs in the IASB's Framework (1989) will be replaced.[5] When the conceptual framework project is completed, the IASB will have a complete, comprehensive and single document called the *Conceptual Framework for Financial Reporting*.

Paragraph OB3 of the IASB's Conceptual Framework for Financial Reporting from 2010 (henceforth Framework 2010) states that ~~t~~he objective of general purpose financial reporting is to provide financial information that is useful to existing and potential investors, lenders and other creditors in making decisions about providing resources to the entity."

As a basis for a theory of required disclosures, however, it is viewed that the objective of providing decision-useful information as insufficiently discriminating, in at least two ways. First, that objective is too general to be helpful in ruling out items from further consideration. For example, the provision of decision-useful information would be consistent with requiring disclosures to reduce information asymmetries between investors and managers (that is, forcing the dissemination of information that management already has), and it would be consistent with requiring disclosures that mandate the collection and dissemination of new information (Schipper, 2007, p. 303).

Second, objective in Chapter 1 unfortunately also does not help with the distinction between recognition and disclosure (Schipper, 2007, p. 303). This difficulty applies elsewhere in the IASB's Framework 2010 as well: recognition is specifically defined in paragraphs 4.37-4.39, but disclosure is not. In addition to defining and describing recognised items, it states that disclosure is not a substitute for recognition (paragraph 4.37) and provides recognition criteria (paragraph 4.38): An item that meets the definition of an element should be recognised if:

a) it is probable that any future economic benefit associated with the item will flow to or from the entity; and
b) the item has a cost or value that can be measured with reliability."

In contrast to the detailed treatment of recognition, IASB's Framework merely discusses disclosures (without defining them) and provide some examples[6]. That discussion is not definitive with respect to the question of

[4] A conceptual framework could be seen as an attempt to operationalize the accounting theory (Higson, 2003, p. 62). Davies et al. (1999, p. 53; in Higson, 2003, p. 63) define a conceptual framework as a statement of generally accepted theoretical principles which form the frame of reference for a particular field of enquiry. In terms of financial reporting, these theoretical principles provide the basis for both the development of new reporting practices and the evaluation of existing ones. The IASB's framework can be interpreted as a given, external set of high-level principles or norms, which reflect fundamental value judgments made by the Board. In the IASB's regulatory context, decisions regarding the identification, definition and hierarchy of these high-level principles are made in the political sphere, that is, after considering constituents' views (Fülbier at al., 2009, p. 462). Solomons (1986, p.116; in McKernan, 2007, p. 173) identifies defence against politicization as one of the key functions of conceptual framework for financial reporting. If there is a sound conceptual framework then the basis for the standard-setting decisions can be more widely understood, not only by politicians but also by other market participants, and hopefully will make the actions of the standard-setter more defensible (Boyle, 2010, p. 301).

[5] FASB's conceptual framework consists of Statements of Financial Reporting Concepts (SFASs). On 28 September 2010 FASB actually issued SFAS No. 8 that replaced SFAS No. 1 *Objectives of Financial Reporting by Business Enterprises* and SFAS No. 2 No. 2 *Qualitative Characteristics of Accounting Information*.

[6] For example, the current IASB's Framework in paragraph 4.41 states that the financial statements also contain notes and supplementary schedules and other information. For example, they may contain additional information that is relevant to the needs of users about the items in the balance sheet and income statement. They may include disclosures about the risks and uncertainties affecting the entity and any rights and obligations not recognised in the balance sheet (such as mineral reserves). Information about geographical and industry segments and the effect on the entity of changing prices may also be provided in the form of supplementary information.

what disclosures are, conceptually, expected to achieve in the communication of decision-useful information. However, the discussion in the Framework is indicating that recognition is a special case of disclosure, restricted to items that meet certain criteria, that is, disclosures in the notes differ from recognised items because disclosed items fail one or more of the recognition criteria. That yields following inferences. First, because recognition is subject to special criteria, and because IASB's Framework state that disclosure and recognition are not substitutes, it is evident that disclosure and recognition are not financial reporting alternatives—they are not intended to serve the same purpose. Second, items that meet the definitions of financial statement elements but fail one or more of the recognition criteria should be disclosed, and the most likely criterion to matter for this distinction is reliability[7] (Schipper, 2007, p. 303).

One rationale for relegating amounts to the footnotes is that the information is less reliable due to significant uncertainty associated with measurement of the amount (Johnson and Storey, 1982). For example, opponents to expensing stock compensation often argued that the estimates arising from Statement of Financial Accounting Standards (SFAS) No. 123's *Share based payment* and IFRS 2 *Share based payment* fair-value method are unreliable (Malkiel and Baumol, 2002). Under this rationale, reliability can determine information location.[8]

However, standard setters may determine information location for other reasons (Bernard and Schipper, 1994). Despite the fact that Schipper (2007, 302) stated: "It seems implausible that a standard setter would not require the recognition of highly reliable items unless those items do not meet the definitions of financial statement elements", former FASB members have indicated that the decision to allow disclosure rather than recognition has been driven by political pressure in some cases (e.g., Beresford, 1997). This suggests that information location decisions can be influenced by considerations other than those described in the conceptual frameworks.

On the other hand, the concept of limited attention and processing power (Section 3) and auditor behaviour related to recognised and disclosed numbers (Section 4) in our opinion strengthen the case for the preference for recognition in the standard-setting context.

3. LIMITED ATTENTION AND PROCESSING

Paper by Hirshleifer and Teoh (2003) represents a step towards bridging what appears to be an increasingly wide gap between the views of many accounting and finance researchers (specifically, the views of 'hard core' believers in market efficiency) and the views of just about everyone else in the world with respect to the perceived efficiency of capital markets (Lambert, 2003, p. 387).

Their approach departs from theories in assuming that investors have limited attention and processing power. Limited attention is a necessary consequence of the vast amount of information available in the environment, and of limits to information processing power. Attention must be selective and requires effort (Hirshleifer and Teoh, 2003, p. 339).

In their model, owing to the limits to investor attention, the information that is presented in prominent, easily processed form is assumed to be absorbed more easily than the information that is less prominent, or that is only implicit in the public information set. Thus, (some) investors neglect relevant aspects of the economic environments they face. Although inattention maybe seems foolish as inattentive investors lose money by ignoring aspects of the economic environment, but if time and attention are costly, such behaviour may be reasonable (see Barth et al., 2003 below).

[7] We agree with Schipper (2007, p. 311) that there is no general agreement with regard to either the construct of reliability itself or its measurement. Some appear to believe that reliability is the ability of information to be vouched to, or confirmed by, an external archival source. Others appear to believe that reliability means the item's measurement is characterized by a high degree of consensus among independent measurers (a notion that subsumes the first idea of reliability). Still others appear to believe that reliability refers to precision of measurement (which is related to but differs from the consensus-of-measurers notion of reliability). Because attempts to explain what reliability was intended to mean in the standard-setting context have proved unsuccessful, the IASB and FASB sought a different term that would more clearly convey the intended meaning. The term *faithful representation*, the faithful depiction in financial reports of economic phenomena, was the result of that search. The IASB and FASB claim that term encompasses the main characteristics that the previous frameworks included as aspects of reliability, so the term reliability disappeared from the IASB's Framework 2010. For more on qualitative characteristics in the IASB's Framework 2010 see Novak (2013).

[8] The evolution of stock option accounting in the framework of U.S. GAAP from the initial adoption of SFAS No. 123 to the passage of SFAS No. 123R encompasses three reporting environments for stock option expense: (1) voluntary note disclosure, (2) voluntary income statement recognition, and (3) mandated income statement recognition (Frederickson et al., 2006, p. 1089). Frederickson et al. (2006) find out that mandated income that mandated income statement recognition, as required by SFAS No. 123R, leads to higher user assessments of reliability than either voluntary income statement recognition or voluntary note disclosure, options allowed under SFAS No. 123. Users view voluntary note disclosure as the least reliable reporting alternative.

The paper develops a theoretical model in which a nontrivial fraction of investors are ‚inattentive' (unsophisticated) and either miss important information disclosures entirely or systematically misinterpret their implications. In such a world, accounting measurement rules, earnings management activities, and discretionary disclosures have an impact on stock prices even when these features bear no relation to the underlying cash flows of the firm (Lambert, 2003, pp. 387-388).

Moreover, these features have an impact despite the existence of ‚attentive' investors who have the ability to ‚see through' them.[9] The paper derives a link between reporting and disclosure decisions and stock prices, and goes on to analyse how sophisticated managers would make reporting and disclosure decisions to exploit the inability of the market to price their firms ‚correctly', thereby increasing the stock prices of their firms (Lambert, 2003, pp. 387-388).

One of the conclusions Hirshleifer and Teoh (2003, p. 380) make is that limited attention may help explain why investors are insufficiently sceptical of firms that are positioned to conceal liabilities, such as off-balance sheet contractual provisions, for example operating leases.[10] Limited attention may also help explain, without appealing to political or contracting constraints, certain peculiarities in the structure of accounting rules. In the age of information technology, it has become cheaper to require detailed reporting of numerous transactions (for a given level of resources devoted to auditing). Actual accounting reports differ from such a standard in ways that, from a pure reporting perspective, seem either irrelevant or harmful. For example, accounting rules permit aggregation, which ‚throws away' information. A limited attention approach suggests that even from a pure reporting perspective, aggregation can make sense, because investors may have trouble processing disaggregated information. Similarly, redundancy can be helpful when different presentations ease the processing of that information for different uses.

Similar theoretical paper by Barth et al. (2003) compare disclosure with three types of recognition: aggregate recognition with disclosure, separate recognition, and aggregate recognition without disclosure. They assume that investors decide whether to acquire accounting expertise. In doing so, investors trade off the cost of expertise acquisition against informational benefits they obtain from understanding disclosures. They assume that the expertise acquisition is costly because understanding disclosures requires accounting expertise beyond that needed to understand recognised amounts.

If information is disclosed only in the notes, users of financial statements have to expend time and effort to become sufficiently expert in accounting to know (a) that there are items that are not recognised in the financial statements, (b) that there is information about those items in the notes, and (c) how to assess the note disclosures. Because gaining that expertise is costly, some users of financial statements, i.e. those whose perceived expertise acquisition costs are higher than perceived informational benefits, will not become accounting experts. Therefore, information that is merely disclosed may not be fully reflected in share prices.

When comparing the disclosure regime with the separate recognition regime, they find that recognition always increases price informativeness. This is because in this regime recognition results in the disclosed amount being freely available to all investors. However, when aggregation is a part of recognition, as it is in the aggregate recognition with or without disclosure regimes, the results are more complex. In particular, in the aggregate recognition with disclosure regime, they find that recognition of an accounting component that results in a higher (lower) quality recognised amount does not always result in greater (lower) price informativeness.

Lambert (2003, p. 399) agrees that individual investors cannot possibly process everything or even pay attention to everything that is of potential relevance to the valuation of the firm. In such a world, summary statistics can be of value, even if their role is to reduce economic search costs and is unrelated to psychology reasons. The big questions are: how important are these effects, and what factors influence their importance?

[9] Model assumes that since the attentive investors all have full information, they all calculate identical expected values. Inattentive investors are assumed to calculate the wrong expected value relative to the expected value calculated by attentive investors. Moreover, all inattentive investors calculate the same wrong value. Inattentive investors are assumed to utilise the same value for the residual variance of cash flows as do attentive investors. As a result, they trade just as aggressively based on their (incorrect) assessment of firm value as do attentive traders based on their correct assessment. In what sense are market prices inefficient in this equilibrium? They are inefficient in the sense that the price is not the same as it would be if everyone was attentive (Lambert, 2003, p. 392).

[10] Under the operating lease, the lessee does not recognize any lease asset or liability in the balance sheet. Nevertheless, in contrast, it is obliged to disclose future expected rental payments in the notes to the financial statements. For operating leases having initial or remaining non-cancellable lease terms in excess of one year, the following information shall be disclosed in the notes to financial statements: future minimum rental payments required as of the date of the latest balance sheet presented, in the aggregate and for each of the five succeeding fiscal years, and the aggregate for the periods beyond five year. The usefulness of only a lump-sum amount disclosure beyond five years is in our opinion questionable. For more on lease accounting see Novak (2011).

4. AUDITOR BEHAVIOUR RELATED TO RECOGNISED AND DISCLOSED NUMBERS

Paper by Libby et al. (2006) examines whether auditors are willing to tolerate more error in disclosed numbers than in recognised numbers, which should reduce the reliability of disclosed numbers. They report two experiments that examine audit partners' willingness to tolerate misstatements in recognised and disclosed amounts.[11]

Results from the experiments indicate that auditors require much greater correction of misstatements in recognised amounts than they do for the same amounts that are only disclosed. Debriefing data indicate that this effect is intentional. Even though recognition increases expected client resistance to correcting the misstatement, auditors view recognised misstatements as more material than disclosed misstatements and indicate a willingness to pressure the client more to correct recognised misstatements. Recognition also increases the amount of time auditors expend making a correction decision.

These results suggest that auditors believe their misstatement-reduction responsibilities vary between recognised and disclosed amounts, at least in part because they view misstatements in disclosed amounts to be less material. To the extent that financial markets and contracts rely less on disclosed numbers, setting higher materiality thresholds for disclosed numbers could be viewed as consistent with current accounting and auditing guidance. Therefore, allowing more misstatement in disclosed amounts in such circumstances may be a rational response by auditors to the lower risk of litigation or reputation loss associated with disclosed amounts (Libby et al., 2006, p. 535).

However, the lower reliability produced by auditors' greater tolerance for misstatement in disclosed amounts may reduce the overall quality of information available to users. It is unclear whether such an effect was intended by regulators, particularly in cases in which disclosure has been allowed as a political compromise. These results have potential implications for the interpretation of prior research, and for accounting standard setters and auditing regulators (Libby et al., 2006, p. 535).

From a financial-reporting research perspective, the results from Libby et al. (2006) indicate that prior findings of reliability differences between recognised and disclosed amounts may be caused, in part, by differences in the extent of misstatement reduction provided by auditors. Thus, accounting standard setters' information-location decisions may to some extent be ‗self-fulfilling prophesies' with respect to information reliability. Accounting regulators might consider whether an unintended consequence of relegating information to the notes to the financial statements is that the reliability of such information could be reduced by the interpretations and actions of auditors.

Similarly, decisions to require recognition may have a positive effect on information reliability because recognition encourages auditors to require correction of detected misstatements[12]. In addition, Bischof et al. (2011) demonstrate that required disclosures are not adequately enforced and that, in their case banks, get away with substantial non-compliance with disclosure requirements.

5. CONCLUSION

In the framework of literature on capital market effects of recognition versus disclosure we support Jifri and Citron's (2009, p. 123) conclusion that further research should investigate the extent to which market assessment of recognised versus disclosed amounts depends on the accounting item in question, its method of valuation and processing through books of account as well as the characteristics of the firm. For example, empirical results from Bratten et al. (2013) suggest that recognized and disclosed amounts are not treated

[11] One experiment reports data from 44 Big 4 audit partners, and varies whether a misstatement relates to stock-compensation expense that is recognised or disclosed. The other experiment reports data from 33 Big 4 audit partners, and varies whether a misstatement relates to lease liability that is recognised (as a capital lease) or disclosed (as an operating lease). In both experiments, they hold constant the company's economic circumstances, the sign, quantitative materiality, and certainty of the misstatement, and client opposition to correction of the misstatement (Libby et al., 2006, p. 534).

[12] It is also important to note that the effect of information location on post-audit misstatement depends on its effect on both managers and auditors. Libby et al. (2006) held constant the amount of pre-audit misstatement, and demonstrated that auditors tolerate more misstatement in disclosed amounts, which produces greater post-audit misstatement in disclosed amounts. Pre-audit misstatement may not be constant in practice. Since recognised amounts may be more important in valuation and contracting, client managers may face greater incentives to create pre-audit misstatement in recognised amounts than in disclosed amounts. Alternatively, managers may create more pre-audit misstatement in disclosed amounts in anticipation of more lax auditing. A useful direction for future research is to better understand how information location affects the extent of pre-audit misstatement.

differently by capital market participants[13] in the leases setting in which the disclosed amounts (in the notes to financial statements) are *reliable* and the disclosed information is *readily identifiable* and *easily processed*. However, in our opinion, for non-sophisticated users of financial statements the information location in any case indeed matters.

Since different stakeholders try to influence the information-location decisions (recognition versus disclosure) by the standard-setters by considerations other than those described in the conceptual frameworks, it seems that they believe that the information location in practice really matters. Our paper suggests a couple of reasons for the perceived differences between recognised and disclosed amounts. We believe that the relegation of amounts to the notes to the financial statements generally reduces informativeness of financial reports, especially for non-sophisticated users, and reduces the reliability of financial information. In our opinion, the preparers of the financial statements also take less care about disclosures relative to recognised items because the inadequate auditor pressure. Libby et al. (2006) demonstrated auditors' greater tolerance for misstatement in disclosed amounts, while Bischof et al. (2011) revealed that sometimes the preparers get away with substantial non-compliance with disclosure requirements, even in Western European countries with supposedly strong enforcement regimes. All these factors in our opinion strengthen the case for the general preference for recognition in the standard-setting context.

Therefore, it should not come as a surprise that currently the note disclosure problematic is receiving a lot of attention in the accountancy community. For example, European Financial Reporting Advisory Group (EFRAG) and the national standard-setters of France Autorité des Normes Comptables - ANC) and the UK (Financial Reporting Council FRC) in July 2012 issued a discussion paper titled *Towards a Disclosure Framework for the Notes*. It emphasises that a Disclosure Framework should contain a clear definition of the purpose of the notes, which should drive what (financial) information should be included in the notes and what belongs elsewhere. FASB launched the Disclosure Framework project back in July 2009 and in July 2012 issued Invitation to Comment – Disclosure Framework, a document very similar to the joint discussion paper of EFRAG, ANC and FRC.

In addition, the IASB formally added a short-term initiative on disclosure to its work programme in December 2012 as a part of its response to its Agenda Consultation 2011. The objective of the initiative was to explore opportunities to see how those applying IFRS can improve and simplify disclosures within the existing disclosure requirements (Deloitte, 2013).

REFERENCES

Aboody, D. (1996). Recognition versus disclosure in oil and gas industry. Journal of Accounting Research, 34(Supplement), 21-32. Doi: 10.2307/2491423

Ahmed, A. S., Kilic, E., & Lobo, G. J. (2006): Does recognition versus disclosure matter? Evidence from value-relevance of banks' recognised and disclosed derivative financial instruments. The Accounting Review, 81(3), 567-588. Doi: 10.2308/accr.2006.81.3.567

Altamuro, J., Johnston, R., Pandit, S., & Zhang, H. (2014). Operating leases and credit assessments. Contemporary Accounting Research, article accepted for publication, first published online: 14 January 2014. Doi:10.1111/1911-3846.12033

Barth, M. E., Beaver, W., & Landsman, W. R. (2001). The relevance of the value relevance literature for financial accounting standard-setting: another view. Journal of Accounting and Economics, 31(1–3), 77-104. Doi: 10.1016/S0165-4101(01)00019-2

Barth, M., Clinch, G., & Shibano, T., (2003). Market effects of recognition and disclosure. Journal of Accounting Research, 41(4), 581–609. Doi: 10.1111/1475-679X.00117

Beresford, D. R., & Johnson, L. T. (1995). Interactions between the FASB and the academic community. Accounting Horizons, 9(4), 108–117.

Bernard, V. & Schipper K. (1994). Recognition and disclosure in financial reporting. Unpublished paper, University of Michigan, Ann Arbor, MI, USA.

Bischof, J., Brüggemann, U., & Daske, H. (2011). Fair value reclassification of financial assets during the financial crisis. Retrieved from http://papers.ssrn.com/sol3/Papers.cfm?abstract_id=1628843

Boyle, P. (2010). Discussion of ' How do Conceptual Frameworks contribute to the quality of of corporate reporting regulation' . Accounting and Business Research, 40(3) (Special Issue), pp. 301-302. Doi: 10.1080/00014788.2010.9663404

[13] Altamuro et al. (2014) empirical study provides evidence that the current off-balance sheet treatment of operating leases does not result in them being ignored in credit assessments by banks and credit rating agencies, which could be labelled as sophisticated users of financial statements.

Bratten, B., Choudhary, P., & Schipper, K. (2013). Evidence that market participants assess recognized and disclosed items similarly when reliability is not an issue. Accounting Review, 88(4), 1179-1210. Doi: 10.2308/accr-50421

Davies, M., Paterson, R. & Wilson, A. (1999). UK GAAP (6th ed). London, UK: Butterworths Tolley.

Davis-Friday, P. Y., Folani, L. B., Liu, C. S., Mittelstaedt, H. F. (1999). The value relevance of financial statement recognition vs. disclosure: evidence from SFAS No. 106. The Accounting Review, 74(4), 403-423. Doi: 10.2308/accr.1999.74.4.403

Davis-Friday, P. Y., Liu, C. S., Mittelstaedt, H. F., (2004). Recognition and disclosure reliability: evidence from SFAS No. 106. Contemporary Accounting Research, 21(2), 399-429. Doi: 10.1506/T0VC-Q15Y-W5QV-4UKQ

Deloitte (2013). Disclosure Framework. Retrieved from http://www.iasplus.com/en/projects/research/disclosure-framework

Dye, R. (2001). An evaluation of ' essays on disclosure' and the disclosure literature in accounting. Journal of Accounting and Economics, 32(1–3), 181–235. Doi:

EFRAG – European Financial Reporting Advisory Group, ANC – Autorité des Normes Comptables, FRC – Financial Reporting Council (2012). Towards a Disclosure Framework for the Notes: Discussion Paper. Retrieved from http://www.efrag.org/files/ProjectDocuments/PAAinE%20Disclosure%20Framework/121015_Disclosure_Framework_-_FINAL1.pdf

FASB – Financial Accounting Standards Board (2013). Disclosure Framework: Board's Decision Process. Retrieved from http://www.fasb.org/cs/ContentServer?c=FASBContent_C&pagename=FASB%2FFASBContent_C%2FProjectUpdatePage&cid=1176163077030

Frederickson, J. R., Hodge, F. D., & Pratt, J. H. (2006). The evolution of stock option accounting: disclosure, voluntary recognition, mandated recognition and management disavowals. The Accounting Review, 81(5), 1073-1093. Doi: 10.2308/accr.2006.81.5.1073

Fülbier, R. U., Hitz, J.-M., Sellhorn, T. (2009). Relevance of academic research and researchers' role in the IASB's financial reporting standard setting. Abacus, 45(4), 455-492. Doi: 10.1111/j.1467-6281.2009.00300.x

Higson, A. (2003). Corporate financial reporting – theory & practice. London, UK: SAGE Publications.

Hirshleifer, D., & Teoh, S. H. (2003). Limited attention, information disclosure, and financial reporting. Journal of Accounting and Economics, 36(1-3), pp. 337-386. Doi: 10.1016/j.jacceco.2003.10.002

IASB – International Accounting Standards Board (2010). Conceptual Framework for Financial Reporting 2010. London, UK: IFRS Foundation.

Jifri Al, K., Citron, D. (2009). The value relevance of financial statement recognition versus note disclosure: Evidence from goodwill accounting. European Accounting Review, 18(4), 123-140. Doi: 10.1080/09638180802324351

Lambert, R. A. (2003). Discussion of limited attention, information disclosure, and financial reporting', Journal of Accounting and Economics, 36(1-3), 386-399. Doi: 10.1016/j.jacceco.2003.10.005

Libby, R., Nelson, M. W., & Hunton, J. E., (2006). Recognition v. disclosure, auditor tolerance for misstatement, and the reliability of stock-compensation and lease information. Journal of Accounting Research, 44(3), 533-560. Doi: 10.1111/j.1475-679X.2006.00210.x

Malkiel, B. G., & Baumol, W. J. (2002). Stock options keep the economy afloat, Wall Street Journal, April 4 2002, p. A18.

McKernan, J. F. (2007). Objectivity in accounting. Accounting, Organisations and Society, 32(2), 155-180. Doi: 10.1016/j.aos.2006.03.008

Novak, A. (2011). A new approach to lease accounting, in: Kern T. (ed.) People and sustainable organization. Frankfurt am Main, Germany: Peter Lang, 362-401.

Novak, A. (2012): Qualitative characteristics of useful financial information in conceptual framework, in: Ferjan M. (ed.) Quality, innovation, future: proceedings of the 31st International Conference on Organizational Science Development. Kranj, Slovenia: Moderna organizacija, 802-813.

Schipper, K. (2007) Required disclosures in financial reports. The Accounting Review, 82(2), 301-326. Doi: 10.2308/accr.2007.82.2.301

Solomons, D. (1986). The FASB`s conceptual framework: An evaluation. Journal of Accountancy, 161(6), 14-124.

THE ROLE OF FINANCIAL INFORMATION IN THE EVALUATION OF STRATEGIC MATTERS IN BANKS

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Abstract: *Given that today's banks operate in circumstances that characterize the dynamic changes in the environment, utilizing a certain strategy of an organization is much more complex work than just creating the strategy. The authors choose this topic because of the increasing importance of financial information to create competitive advantages for banks in the current business conditions globally. Significant insight into the accounting information of strategic importance can be achieved just by estimate based on published financial statements. Analytical framework that can be applied to the published financial statements of competitors should be treated as part of the assessment of competitive advantages for banks. This type of financial analysis should include the monitoring of trends in sales of banking products, profit levels, structure of the assets and sources of funding. Through the integration of information which strategically oriented management accounting provides from the environment and the bank itself, it generates information that can serve to improving the quality of strategic financial decision. In this context, it is important to have continued cooperation of management accounting with senior management, corporate and competitive strategy, as well as with other functions represented in the organizational structure of the bank.*

Keywords*: bank, financial information, competitive advantage, strategic management accounting*

1. INTRODUCTION

Financial statements can provide data about the summary of economic information. Financial analysts determine the appropriateness of management forecasts which imply the choice of accounting methods and calculation and are focused on the analysis of the cash flows and transparent disclosure in the notes to the financial statements, so that conclusions and judgments made on the basis of financial analysis adequately reflect the economic realities of actual financial performance of the bank. Analyst reports can provide information to investors about whether the financial decisions of the bank are valid or whether managers overestimate the economic performance of banks in order to protect their personal business interests and increase their bonuses.

Important role in that process has the internal control as an essential support in controlling financial flows and financial reporting service which should provide specific reports for liquidity management (see more Knežević, Djurić & Dmitrović, 2012a). Sources of risk in banks are contained in their assets and liabilities. Therefore, it is impossible to manage risks in banks without quality financial reporting. Accounting reports, meaning that information contents are prepared as a basis for decision making and their customers are the carriers of management and decision making bodies. The financial statements as carriers of accounting information on the financial position of the entity at the end of the period, the overall result of the entity for the period and cash flows of the entity are used for making economic decisions by wide range of users.

Efficient asset management is particularly important for long-term survival and development of the bank in the market in which it operates [see more about techniques for measuring the efficiency in banks (Knežević, Marković & Barjaktarović Rakočević, 2012c).

In the first part the emphasis will be placed on the link between the process of financial decision making and accounting as a source of information, in the long-term, while in the second part it will be evaluated more strategic aspects of financial performance of the bank.

2. FINANCIAL DECISION MAKING IN BANKS FROM THE STRATEGIC POINT OF VIEW AND ACCOUNTING

Since every decision can only be as good as its information base, the quality of bank management decisions also depend on the extent to which it can successfully optimize decision-making basis. Information thus becomes the strategic resource management. In addition, the information system is intended to serve primarily inclusion, storage and distribution of relevant information. In other words, information systems are expected to provide the right information available at the right place at the right time. Adequate management information system in bank basically consists of two related parts: accounting and reporting.

Ongoing challenge faced by managers, consultants and researchers is how to harmonize the functional activity and discipline with each other and at the same time to support corporate strategy. Part of the burden of adjusting strategy and management accounting, including management control and performance measurement refers not only to the dynamic nature of the strategy in different contexts, but also to the spread of different views and strategies for academics and practitioners. For optimal information funding decision is that bank management needs to build accounting that would be a leading instrument. Accounting as main source of information in banks should provide the following information:

- What is the bank's earnings in certain activities;
- What is the interest in specific transactions with customers;
- Which, how much and where the related costs for banking services arise;
- Which contribution to the result of banks certain types of businesses, groups of customers or business units have;
- Which structure of operations show profit profile and risk profile;
- Which business conditions have effects on the level of results;
- What is the relationship between profitability flow and cash flow in the bank and so on.

In defining the strategic direction of the bank, it is necessary to include the following essential elements (Djurić, Knežević & Barjaktarović Rakočević, 2011):

1. Definition of profile of the bank;
2. Analysis of the macroeconomic environment;
3. Projection of future business activities and identification of the target of operating results.

The concept of strategy implies the use of formal information management systems. Achieving the goals requires analyzing information in the process of decision making. If a strategic decision is structured and planned venture it will draw significant attention. It is necessary for management to proactively identify internal and external strategic opportunities and threats, without denying the possibility of strategic innovation. It is assumed that managers formally analyze the competitive advantage and meaningful assessment of the distribution and use of resources, as part of a development strategy. Formal information systems will provide such analysis. Strategic management accounting is a good tool for managers to make sound business decisions (see more - Knežević, Milosavljević & Dmitrović, 2010).

Strategic goals of the bank can be the following:

1. Long-term profitable business with an adequate protection of capital;
2. Growth of market share;
3. Growth credit portfolio;
4. A long term implementation of the social responsibility concept.

From management accounting strategic orientation is expected strong information support that will enable the implementation of preventive measures aimed at eliminating ineffective results in the bank. It is essential that the bank has the ability to successfully manage unplanned changes in funding sources, for which the accounting estimates are necessary, which suggests that the bank is adequately responding to market changes.

Dynamic changes in the external environment are the main reasons for the necessary changes, which require closer cooperation between strategic managers and management accountants, especially in the monitoring and analysis of the costs, as well as their design, especially in the business environment which is characterized by risk and uncertainty. In addition, it is very important and powerful information support in the area of measuring the profitability of individual banking products and changes related to key customers of the bank.

Strategically oriented management accounting is a multipurpose information resource oriented towards management and future, and focused on strategic business units. Simmonds (1981) has defined and described that strategic management accounting focused on the comparison of companies with rivals. He advocated the collection of information necessary to determine the share of the market, price competition, cost and scope. A bank that follows the market share can measure the extent to which it win or loses competitive position.

Given the fact that the strategic development of the bank is directly connected with the plans of the bank, it is important to note that strategic planning directly depend on information management accounting. In other words, there must be a high degree of coordination between planning and reporting.

Bearing in mind that the market environment has become more dynamic and competitive, in order to operate successfully banks are forced to continuously improve their activities in terms of having more accurate predictions of future operations. However, banks can no longer allow themselves to have any inconsistency between anticipated revenues and expenditures. With the growing importance of the budgeting process in the banks, the need for more detailed reporting system is on the rise.

In the strategic analysis of competitors of an observed bank, it is necessary to answer to the following questions:

1. Who are the strongest competitors?
2. Whose strategic actions largely affect the observed bank so that special attention needs to be given to their activities?
3. What are the goals of past strategy of competitors?
4. What are the objectives of the current strategy of competitors?

Benchmarking is based on the idea that own business is compared with the strongest competitors in order to be able to use the obtained knowledge in attempt to improve own business.

The market justification of certain market undertake includes identifying information about own customers and suppliers, competition and trends in the industry in which it operates. It is necessary that analyze current and anticipated future competitors.

Strategic planning is the process of defining the strategy of the bank, as well as the decision making process in order to enable the implementation of approved strategies. Crucial issue of each bank is to define the direction which the bank should follow. Based on the strategic plan operational plan is carried out, which is usually focused on a period of one year. Organizational activities are undertaken in order to design various interests, including bank, specific authority, and institutional pressures.

The strategic plan of the bank consists of two parts: qualitative and quantitative. The qualitative part of the analysis includes the analysis of macroeconomic scenario, the SWOT analysis, the bank's mission, strategic direction and action plan, which should enable the achievement of defined plans. Quantitative methods include the application of financial models into strategic financial management of the bank. The chosen strategy of the bank is to be then translated into a set of objectives (Djurić, 2010). In the context of strategic planning it is necessary to mention the concept of the Balanced Scorecard, which reflects the intention to maintain a balance between short-term and long-term objectives between financial and non-financial measures as well as between the backlog and leading indicators. Hence, the point is that the management takes the bank towards achieving strategic goals. The central queston for the bank management is “how well are we doing”?

In assessing the commercial bank performance it is essential to define the criteria from several aspects (Knežević, Barjaktarović Rakočević & Djurić, 2011):

First – financial perspective: revenue management, market share, profitability capacity, asset management;

Second – a client's perspective: to win the client before others, customer profitability, customer retention, special financial services;

Third – internal business process perspective: creating information systems, information support for management, maintaining the quality of the business;

Fourth – perspective for learning and professional development of managers: knowledge and development of managers, teamwork, policies for stimulating and rewarding.

It is important to mention the role of the banking controlling which is used for adequate information communication in the bank, so that the variance between the strategic and operational objectives and the results achieved will be as small as possible.

From strategically oriented management accountant is expected to anticipate the financial aspect of business events and create a business vision using bank management accounting information.

For an adequate cost management it's necessary to have evaluation of alternative strategies or plans that display all costs. In order to design appropriate information model of strategic management accounting for banks involve various experts: management accountants, experts in planning and analysis, financial and other bank managers, experts in information technology and more. Monitoring the activities of competitors, especially in the domain of actual performance management team of the bank may make positioning of the bank in the future in relation to competitors.

Significant support for improving business performance of strategic business units is expected from the marketing manager. Marketing surveys estimate future outcomes and results in order to facilitate decision making on different options of cost estimates which are in line with corporate objectives. Managers involved in managerial accounting are trying to identify the cost structure of competition and based on that determine the prices of banking products taking into account to offset the inflationary effects of the variables observed. Adequate assessment of price competition begins with an analysis of costs and continuing analysis of the impact of possible changes in prices of other competitors in the financial market, which requires accounting analysis. Afterwards, a scope of market influence is considered. Of course, competitive advantage is not possible to express as a single variable, but rather as a group of indicators that show competitive picture that will serve the strategic managers to monitor whether the bank is moving in the right direction. The possession of information about the costs of competitors allows the bank to recognize when a competitor is trying to change the relative competitive position, for example to management prices.

In many areas related to the environment there is increased interest in transparent calculations and analyzes that often include in addition to economic and financial calculations. At the level of the business system so-called accounting for environment is identified as a segment of financial accounting as well as a segment of the strategic orientation of management accounting. Social responsibility is particularly important for the bank's reputation in terms of increase of financing of environmentally sustainable projects, funding projects that increase energy efficiency and more. For this purpose predictive information is necessary, both financial and non-financial.

3. STRATEGIC MANAGEMENT OF THE FINANCIAL PERFORMANCE OF A BANK

Banks are entities in the financial markets and the overall financial system of the economy and thus banks have become directly or indirectly trigger and control mechanism of the financial system, without which the process of reproduction was virtually impossible. As specific financial institutions banks are at the central point of the financial system, because of the function they perform and the relative magnitude of financial resources that is on their accounts.

In banking, as well as in many other industries, business reputation is particularly important and this significantly affects the overall financial performance. For each bank, regardless of how the bank is present in a particular market, the biggest threat is the loss of business reputation. Safety of a bank is a basic prerequisite for the acquisition and preservation of its long-term reputation in the public. One of the parameters of safety of a bank is its assets, or assets that it has in the performance of its business activities and the realization of the target performance – profitability, solvency and liquidity.

For the implementation of the strategy that leads to the achievement of financial performance targets it is necessary to solve the three generic questions:

1. Which dimensions of performance does banking institutions tend to develop?
2. How will the goals be properly set?
3. What rewards and / or penalties should be linked to the achievement of performance standards?

Strategic management of bank performance can be represented as the activity of management bank solvency in order to define the optimal relationship at two levels: maximizing yield and meeting the demands of regulatory institutions that are focused on preserving the stability of the banking system, while minimizing risk to the business.

Directing the bank's business activities towards the realization of the strategic performance of the bank is a very complex process, because of contradictions of objectives of shareholders and depositors of the bank. Information horizon of management accounting in the function of the realization extends to the following strategic objectives of the bank:

- Identify opportunities and weaknesses of competitors in terms of cost components (cost banking products), the relative share of the market and the level and structure of fees and commissions;
- The trend of expanding or narrowing the scope of the bank's domestic and international markets in the field of financial indicators;
- Comparison of actual strategic goals and objectives with planned, types and causes of deviations and taking corrective measures to eliminate the negative deviations.

Performance measures play a critical role in the organization, in order to check how efficiently the banking institution achieves its goals, as well as identifying necessary improvements. For the analysis of financial performance (see Table 1), it is necessary to perform financial projections of the balance sheet and the income statement with expected trends and calculate of the following indicators of business (Djurić, 2010).

- Net profit / Average assets - Net profit / Average shareholders's equity - Operating and other expenses/Interest income - Operating and other expenses/Net non-interest income - Operating and other expenses/Assets - Net interest income/Interest-earning assets - Net income from interest and fees/Interest-earning assets - Interest income/Interest-earning assets
- (Interesed earned – Interesed expensed)/Total assets - Interest-earning assets/Total assets - Average interest rate on interest-earning assets - Average interest rate on interest-earning liabilities
- Total capital/Total assets - Primary capital/Total assets - Deposits and other accounts up to three months/Shareholder's equity
- The growth rate of total assets - The growth rate of interest-earning assets - Loan growth - The rate of growth of deposits - The rate of growth of income - The rate of profit growth
- Total loans/Deposits - Liquid assets/Total deposits - Liquid assets/Total assets - Liquid assets/Current liabilities - Liquid assets/Deposits up to three months - Liquid assets/Risky off-balance sheet liabilities and total deposits - Gross advances/Deposits and other accounts
- Cash generated from operating activities/Net profit
- (Current deposits – Previous deposits)/Previous deposits - (Current loans – Previous loans)/Previous loans - Debts/Net worth - Non-performing loans/NPLs and discount - Regulatory capital/Risk-weighted assets - Sales/Number of bank employees - Profit before tax/Number of bank employees - Net interest income/Average assets earned from interest - Provisions for loan losses/Average loan portfolio - Operating and other expenses/Total expenses - Operating and other expenses/Net income from interest and fees - Operating and other expenses/Net other financial income - Overheads/Total operating income - General expenses and provisions for losses/Average total assets - Operating expenses/Average assets - Regulatory capital/Risk-weighted assets - Provision for loan losses/Average loan portfolio - Provision for loan losses/Average total assets - Reserve for loan losses/Gross loan portfolio

Table 1. Financial indicators for banks

From a strategic point of view market share analysis of banks in individual segments is significant. Besides, the analysis of the strategic business plan is important to the bank in terms of the level of investments in information systems, and from a spread of branch expansion, in order to be possible to make a realistic assessment of future growth and strengthen the market position of the bank.

From strategic management accounting series of indicators related to the competitive position are expected, with particular emphasis on market leaders, close and slow competitors. The reduction in market share shows a loss of competitive position of the bank, with implications for future reduction in profits, while increasing market share points to improve the competitive position of the prospects for increased profitability in the future.

Changes such as new cost allocation methodology, new approaches to estimating the value of money and greater participation in the budgeting process initiated intensive communication between managers and accountants. The focus of banks today is productive budget oriented product profits and reduced costs. Different information systems are used for a variety of organizational levels. For example, the five-year budget plan and five-year profit forecast sales trends are used to support systems executives *(Executive Information System*s), while on the other hand, the administrative-level control system for the preparation of the annual budget and capital investment analysis for sales management use management information system, while at the same organizational level in the analysis of profitability, costs and sales by region using decision support systems (*Decision Support Systems*). Accounting information system is part of a management information system (*Management Information Systems*) and has the characteristics of bank information systems, which produce a variety of information for different purposes (see more – (Stanković, Mitrić & Knežević, 2012); (Stanković, Knežević & Mitrić, 2013).

Financial information is also an important source of information for reporting on risk management - liquidity risk and for identify the strength and weakness of banks and banking partners for the future and for benchmarking own performance.

Effective reports supported by adequate banking software of the operating risk for the bank provide managers with detailed information for strategic decision making. Such reports are useful for the board of directors, executive committee, operational risk managers and executive risk managers and they have early-warning character. Strategic management accountants need to be oriented towards learning new skils (Coad, 1996).

Information from published balance sheet can be used for calculation of Herfindahl–Hirschman index. According to the regulatory provisions of the Federal Reserve System (Fed) the degree of concentration determined by the Herfindahl–Hirschman Index is calculated as the sum of squared share of individual bank in the overall category which is observed (assets, deposits, loans) with the value of the 1,000 points at the low concentration level, the value of 1001-1800 in moderate concentration, a value above 1,800 shows the existence of strong competition. By calculating this indicator it is possible to compare the degree of concentration of the banking sector in Serbia with the average of, for example, Central and Eastern Europe, or Southeast Europe.

Information from the financial statements may serve as sources for the application of various quantitative methods such in research as:

- I-distance method – measuring the efficiency of banks (see – (Knežević, Jeremić, Žarkić Joksimović & Bulajić, 2012b));
- Correlation and regression analysis (see – (Knežević, Marković & Živković, 2013));
- Data and Envelopment Analysis – DEA (see – (Knežević, Marković & Barjaktarović Rakočević, 2012)).
- DEA Windows Analysis Approach for Mesuring the Efficiency of Serbian Banks Based on Panel Data (Savić, Radosavljević & Ilievski, 2012).

4. CONCLUSION

Significant insight into the accounting information of strategic importance can be achieved based on evaluation of published financial statements. Analytical framework that can be applied to the published financial statements of competitors should be treated as part of the assessment of competitive advantage. This type of financial analysis should include monitoring sales trends, profit levels, as well as assets and liabilities of the bank. Accounting of competitors and strategic prices are the most widespread application of strategically dimensioned management accounting. Strategic management accounting is an evolutionary, systematic process that is constantly evolving and adapting and changing according to the changes in the bank and environment, as a function satisfying changing information needs of the business and financial decision-making strategic orientation.

An important piece of information for the assessment of competitors' costs can be obtained in part by the follow-up of technological innovations, which have important information about investing in research and development. Long-term orientation of banks towards investments implies that the bank as a profit and economically oriented institution continually seeks new opportunities to improve the competitive position and to increase awareness of the cost of competitors. Trends of competitors should be followed through systematic data collection about their development. Trend analysis of competitors involves measuring the current achievements of a bank to be able to predict future actions and achievements of competitors.

In certain countries accounting has very high application in performance evaluation of competitors based on published financial statements.

It is first necessary to create conditions for the proper integration of the system of management accounting in the information system of the bank, and then assign a strategic dimension to it. Banking institutions should measure output that are exact, and all other output that have an impact on the bank. It is important to use tools of management accounting for strategic decision making in banks.

REFERENCES

Coad A. (1996), Smart work and hard work: explicating a learning orientation in strategic management accounting, Management accounting research, 7(*4): 387-408.

Djurić, D. (2010). Management accounting statements for the purpose of decision making in banks. Management – Journal for theory and Practice Management, 15(55): 17-24. Faculty of organizational Sciences, Beograd

Djurić, D., Knežević, S. & Barjaktarović Rakočević, S. (2011). Accounting information system in banking planning and control. Management, – Journal for theory and Practice Management, 16(61): 43-53. Faculty of organizational Sciences, Beograd

Knežević, S., Barjaktarović Rakočević S.,Djurić, D. (2011). Management accounting in achieving competitive advantage and bank controlling. Knežević, S., Djurić, D. & Dmitrović, V. (2012a). General Financial reporting and special purpose reports of banks. Management – Journal for theory and Practice Management, 62: 45-55. Faculty of organizational Sciences, Beograd

Knežević, S., Jeremić, V. & Žarkić Joksimović, N. & Bulajić, M. (2012b). The Serbian Banking Sector: a Statistical Approach. Metalurgia International, Bucureşti: Editura Ştiinţificæa F.M.R., 17(1), pp.171-174.

Knežević, S., Marković, M. & Živković, A. (2013). Correlation and regression analysis of Serbian banking sector. Metalurgia International. Bucureşti: Editura Ştiinţificæa F.M.R., 18(4),pp. 253-258.

Knežević, S., Marković, M. & Barjaktarović Rakočević, S. (2012c). Assessing efficiency in banking. Industry - Journal of the Institute of Economics in Belgrade, 40(3), pp.71-92.

Knežević, S., Milosavljević, M. & Dmitrović, V. (2010). Importance of strategic management accounting for bank management. Management – Journal for theory and Practice Management, 57: 23-29. Faculty of organizational Sciences, Beograd

Management – Journal for theory and Practice Management, 59: 5-13. Faculty of organizational Sciences, Beograd

Simmonds, K. (1981). The fundamentals of strategic management accounting. Institute of Cost and Management Accountants: London.

Savić G., Radosavljević M., & Ilievski D. (2012). DEA Windows Analysis Approach for Measuring the Efficiency of Serbian Banks Based on Panel Data, Management – Journal for theory and Practice Management, 65:5-14. Faculty of organizational Sciences, Beograd

Stanković, S., Mitrić, M. & Knežević, S. (2012). Business and financial decisions based on information provided by accounting information systems. The 1st Virtual International Conference on Advanced Research in Scientific Areas (ARSA-2012), Slovakia, pp. 660-664.

Stanković, A., Knežević, S. & Mitrić, M. (2013). Accounting information system as the central point of a modern organization. 3rd International Conference Economics and Management Based on New Technologies, EMoNT 2013., Vrnjacka Banja, Serbia, pp. 461-465.

MUNICIPAL BONDS AS A MODEL OF PROJECT FINANCING OF INFRASTRUCTURE PROJECTS

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Abstract: *The development of the capital market in Serbia came to a sudden stop directly affected by the outbreak of the global financial crisis, i.e. since the last quarter of 2008. The bank-centric ambient and insufficient development of diversified investment instruments in Serbia, due to systemic risks which Serbia is facing, requires further consideration of new models of business investments, particularly in the field financing long-term infrastructure projects. This paper highlights prospects of financing infrastructure projects using municipal bonds, taking into consideration advantages and disadvantages of this type of financing and pointing on potential dangers and opportunities of this model of project financing. The improvement of cooperation between local governments and competent state institutions is a prerequisite for the realization of options and potentials for the development of municipal bonds as securities to finance infrastructure projects.*

Key words: *municipal bonds, project financing, infrastructure projects, municipal bond risks, Serbian financial market*

1. INTRODUCTION

In the past fifteen years, many states worldwide welcomed the project financing as the driving force for rendering various services related to the improvement of infrastructure. The UK government, a pioneer in this field, and a country whose experience in financing projects of great social-economic importance, from private funds in early „30th of the last century, made a significant contribution in accepting, adjusting and implementing the concept of project financing of infrastructure projects at all levels in the countries worldwide.

It is commonly stated that project financing is the form of financing which includes the community as well. Thus the comprehensive analysis should cover economic costs, revenues and benefits on one side, and risk to be accepted by all participants involved in the realization of the project, on the other side, in order to finalize it within the foreseen timeframe. Only under such circumstances one may say that the project realization is certain.

Project financing has numerous advantages in relation to direct i.e. corporate project financing. However, these benefits are often visible only after careful analyzing and smart financial engineering. The organization of project realization, its legal structure and financial plan should reflect the nature of the project, since different elements such as risk, expected profitability, eligibility of participants, requests and amounts of collaterals related to securing the borrowed financial assets with financial institutions, then the ability to achieved tax savings, financial situation of the project sponsor, expectations of the Government of the domicile country, expectations of local self-governments, and many other factors may influence the delivery of the project.

It is often stated that project financing may be defined as "founding of an independent project company, financed by the capital of one or more sponsors and without the right to compensation based on granted loans for the purpose of investing capital in assets (East Asia Analytical Unit, 1998). The project financing is most often used for new, independent, complex infrastructure projects with a high-level of risk and huge discrepancy of information available. Likewise the stakes of the sponsor"s capital are decreasing, and the burden of financing is provided in the form of tranches of syndicated loans.

Parallelly, the issue of municipal bonds is often stated as one of the source of financing the development of infrastructure of local governments. Therefore the purpose of this paper is to point out on potentials of municipal bonds as the source of financing of infrastructure projects through the concept of project finance. Furthermore, this paper is also to underline constraints of the issue of municipal bonds, which is the exact reason why this concept has never took root sufficiently as a concept of obtaining additional funds in Serbia.

The paper is divided in several chapters. The *Chapter I* is dedicated to the role of banks in project financing of infrastructure projects, the *Chapter II* elaborates on municipal bonds as a model of project financing of

infrastructure projects, while the *Chapter III* provides a brief overview of options which municipal bonds offer as an alternative model of financing. The next chapter presents experiences which other countries in the region had in using municipal bonds as the source of project financing, followed by the chapter giving the review of revenues. The last one is reserved for concluding remarks.

2. ROLE OF BANKS IN PROJECT FINANCING OF INFRASTRUCTURE PROJECTS

During the phase of initial overview and structuring of project financing, leading banks i.e. banks-loan-providers, became the project insiders in working with project sponsors. At the same time they became accountable for loan financing by means of overall syndicated loans by attracting other banks which became members in loan syndication (Gatti et al, 2008). As the respective loans do not include the indemnity clause, i.e. they relate to financing of Project Company with or without limited support from the sponsor, the loan syndication itself (deriving from syndication of the capital of financial institutions which fund the project) is in many way responsible for operational risk. By assigning the project a higher l*everage*, the operational risk must be reduced to an acceptable level. This is exactly where one of the key advantages of project financing lies– it is possible to allocate a specific risk of the project (risk of project realization and operational risk, risk of generating revenue and risk of adequate pricing, and risk of political influence and expropriation) to those participants who deal best with them (Brealey et al, 1996).

As for credit lines intended for project financing of infrastructure projects there is no significant correlation between the use and project closure timeframe. The issue related to liquidity of this model of project financing is mainly the consequence of inevitable reliance on cash flow of the project, expected higher *leverage ratio*, and volatile level of risk immanent in certain stages of the project.

There are many reasons behind “pros and cons“ for both loans and bonds when considering project financing as the model for financing infrastructure. Thus Yascombe (2010) points to the fact that credit risk associated with investment in project, in particular the one referring to a long-term projection of inflation, cannot be curbed with bank arrangements; however, when it comes to the issue of bonds, on specific markets they can be derived based on inflation index (inflation-indexed bonds). Additionally, money collected through the issue of bonds may be withdrawn in bullet, whilst with the loan arrangement it may not be the case.

At the same time, loan arrangements may be rather flexible when it comes to repayment of borrowed funds, and in case of refunding of assets collected by means of bond issue, it is provided by repurchase i.e. c*all* option. Furthermore, banks are very prudent is controlling all changes which refer to the project agreement and project company whilst creditors bond buyers control only large-scale cases which have a considerable impact on coverage of cash flow of the project or security.

It is true to say that due to the fact that obtaining financial resources from financial institutions such as banks is often dependent on situation on the capital market and level of financial resources needed for financing infrastructure projects. Thus, during 2013 the banking sector in the whole Europe and even in Serbia shows a dramatic decline in lending activity of economy. Namely, in the first eleven months of 2013, lending decreased in net amount of EUR 0.9 million which is 9% compared to December 2012 (NBS, 2013). In the circumstances of moderate lending activity, evidently reduced risk appetite, and high share of NPL (Non-performing loans) of commercial banks in Serbia, the question is to how to finance infrastructure long-term projects. This at same time implies the need for new, i.e. alternative models of project financing.

Table 1. Indebtedness of local governments of the R Serbia by creditors as of June 30, 2011

in EUR 000

Number	Name of creditor	Total amount	Repaid amount	Outstanding amount
1	EIB	265,000	510	264,490
2	EBRD	208,087	40,822	167,265
3	Banca Intesa a.d, Beograd	106,024	25,442	80,582
4	AIK banka a.d, Niš	54,630	5,220	49,410
5	Unicredit Bank Srbija a.d, Beograd	25,343	6,070	19,273
6	Komercijalna banka a.d, Beograd	13,501	1,027	12,474
7	Hipo Alpe Adria Bank a.d, Beograd	12,334	2,499	9,835
8	KBC banka	6,508	89	6,419
9	Republic of Serbia Development Fund	4,221	0	4,221
10	Others	3,563	885	2,678
11	Erste bank a.d, Novi Sad	2,176	97	2,079
12	Raiffeisen bank	3,205	1,937	1,268
13	Bank Austria credit ansalant AG Vienna	1,355	507	848
14	Vojvođanska banka a.d, Novi Sad	2,071	1,493	579
15	JP Vodoprivreda Ćuprija	956	569	387
16	NLB Continental banka, Novi Sad	580	325	255
17	CrediAgricolbanka	547	382	165
18	Agrobanka AD Beograd, filijala Zaječar	152	118	34
19	VB leasing	26	14	12
	TOTAL:	**710,282**	**88,006**	**622,276**

Financing local self-governments has a small stake in placements of majority of commercial banks. Consequently financing local self-governments is out of focus, thereby undermining the necessary understanding of financing local governments in relation to banks (Peteron George, Fellow Senior). However (Kovac, 2011)a more flexible cash flow of bonds is detrimental in favor of bonds relative to bank loans, provided bonds are used for financing the entire sums of capital payments only upon maturity. Thus, if needed or intended, the repayment of the respective sum will be financed using a financial instrument from a new issue of bonds and that way liabilities based on payment may be „renewed".

Although commercial banks in Serbia after long cooperation with local governments" structure gained knowledge on needs for financing development and capital projects, in particular throughout the crisis period, the empirical research showed that long-term projects are still beyond their focus. The above stated may be proved from the Table 1,which shows high share of international financial institutions, much as 70% financing local governments in Serbia compared to commercial banks, state fund, and other creditors. The main reason for this is steep prices i.e. high interest rates, and limited potential for investment in large projects.

3. MUNICIPAL BONDS AS A MODEL OF PROJECT FINANCING OF INFRASTRUCTURE PROJECTS

Municipal bonds belong to a special category of bonds issued by public bodies in order to finance projects related to goals of local government development. It is important to note this type of financing as bonds are structured the same as project bonds. Municipal bonds refer to bonds issued by public entities such as states, governments, provinces, local governments to other entities, for financing costs of business or specific projects. This type of bonds can be sold by public offering to small investors or specific institutional investors.

According to some managers this type of funding predates not only project financing through bond issue but the very project finance in general. As a matter of fact, the US municipal bond market has existed and developed over 100 years and in the meantime became the largest market. The market expanded due to the fact that interests are tax-free (which decreased funds the market accounts) and it is usually issued for a relatively low value, which makes them particularly suitable for small-scale projects. According to (Daher,

1997)municipal bonds are an important segment in the US bond market and are a primary source of financing local infrastructure. The development of emerging markets will be a great challenge as in those markets borrowing by local governments is largely restricted to bank loans.

At the same time it is to be emphasized that other countries began to use this type of instrument as well, for instance Eastern European countries (Poland, Check Republic, Bulgaria, Hungary, Estonia and other) and countries in South America (Brazil, Argentina, Columbia, and other) most often issuing them on European market.

Instruments of this type may be grouped in the following categories (Gatty, 2008):

- General Obligation bonds (GOs),
- Project Revenue bonds and
- Dedicated revenue bonds.

General obligation bonds (GOs) are securities where debt service is guaranteed with full trust and credibility of the issuer, which depends on its power to define the tax environment and related liabilities, from which the borrowed funds will be repaid eventually.

Project Revenue bonds are bonds with debt serving as a loan, guaranteed i.e. secured by cash flow generated by the project itself. The main difference between these bonds and project revenue bonds is that the issuer is a public entity instead of SPV. Bonds are often named after the sector for which funds are collected; so there are bonds related to the airport revenue, highway revenue, hospital revenue, sports revenue, water and sewer revenue, bonds related industry revenue etc. Funds collected from the issue are transferred by a public entity to a private company for the purchase of the plant or facility, and the generated revenue will be later used to repay the borrowed funds through the issue of bonds.

Finally, *dedicated revenue bonds* present a special category of bonds where a debt is guaranteed with a specific cash flow generated through public entity revenue. In depth, this cash flow is not tied to any specific project but revenues generated from taxation, such as for instance production and selling of alcoholic beverages, cigarettes, fuel, gas and the like where a public entity is the party with the right to dispose of collected funds or to transfer them to higher level of administration.

The categorization of municipal bonds according to timeline and from the aspect of purpose (Fabozzi, 2008) is divided to:

Short-term municipal bonds, typically sold to receive funds based on tax or revenue from the sale of bonds issue.

Long-term municipal bonds for financing:

a) Long-term capital projects, such as: schools, bridges, roads and airports, and
b) Long-term budget deficit arising from ongoing operation.

(Peteron George, Fellow Senior) emphasize two models of lending to local governments which needs to be addressed: (i) bank loans, used for financing investments in Western Europe to a largest extent during XX century and still being the primary source of financing and (ii) municipal bonds, as the ground of indebtedness of North America. According to them, emerging countries should build and strengthen credit markets by selecting features of both models and encourage competition in a fair way between lending by banks and bond issue.

4. MUNICIPAL BONDS AS AN ALTERNATIVE MODEL OF INVESTMENT

In order that municipal bonds reach potential foreign investors easily, one of the preconditions is determining / assigning rating by international credit rating agencies, such as: Moody"s, Standard&Poor"s and Fitch.

At the end of 2010, the credit agency Standard&Poors improved the credit rating to the RS from BB- to BB, as it was assessed that the RS will be able to meet all criteria in future in order to receive the candidate statues for accession to the European Union.

Following the improved credit rating of the RS, local self-governments Kraljevo, Novi Sad and Valjevo were the first in Serbia to receive the credit rating from the international credit rating agency Moody"s, which was

the impetus for the issuance of municipal bonds. In fact, issued bonds by virtue cannot have a better credit rating that the domicile country of local governments.

This is supported by the review of credit ratings of municipalities in Serbia assigned by Moody"s in 2010 as shown in Table 2 ((Moodys, 2010).

Table 2. Credit ratings of municipalities in Serbia assigned by Moody"s in 2010

Name of the local self-government	Credit rating level
Novi Sad	Ba3
Kraljevo	B1
Valjevo	B1

The assigned credit ratings are the result and appraisal of budget performance of local governments and direct limit of debt exposure, as well as limited flexibility from the aspect of profit and loss and high infrastructure needs. In fact, managing the expenditure side of the budget is a „bottle neck" for a vast majority of local governments in Serbia, which additionally resulted from the global financial crisis to the detriment of income side, i.e. shortening of own sources of financing, and aggravating adequate management of finances of each town in particular.

Novi Sad was assessed as a town well managing the budget, which was argued by stable operating margin especially in 2009, when costs and expenditures were considerably cut in order to amortize the drop in business revenue by 8%, as the result of upcoming recession. It was suggested that the town recorded no direct debts and had sound cash reserves which provided for covering of budget deficit in 2009.

According to (Moodys, 2010) the credit rating B1 assigned to Kraljevo is reflecting a flexible strategy of implementation of investing in infrastructure, which ensured balanced budget performances and keeping the debt level three years behind. In the process of assessment regarding the assigned credit rating to Valjevo (Moodys, 2010) it is stated, inter alia, that the credit rating demonstrates adequate budget and debt policy management of the town in the last four years, with a balanced debt level and adequate management of debt servicing.

Eventually, in case of analyzing arguments made by the credit rating agency Moody"s, one might conclude that the issue related to credit risk and liquidity risk management was a key and decisive factor in assigning credit ratings to above stated local governments.

From an empirical standpoint risks were recognized from the perspective of institutional investors acting as underwriters and/or agent, to which municipal bonds issued in Serbia are exposed to at pricing, in the period of reviewing the issue of first Serbian municipal bonds. Municipal bonds expose investors to common risks related to investments: credit risk, interest rate risk, call risk, liquidity risk, and unique risks – risk structure and tax risk as stated by (Fabozzi, 2008) in specific relating to most developed US market. Basic risks recognized in Serbia, in the process of preparing for the issue of municipal bonds in the municipality Pančevo in its initial phase included interest risk, credit risk, liquidity risk, currency risk and regulatory risk, all together influencing the country risk, as calculated according to the equation below:

$$\sum (\text{interest risk} + \text{credit risk} (\sum \text{liquidity risk} + \text{currency risk} + \text{regulatory risk}) * \rho_0) \quad (1)$$

P_0 – 100% weight value

- Interest risk directly correlates with pricing from the aspect of the commercial bank acting as underwriter / agent relative to alternative source of lending to local governments in the form of loan approval. A pricing aspect is defined mostly in the recognized risk, in particular in the part related to establishing risk appetite the value of which is reflected in the invariable portion of total price i.e. margin. A high percent of invariable price indicates that this type of placement is more risky compared to lending to local governments.
- The credit risk has been also recognized particularly with local governments which have no assigned credit rating. However, the existence of the credit rating is not a sufficient factor which local institutional investors will follow and take as key i.e. decisive factor; this is supported by the fact that Kraljevo and Valjevo have not issued municipal bonds.
- The Liquidity risk is considered as *primus inter pares* among risks. Actually, the majority number of local governments is facing budget deficit i.e. balance deficit. Under global financial crisis, local

governments are directly hit by drop in revenues from current operations, which resulted in taking more active role in cost cutting, in order to maintain current liquidity. The liquidity related issue means that the underwriter / agent may project cash flow in their own balances when paying out coupons, with quarterly, semi-annual or annual dynamics. The liquidity risk is related to the non-existence of secondary market of municipal bonds on organized market, and thus disabling institutional clients, i.e. pension funds, investment funds, insurance companies and individuals to approach it.

Finally, a stable macroeconomic environment with sound movement of local currency inflation movement within bounds of targets set by the central bank, and strong fiscal policy and existence of secondary market where municipal bonds were traded, are vital for the development of this segment of securities. Limitations recognized for the development of this instrument are insufficient knowledge, uncompleted institutional framework, complex issuing procedure and the risk of failure in case of issuing through public issue.

Issuing municipal bonds in Serbia may probably be intended exclusively to known investors i.e. commercial banks, and partially to institutional investors. Listing on the organized stock exchange market would provide access to a wider range of investors, which is a direction to follow in future. The issue related to currency risk and pricing of municipal bonds, in case of closed circuit of investors, is one of the essential topics. Bearing in mind this concerns deals with long-term maturities over five that is ten years, the pricing of placements for this type of securities requires a significant pricing approach, in particular if the potential investor is a business bank. In fact, the question of lending vs. municipal bonds in the trend of reducing credit rating of Serbia will go definitely in favor of lending due to much favorable price.

Basic advantages of municipal bonds have been recognized in: (i) option to issue bonds in tranches, (ii) importance of transparency and option for citizens" to follow the development of an infrastructure project, (iii) long-term maturity of lending, (iv) and flexibility of financing to suit needs of citizens.

Nevertheless, there are significant potentials in: (i) harmonization of institutional framework under the competence of state institutions of the National Bank of Serbia, RS Ministry of Finance, Securities Commission, Belgrade stock exchange, to provide for development of alternative platform and decreased of set limits, (ii) broader investment base of institutional clients, insurance companies, pension and investment funds, and citizens on primary market, by way of which the dispersion itself would significantly influence price reduction of securities and (iii) monitoring the price of own debt and call option to additionally encourage secondary market.

Lastly, as potential threats may be observed lack of skilled personnel in local governments, lack of transparency immanent to Serbia in transition, lack of confidence of citizens and other institutional groups as well.

5. EXPERIENCE OF OTHER COUNTRIES IN THE REGION WITH MUNICIPAL BONDS AS A SOURCE OF PROJECT FINANCING

Experiences from the Region related to issuing municipal bonds are important especially in Croatia, Serb Republic, Romania, Hungary and Bulgaria. However, these experiences largely refer to the period of high rates of lending activity of listed countries, and the fact that this concerns in which this instrument developed before the outbreak of global financial crisis. Experiences from regional countries i.e. their local government units are different: with different currency marks, different dynamics of repayment, different purposes, and existence of secondary trade channels.

Municipal bonds of the city of Rijeka, Croatia were issued before the start of global crisis in three tranches, between 2006-2008 totaling EUR 24.5m and a 10 year-maturity. The secondary trade is enabled through the national Zagreb Stock Exchange with the purpose of issued municipal bonds to develop sports and culturally oriented projects.

Municipal bonds of the Serb Republic have been actively supported by local business banks, insurance companies, and citizens through secondary trade on Banjaluka Stock Exchange. The citizens, in fact, recognized the option of alternative instrument investing with higher yield than offered by traditional savings in commercial banks.

Table 3. Issued municipal bonds in surrounding countries between 2006 and 2011 by Bloomberg

Issuer	Nominal amount of issued municipality bonds	yield	Issue date	Maturity date	Secondary market
Croatia					
Rijeka	EUR 24.574.513,0	4,13%	28.06.2006.	18.07.2016.	Zagreb Stock Exchange
Republic of Srpska					
Srbac second emission	KM 1.000.000,0	3,00%			Banjaluka Stock Exchange
Jahorina, Pale	KM 15.000.000,0	6,00%			Banjaluka Stock Exchange
Novi grad	KM 2.000.000,0	3,13%			Banjaluka Stock Exchange
Gradiška second emission	KM 7.000.000,0	3,00%			Banjaluka Stock Exchange
Romania					
Foscani	RON 28.000.000,0	ROBOR3M + 0,9%			Bucharest Stock Exchange
Hungary					
Budapest	EUR 10.000.000,0	EURIBOR6M + 4,1%	27.01.2010.	27.01.2025.	Not listed
Bacsalamas Varos Onkoroman	CHF 3.713.000,0	CHFLIBOR3M + 1,35%	11.03.2008.	11.03.2023.	Not listed
Budapest	CHF 9.230.000,0	CHFLIBOR6M + 0,4%	04.10.2008.	30.11.2026.	Not listed
Budapest	CHF 12.382.000,0	CHFLIBOR6M + 2,2%	31.03.2006.	31.03.2031.	Not listed
Budapest	CHF 3.311.260,0	CHFLIBOR6M + 2,2%	31.01.2007.	31.01.2022.	Not listed
Csorvas Varos	CHF 943.000.000,0	CHFLIBOR3M + 1,0%	19.03.2008.	19.03.2023.	Not listed
Gyon Gyios Varos	EUR 2.952.000,0	EURIBOR6M + 4,75%	22.02.2010.	15.12.2024.	Not listed
Herend Varos	EUR 551.000,0	EURIBOR6M + 5,0%	24.02.2011.	31.03.2026.	Not listed
Bulgaria					
Vama	EUR 6.000.000,0	EURIBOR6M + 4,45%	25.06.2010.	30.06.2020.	

According to Romania"s experience, the driving force of municipal bonds listed on the local Stock exchange, as shown in the table above, was the increasing autonomy of local governments and a 17-year maturity. This market considerably developed on respectable stock exchange"s listing municipal bonds of the city of Bucharest on the London Stock Exchange in the amount of EUR 500m.

The main feature of issued municipal bonds of Hungary and Bulgaria is lack of listing on stock exchanges.

6. DISCUSSION

This paper explored municipal bonds in Serbia as an alternative model of project financing of infrastructure projects. We came to the conclusion that the state i.e. the Republic of Serbia partially enabled access to potential domestic investors through regulations. The proof is evidenced by changes (Public debt law, 2011)on one side, by which citizens as clients are enabled to invest in municipal bonds issued in Serbia. While on the other side as determined by the central bank"s bylaws (Decision on more detailed conditions and maximum amounts of voluntary pension fund assets investment and manner of investing such assets abroad, 2011) the defined limits curb investments of pension funds, since the level of cca. EUR 5m for the value of issue is a rather high threshold for circumstance on Serbian municipal bond market, as this instrument is in its infancy.

We have also concluded that the option to access organized secondary market is only general, as the (Law on capital market, 2011) stipulates that the issuer of municipal bonds is not bound to list them on the market, thus denying potential access to citizens as clients, which leads to another conclusion that the only potential investors are actually business banks from the banking sector of Serbia.

Municipal bonds could potentially enhance and improve infrastructure projects and development of local governments. As we are expecting the downward trend in rates on FX and dinar savings of citizens to continue, the placements of which are burdened with a tax treatment of 15%, municipal bonds for citizens, tax-exempted, would be an alternative instrument of investment. The basic risk in Serbia pertaining to municipal bonds is identified in political risk as frequent changes of government indicates instability in the horizon of “received mandates”, and that potential investors perceive the state to be a “bad boss” in managing financing at a local level.

In circumstances when the credit rating agency is lowering the credit rating to the Republic of Serbian, as it was the case on January 17, 2014, when the Fitch agency announced the downgrade of credit rating from BB- to B+, the rated local governments cannot hope for potential investors with acceptable price, meaning more competitive price, than if the local government decides to take up a commercial loan from business banks. Until the mid-2014, another four local governments are expected to make a public invitation at the territory of Serbia.

In line with the previously stated, prospects for development of municipal bonds market are limited, on one hand due to the slowdown of credit function of commercial banks is Serbia as the result of discouraging legal frameworks. Further directions of the research should lead towards monitoring and analyzing the alignment of regulatory framework of competent state institutions, towards lifting existing restrictions which curb development of these securities, and monitoring the trend which implies reduction of bank-centric economy in Serbia, on one hand, and development of alternative instruments of capital market, on the other.

At the same time the cooperation of local governments and state institutions need to be enhanced in order to realize options and potentials in implementing development of a new alternative instrument for financing infrastructure projects.

7. CONCLUSION

A new source of financing in the form of municipal bonds in Serbia has not seen its light conceptually as this type of instrument was first time issued in the period of global financial crisis. Apart from this, another aggravating factor was a dramatic fall in banks‟ lending activities because of which the new instrument was not considered as an alternative to loans alongside business banks. A case in a point is the local self-government Užice. Namely, the offered price of the loan was far more favorable than of formerly granted loans, and also better relative to the price offered for a municipal bond.

The limiting factor for alternative financing of capital and development projects through municipal bonds requires both institutional and legal frameworks, in order to finance much-needed finance projects. Listing on organized markets and ability to access provided not only to business banks and institutional clients, but citizens as well, in one of essential conditions. The role of the underwriter in cooperation with a local government could considerably „animate“ citizens in local governments if this instrument is offered through local branches, provided the issuer offers the guarantee for issued securities. Main weaknesses of municipal bonds versus loans may be noticed unambiguously in costs and complex procedures. Furthermore, listing municipal bonds on local stock exchanges entails services related to preparation of project documentation, costs of listing, marketing costs, and substantial formalities than it is the case with loans.

REFERENCES

Brealey, R., Cooper, I., &Habib, M. (1996).Using Project Finance to Fund InfrastructureInvestments.Journal of Applied Corporative Finance.No. 9. pp. 25-38.

Daher, E.Samir, Municipal Bond Markets Experiance of the USA, World Bank (1997), Urban No.FM-8a, Working Paper.

East Asia Analytical Unit, (1998). Asia‟s Infrastructure in The Crisis: Harnessing Private Enterprise, Canberra: Department of Foreign Affairs and Trade.

Fabozzi J. Frank, Handbook of finance, Volume 1, (2008), John Wiley&Sons, Inc, USA

Feldstein G, Sylvan, FabozziJ.Frank, Handbook of Municipal Bonds, (2008) John Wiley&Sons, Inc, USA

Gatti, S. (2008). Project Finance in Theory and Practice, Designing, Structuring and Financing Private and Public Projects. Elsevier Inc. Oxford.

Gatti, S., Kleimeir, S., Megginson, W. L. &Steffanoni, A. (2008).Arranger Certicification in ProjectFinance, Working Paper.

Kovac Gabor, Municipal Bond Boom in Hungarz: Focusing on the Analysis of Local Financial Management, (2011), European Financial and Accounting Journal 2/11

Law on Public Private Partnerships and Concessions of the Republic of Serbia.(2011). Official Gazette of the Republic of Serbia No. 88/2011.
Ministry of finance Republic of Serbia, Public debt law, (2011), Official Gazette of the Republic of Serbia No. 61/2005, 107/2009 i 78/2011
Moodys (2010), Research,https://www.moodys.com/research/Moodys-assigns-Ba3-rating-to-the-City-of-Novi-Sad--PR_201326(last time accessed in January 2014)
National bank of Serbia (2011), Decision on more detailed conditions and maximum amounts of voluntary funds assets investment and manner of investing such assets abroad, http://www.nbs.rs/export/sites/default/internet/english/20/spf/investment_manner_abroad_new.pdf,
National bank of Serbia (2013), Statistika, Bank Claims on the Corporate sector by Purpose, http://www.nbs.rs/internet/english/80/index.html
Public Debt Administration, Ministry of Finance of the Republic of Serbia (last time accessed in November 2011
Peterson E. George, Fellow Senior, Bank or Bonds? Building a Municipal Credit Market, Urban Institute Washington DC, OECD, (2003) Working Paper.
Republic of Serbia securities commission, Law on capital market (2011). Official Gazette of the Republic of Serbia No. 31/2011http://www.sec.gov.rs/index.php?option=com_content&task=view&id=1131&Itemid=62,

HEDGE FUND MANAGEMENT COMPANIES AND DATABANK TRANSPARENCY

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Abstract: *Research in the field of transparency of hedge fund industry has been extensive in the last decade. However, most of the studies focus on transparency of hedge funds' performance measures. Our approach is more general, since we are studying the overall transparency of big management companies, in order to find patterns in their behavior. We use concepts of transparency scores and answer densities to see if management companies have uniform policy in disclosing information and thus attracting investors through databanks. The results proved that transparency was mostly individual portfolio manager's decision and that it was difficult to relate it to specific investment strategy that management company applied. Moreover, through answer densities we found that low transparency regarding specific questions, was common for all strategies and all management companies.*

Keywords: *hedge funds, transparency, strategies, information disclosure, answer densities*

1. INTRODUCTION

When it comes to hedge fund industry, whose size is rapidly growing[1] in the last decade, the accuracy and availability of information, as well as precise measurement and reporting are of an extreme importance. Given that there is no sole definition of hedge funds, as a starting point we will adopt the following one: "Hedge funds are privately organized, loosely regulated and professionally managed pools of capital not widely available to the public" (Lhabitant, 2004). The key points in this definition are private nature of hedge funds and low availability to public. Since hedge funds are only open to a limited range of professional or wealthy investors who meet the criteria set by regulators, they are exempted from many regulatory requirements that govern the ordinary investment funds. Among these the most important ones are investment freedom and reporting requirements. Mainly, hedge fund managers may use every type of financial instruments, from cash, equities, fixed income to the most sophisticated derivative products. They are even allowed to invest in illiquid assets. Moreover, as opposed to mutual funds and long only funds, they may combine "long" and "short" positions and use unrestricted amounts of debt financing (leverage). In order to focus on investments and performance, rather than on cash management, hedge funds usually impose some restrictions, such as lock-up periods, gate provisions and minimum notice time to restrict redemptions in periods of market stress. Their primary goal is to achieve target returns irrespective of current market conditions (therefore they are called absolute returns). For this, hedge fund managers are rewarded through incentive scheme that combines management and performance fees. Management fee is usually 2% of the assets under management, whereas performance fee is typically 20% of the annual hedge fund profits. Since high fees are very attractive, in order to ensure that managers will behave in best interest of their clients, most hedge funds request their manager to invest huge portion of their personal wealth alongside other investors. Moreover, there are often limiting restrictions on payment of performance fee, such as high watermark[2] and/or hurdle rate[3].

From the regulation prospective, hedge funds are free of any type of disclosure of its holdings and positions. However, in the wake of latest financial crisis, increasing calls to reform the financial regulatory system of hedge funds were heard from government authorities and investors worldwide. New regulations should tackle the area of registering, reporting, disclosures and prudential requirements for either hedge funds or hedge fund managers and oversight of new risk regulator. While registering is already well established in markets such as UK and USA, financial industry largely opposes applying bank-like capital rules or mutual fund-like investment restrictions. In favor of the latter goes that hedge funds attract capital of high net individuals and institutions through private placements and these investors are likely to be educated enough to assess the risk of their investing decisions, thus not in a need of regulatory supervision. Nevertheless,

[1] Current estimate of hedge fund industry assets under management (AuM) ranged is $1.75 trillion managed by over 10000 funds (http://www.eurekahedge.com/news/Eurekahedge_Jul_2012_Global_Hedge_Funds_Key_Trends.asp)

[2] High watermark is the highest net asset value (NAV) of a fund up to date. If the NAV of a fund declines throughout the year no performance fee will be payable to investment manager.

[3] Hurdle rate is the level of return that the fund must achieve in order to charge performance fee.

hedge fund managers recognize the need for improved transparency and increased self regulation. In line with this in 2009., The Asset Managers' Committee ("AMC") issued a comprehensive Report that sets a new standard of best practices to answer the call of the President's Working Group on Financial Markets ("PWG") to reduce systemic risk and foster investor protection. This report should serve as self-regulation guidelines for hedge funds and also investors' guidelines for due diligence of hedge funds. The first key area stressed in this Report is disclosure and the greater transparency of information provided to investors. The regulatory response comes in 2011., in the form of Directive on Alternative Investment Fund Managers (AIFMs) published in the Official Journal of the European Union which "aims at establishing common requirements governing the authorization and supervision of AIFMs in order to provide a coherent approach to the related risks and their impact on investors and markets in the Union". The Directive presents the huge step from fairly regulated hedge fund markets in EU towards bank-like regulation framework. Among `the set of new rules regarding authorization, leverage management, supervision, of a special interest for this research are transparency requirements and marketing of units or shares of EU alternative investment funds (AIFs). According to the Directive, AIFM are obliged to disclose to investors the following: description of the investment strategy and objectives of the AIF; description of the procedures by which the AIF may change its investment strategy or investment policy; the identity of the AIFM, the AIF's depositary, auditor and any other service providers and a description of their duties and the investors' rights; a description of the AIF's valuation procedure and of the pricing methodology for valuing assets, including the methods used in valuing hard-to-value assets; a description of the AIF's liquidity risk management, including the redemption rights both in normal and in exceptional circumstances, and the existing redemption arrangements with investors; a description of all fees, charges and expenses and of the maximum amounts thereof which are directly or indirectly borne by investors; the latest net asset value of the AIF or its latest market price of the unit or share; the identity of the prime broker and a description of any material arrangements of the AIF with its prime brokers and the way the conflicts of interest, etc.

By taking a closer look to regulation and the current state of hedge fund transparency, one can easily draw the parallel between new disclosure requirements and "data vendors" requirements, such as TASS/Tremont, Hedge Fund Research and Eurekahedge. Moreover, the decision of a hedge fund to market its shares or units is similar to decision of disseminating information through the aforementioned databanks. The analysis of databank transparency can serve as a good marker of how far away are hedge funds of prescribed disclosure policies. In addition, it illustrates the willingness of hedge fund managers to reveal certain information to potential investors. The focus of this study is to actually interpret the lack of specific information that managers omit when delivering data to databank vendors. In this aspect, we try to explain what investors can infer from the missing data that they obtain from database vendor. We concentrate on management companies managing more than thirty hedge funds while implementing different strategies.

Given that hedge funds are businesses, like any other type of business in order to attract clients they need to market themselves. However, since advertising in hedge fund world is not allowed, the hedge fund managers can promote themselves either through the word of mouth, investors meetings, conferences, or through specialized database vendors who sell this information to qualified investors. Form the visibility point of view, releasing frequent information about their business through database vendors is the best and easiest choice for hedge fund managers. Still, the question is how accurate and transparent is the information provided in this way. Many studies have attempted to quantify the level of hedge funds transparency and database transparency, but most of them mainly focus on level of performance transparency.
Anson (2002) gave an interesting comment on transparency – "Hedge fund transparency is like pornography – it is hard to describe, but you know it when you see it." For Anson there are three main reasons for which investors seek transparency. The first reason is for risk monitoring purposes, in the sense that investors want to be sure that hedge fund managers are operating within stated risk levels. The second one is the risk aggregation, so that investors can be aware of the total risk of their investment portfolio with respect to industries, economic sectors and markets. The third reason for which investors seek transparency is to see if the managers are really following the strategy they claim to apply. With respect to latter, Gibson and Gyger (2006) were investigating the style consistency in the hedge fund industry and showed that the investment style of some managers depart through time from their reported styles. Mackey and Melton (2010) analyzed if hedge funds followed their stated strategy as well. Goltz and Schroder (2010) conducted a comprehensive study of hedge fund managers and investors on current hedge fund reporting practices. They found out that from investors' point of view information disclosure was inadequate, especially disclosure regarding information about fund's liquidity and operational risk exposure. Moreover, the survey proved that 92% of all industry practitioners believe that the quality of reporting is strongly related to fund's overall quality. Liang (2003) investigated the discrepancy, and thus accuracy of hedge fund returns across different databases. He found out that audited funds had a much lower return discrepancy than non-audited funds. Bollen and Pool (2009) investigated the presence of misreporting in the hedge fund industry and demonstrated that approximately 10% of returns in the used databases were distorted.

Since hedge fund reporting to database vendors is voluntary it may cause different types of database biases. Self selection bias is strongly related to manager's decision in terms of reporting to databases or not. For example if the hedge fund is well performing and wants to attract new capital, it will incline to report to database. On the other hand, if hedge fund is poorly reporting, he doesn't have an incentive to report to database. However, in many cases well established hedge funds do not want to report because they already achieved their business goals, or already have investors who want to enter the fund, or do not need additional capital. From the previous, the conclusion might be that databases tend to have average performing funds because of self- reporting bias. Aiken and al. (2010) conducted a study in which they made a comparison of the non-reporting hedge funds and reporting hedge fund performances and evidenced that on average self-reported hedge fund returns were positively biased. Grecu and al. (2007) investigated why funds stop reporting their performance data. Their findings prove that hedge fund returns significantly worsen towards the end of the reporting lives, which suggests that funds cease to report because of their poor performance. In the study we will examine the database transparency from the perspective of completeness of information provided by hedge fund managers. The focus will be on missing data in database and the reasons for their non-disclosure. This will be related to different strategic management concepts that hedge fund managers apply. The study relies on research of Lumbers (2012) in which the set up for measuring database transparency, as a percentage of non-answers with respect to total number of answers, is introduced.

2. DATA AND METHODOLOGY

This research is based on the data provided by Eurekahedge Europe and Eurekahedge North American hedge fund databases, as available in August 2011. At this point in time, European database of hedge funds contained 4783 funds, whereas North American database contained 5102. Each hedge fund was supposed to give information regarding basic details, fund details, management details, unique identifiers, fees and redemption schedule, industry focus, countries, service providers and profile and strategy description. The maximum number of answers for each fund is 92, but often differs across funds. For the purpose of this research we excluded data provided by Eurekahedge and also questions on which hedge fund managers cannot answer with certainty, thus ended up with 48 column variables in our research.
Since the main goal of our research is to analyze the behavior and consistency of management companies with respect to their willingness to communicate their information to investors, we took the sample of companies that manage more than 30 hedge funds. The basic information about management companies and hedge funds that they manage is given in the Table 1.

Table 1. Basic information about management companies

Management company	Number of funds under management	Number of live funds	Number of dead funds	Number of strategies applied
RAB Capital plc	108	34	74	7
Gartmore Investment Management plc	100	54	46	4
Henderson Global Investors	62	42	20	6
Sinopia Asset Management	62	58	4	2
Amundi Luxembourg SA	55	40	15	5
Marshall Wace LLP	51	51		1
Polar Capital LLP	48	35	13	3
Superfund Asset Management	46	46		1
Martin Currie Investment Management Ltd	39	39		1
York Capital Management LLP	35	35		2
DB Advisors	33	9	24	4
Total	639	443	196	

As we can see from the table, 10 management companies manage 639 hedge funds of which 443 are live, while employing from 1 to 7 investment strategies. Eurekahedge accounts for 15 different investment strategies, but the management companies that we included in the research apply 10 different investment strategies: arbitrage, CTA/Managed futures, distressed debt, event driven, fixed income, long/short equities, macro, multi-strategy, relative value and others.

The majority of academic research in the field of hedge fund industry is based on modeling the data provided by the large databanks. The common problem for all the research is how to overcome the missing data. The

usual solutions are to exclude the hedge funds that do not provide complete data, or to interpolate the missing data. In this study we will actually focus on the missing data, and the notion of transparency will be related to missing data or "non-answers". For most of the subscribers to hedge funds databanks the information provided by the databank is a first step in their due diligence process of hedge fund as a potential investment. They want to get as much as possible information in order to understand the investment strategy, returns and riskiness of a hedge fund. For a hedge fund manager, the databank serves as a shop window through which they market their products. They want to reveal information in order to attract their clients, but on the other hand they want to keep amount of secrecy that will not jeopardize their competitive advantage in the market. The more information the hedge fund managers provide to databank, in this case Eurekahedge, we consider them to be more transparent. In order to gauge the transparency of hedge fund managers we use the methodology proposed by Lumbers (2012) which is based on counting blank answers or "non-answers" and assessing their transparency score as a proportion of non-answers of total number of questions After assessing transparency scores for each management company and each strategy, it is important to see what are the main drivers of low transparency. This was measured through answer density which is defined as a proportion of non-answers for each question with respect to total number of hedge funds.

3. RESULTS

In order to see if management companies have consistent approach in their disclosure within each strategy they employ, we analyzed the transparency in more detail for each company and each strategy. While looking at different management companies, especially columns Manager profile, we observed that most of the companies have more than one portfolio manager for each applied strategy. For this reason we analyzed the transparency of each portfolio manager within the strategy and the management company and reported his/her average transparency (number of non answers). The results are presented in Table 2.

Table 2. Breakdown of Non-answers across companies, strategies and managers

Management company	Strategy	Number of managers per strategy	Number of funds managed	Average number of funds managed	Average number of Non answers per manager	Max number of Non answers	Min number of Non answers	Range of Non answers
RAB Capital plc	Arbitrage	1	2	2	0	0	0	0
	Event driven	1	4	4	1	1	1	0
	Fixed income	3	15	5	2.2	5	2	3
	Long/Short	7	54	7.71	3.77	0	7	7
	Macro	1	4	4	5	5	5	0
	Multi-strategy	1	6	6	5.67	7	4	3
	Others	3	23	7.67	3.71	5	2	3
Gartmore Investment Management plc	Arbitrage	1	3	3	11.33	12	11	1
	CTA/Managed futures	1	3	3	11	11	11	0
	Long/Short	19	91	4.79	5.35	14	2	12
	Relative value	1	3	3	6	6	6	0
Henderson Global Investors	Arbitrage	1	6	6	4	4	4	0
	CTA/Managed futures	1	1	1	7	7	7	0
	Fixed income	1	6	6	2.67	3	2	1
	Long/Short	9	28	3	5.32	8	2	6
	Macro	1	6	6	6	6	6	0
	Multi-strategy	4	15	4	5.33	9	3	6
Sinopia Asset Management	Fixed income	2	62	31	5.27	25	4	21
	Long/Short	1*	2	2	25.5	27	24	3

Amundi Luxembourg SA	Arbitrage	1*	31	31	9.81	13	5	8
	Fixed income	1*	8	8	9.37	10	7	3
	Long/Short	2*	12	6	7.41	10	5	5
	Macro	1	3	3	7	9	5	4
	Multi-strategy	1*	1	1	10	10	10	0
Marshall Wace LLP	Long/Short	1	51	51	5.39	6	0	6
Polar Capital LLP	Fixed income	1	12	12	5	5	5	0
	Long/Short	5	33	6.60	6.82	11	2	9
	Macro	1	3	3	2	2	2	0
Superfund Asset Management	CTA/Managed futures	1	44	44	8.5	11	7	4
	Long/Short	1	2**	2	7	7	7	0
Martin Currie Investment Management Ltd	Long/Short	11	39	3.55	5.28	7	4	3
York Capital Management LLP	Distressed debt	1*	1	1	22	22	22	0
	Event driven	3*	34	11.33	12.24	27	6	21
DB Advisors	CTA/Managed futures	2	2	1	7	7	7	0
	Distressed debt	1	1	1	7	7	7	0
	Long/Short	6	29	4.83	6.1	11	5	6
	Multi-strategy	1*	1	1	26	26	26	0

* Some management companies do not gives answers to Managers profile question for all of their funds, therefore we treat them as if they are having just one manager (which is the whole company)

**These two funds classified themselves as CTA/Managed futures, but in their Strategy description field they explained in details that they are Long/Short equity funds

From Table 2. we can see that the average number of funds per one manager across different management companies varies a lot (from minimum 1 fund to 51 funds). Management companies with the highest average number of funds per manager actually didn't want to reveal the details about their portfolio managers and simply left the company name in Manager profile column. Regarding the data, one can also notice that when management companies don't give the data about portfolio manager, they tend to be less transparent (for example DB Advisors Multi strategy has 26 non answers, York Capital Event driven strategy has 27 non answers, which is less than 50% transparency score). Moreover, if we look at the column - average number of non answers per manager we can see that this number significantly varies across strategies in the same management company. For example if we look at RAB Capital, the average number of non answers per manager following arbitrage strategy is 0 (100% transparency score), whereas average number of non answers per manager following multi strategy is 5.67 (88.67% transparency score). This might lead us to the conclusion that actually strategy dictates the degree of transparency of management company. However, from the table we can also see that transparency for the same strategy vary a lot among management companies. Therefore from these two observations we can conclude that transparency mostly depends on the portfolio managers and his willingness to disclose information. This is easily seen from the last column-range of non-answers within the strategy. It is interesting to see that for some strategies such as fixed income this range is not big (maximum range 3), whereas for some strategies such as Long/Short equity is much bigger (maximum range is 12). This clearly indicates that within the same management company and the same strategy, portfolio managers have different views on transparency.

In order to test this assumption we look for single portfolio managers that are running more than one hedge fund within management companies. The important result we have found is that even portfolio managers that are running more than one fund do not show consistency regarding the information disclosure. For example, portfolio manager at Gartmore Investment Management plc. running 9 long/short equity hedge funds, tend to have different level of information disclosure for different funds that he manages. Also, it is interesting to see that management companies such as Henderson Global Investors (committed to Hedge Fund Standard Board's standards in 2010.) and Amundi Luxemburg SA (according to the information available on internet

the most transparent one), which are publicly building an image of very transparent ones, still suffer from the same inconsistencies in their managers' reporting. Therefore we can conclude that the databank transparency of management companies is practically in hands of their portfolio managers. If we look at management company as any company and databank as its way of advertising itself, than portfolio managers are given the freedom to be marketing managers. The question is how much freedom should they have in this sense, bearing in mind that they all work for the same management company? This is still to be defined by the management companies and perhaps the strategies they implement.

In order to see which are the questions to which managers are most reluctant to give answers we estimated answer densities, for each of these. Therefore, we evaluated the answer density across each column in Eurekahedge databank. For better understanding, questions are categorized according to answer density in the following manner:

- High transparency with answer density range from 90% to 100%
- Medium transparency with answer density range from 50% to 89%
- Low transparency with answer density below 50%

High answer density is characteristic for basic characteristics of hedge funds (fund name, flagship, closed, limited, dead, dead reason), most of the fund details, fee and redemption schedule and profile and strategy description, since these are the common details that each fund can provide. Medium answer density is common for part of fund details such as fund size, firm's total asset, minimum investment currency, minimum investment size, equalization/share classes, investment in private placements, managed accounts offered, UCITS and service providers. Low answer density is characteristic for fund capacity, annualized target return and annualized target volatility. In Table 3. only densities below 50% across strategies are given.

Table 3. Answer density across strategies

	Arbitrage	CTA/MF	Distress debt	Event driven	Fixed Income	L/S Equity	Macro	Multy Strategy	Relative Value	Others	Total
Fund Capacity (US$m)	4.76%	0.00%	0.00%	0.00%	5.94%	9.73%	43.75%	0.00%	0.00%	21.74%	8.29%
Firm's Total Asset (US$m)	23.81%	94.23%	100.00%	100.00%	92.08%	74.93%	81.25%	86.96%	100.00%	100.00%	79.03%
Minimum Investment Currency	45.24%	84.62%	100.00%	94.74%	76.24%	96.17%	100.00%	100.00%	100.00%	65.22%	87.79%
Minimum Investment Size	45.24%	84.62%	100.00%	94.74%	76.24%	96.17%	100.00%	100.00%	100.00%	65.22%	87.79%
Equalisation / Share class	47.62%	11.54%	100.00%	57.89%	94.06%	83.78%	62.50%	86.96%	100.00%	100.00%	75.90%
Annualized Target Return	78.57%	0.00%	0.00%	10.53%	80.20%	25.07%	31.25%	26.09%	0.00%	0.00%	33.49%
Annualized Target Volatility	40.48%	0.00%	0.00%	10.53%	80.20%	17.70%	12.50%	17.39%	0.00%	0.00%	26.29%
Principal Prime Broker/ Broker	26.19%	11.54%	50.00%	73.68%	28.71%	79.65%	43.75%	91.30%	100.00%	100.00%	62.44%
Legal Advisor (offshore)	50.00%	36.54%	0.00%	68.42%	83.17%	59.59%	62.50%	26.09%	100.00%	100.00%	61.66%
Legal Advisor (onshore)	26.19%	11.54%	50.00%	10.53%	90.10%	80.83%	93.75%	65.22%	100.00%	100.00%	69.33%
Manager Profile	100.00 %	100.00%	50.00%	73.68%	98.02%	99.41%	100.00%	95.65%	100.00%	100.00%	97.50%
Strategy	100.00 %	100.00%	50.00%	73.68%	98.02%	99.41%	100.00%	95.65%	100.00%	100.00%	97.50%

Fund capacity is the question with the lowest answer density (8.29%) and thus can be regarded as the most controversial. According to Eurekahedge, fund capacity is "an estimate of the size of the fund relative to the turnover of the market it invests in, with the aim of assessing when assets under management become too

large to effectively execute funds investment strategy". In other words, fund capacity is the cap on funds assets under management beyond which fund strategy will not give the desired returns. It is imposed by the portfolio manager and not all the funds have it, therefore to some extent the lack of answer to this question may be the result of the latter. Still, fund capacity is an important feature for both the investors and the competitors. For investors it is the signal for how far away is the fund from being closed to any further investment. For competitors, it is the benchmark for how much the fund is potentially ready to invest in a certain strategy. Given that for some strategies, managers seek to exploit the specific inefficiencies in the market, the greater the investment capital introduced into the market, the lower the potential gain. Therefore, the fund capacity for competitors serves also as a fund's opinion of the overall capacity of the certain strategy. Capacity is correlated with how narrowly or broadly particular strategy is defined. The broader the strategy definition, the greater the capacity. In this sense, macro strategies tend to have the greatest capacity, since they are neither constrained with specific markets nor with specific assets. On the other hand, event driven strategies, which depend on the size and number of special events; and arbitrage strategies, which depend on specific discrepancies in prices, tend to have lower capacity effect. Regarding transparency, this can be interpreted as funds implementing strategies with greater capacity should be more transparent, since there is enough room for everybody in this "game". Our results support this hypothesis, since macro funds have the greatest transparency, whereas event driven, CTA/Managed futures and arbitrage funds have the lowest transparency.

Assuming that the databank is the hedge funds' display window through which they market their products, it is very interesting to see that annualized target return and annualized target volatility have very low answer density. If we look at the hedge fund as a product, the main reasons for which investors are willing to buy this product are target return and/or target volatility. In this sense, the low density is like selling a yacht, but not telling the potential owner how fast can it goes and how safe it behaves on turbulent sea. Knowing that the foundation ground of most portfolio theories relies on the relationship of risk and return, i.e. on how much risk investor is willing to take for the given return, the question is why hedge fund managers are reluctant to give this information? One possible rational explanation is that hedge fund managers are afraid of not fulfilling the target annualized return and therefore would be looked upon unfavorably by their investors. This is specially the case for strategies that are depending on specific market cycles such as event driven strategies, or for strategies that are connected to very volatile markets such as CTA/Managed futures. On the other hand, for fixed income strategies, which have very deep and developed markets, is easier to forecast returns and volatility.

Results from Table 3. also show that total answer density for annualized target volatility is lower than total answer density for annualized target return. For some strategies these densities are the same, but for some strategies they are lower. The potential explanation might be that some managers are willing to take greater risk (volatility) in order to achieve target returns, but they do not want their investors to be aware of that, since that might influence their investment decision. Moreover, as already mentioned for some strategies markets are very volatile (commodity markets) an assessing volatility is a difficult task. Finally, for some strategies such as distressed debt and event driven strategies, it is not easy to calculate target returns and volatility and therefore these data are not provided.

4. CONCLUSION

The aim of the paper is to examine how management companies within hedge fund industry use information transparency in attracting their clients. The data provided was analyzed with respect to transparency score and answer density measures. Both of these measures are based on the proportion of non answers, where non answer is observed each time the manager didn't provide an exact answer to the given question (left the blank answer or n/a or Not available). Given that transparency scores are defined as a proportion of non-answers of total number of questions, they were used to analyze the transparencies of different management companies. The results proved that transparency of management companies was not uniform and that it did not depend on particular strategy that company implements. Moreover, scores showed that transparency mostly depended on single portfolio manager's decision regarding each hedge fund he/she manages. In addition, we found that portfolio managers tend to have different transparency scores for similar hedge funds they managed, thus showing significant inconsistency in transparency. On the other hand, answer density defined as a proportion of non-answers for each question with respect to total number of hedge funds, gave us some useful insights about the issues that all hedge fund managers face regarding transparency. The low answer density scores for fund capacity, annualized target return and annualized target volatility were common for each management company and each hedge fund. However, there were slight differences in these answer density scores among strategies. These differences were explained with the specific characteristics of each investment style. Nonetheless, low answer density for questions such as target return and target volatility was quite surprising, since these are starting points in investor's decision making processes regarding investing into hedge funds.

REFERENCES

Aiken, A. L., Clifford, C. P., Ellis, J. A. (2012), Out of the Dark: Hedge Fund Reporting Biases and Commercial Databases. Retrieved from SSRN: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1519914

Anson, M. (2002), Hedge Fund Transparency, The Journal of Wealth Management, 5 (2), 79-83.

Asset Management Committee (2009), Best practices for the hedge fund industry. Retrieved from: http://www.amaicmte.org/Public/AMC%20Report%20-%20Final.pdf

Bollen, N., V. Pool (2009), Do Hedge Fund Managers Misreport Returns? Evidence from the Pooled Distribution, Journal of Finance 64 (5), 2257-2288.

Connor, G., Lasarte, T. (2004), An Introduction to Hedge Fund Strategies, International Asset Management, Ltd., London, England.

Directive on Alternative Investment Fund Managers (2011), Official Journal of the European Union. Retrieved from:http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:174:0001:0073:EN:PDF

Fung, W., Hsieh, D.A. (1997), Empirical Characteristics of Dynamic Trading Strategies: The Case of Hedge Funds, Review of Financial Studies,10, 275-302.

Gibson, R., Gyger, S. (2007), The Style Consistency of Hedge Funds, European Financial Management, 13 (2), 287-308.

Goltz, F., Schröder, D. (2010), Hedge Fund Transparency: Where Do We Stand?, Journal of Alternative Investments, 12 (4), 20-35.

Grecu, A., Malkiel, B., Saha A. (2007), Why do hedge funds stop reporting performance?, Journal of Portfolio Management, 34 (1), 119-136.

Lhabitant, F. (2004), Hedge funds: Quantitative insights, John Wiley and Sons Ltd., Chichester, England.

Lumbers, C. (2012), Strategic management issues and hedge funds: insights based on the concept of databank transparency, EDHEC working paper.

Liang B. (2003), Hedge fund returns: auditing and accuracy, Journal of Portfolio Management, 29 (2) 111-122.

Mackey, S.P., Melton, M.R. (2010), Hedge Funds: Do They Do What They Say They Do?, Journal of Business & Economics Research, Vol. 8, Issue 10, p7-17.

CURRENCY DERIVATIVES USE IN EMERGING MARKETS

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Abstract: *Emerging markets have enabled foreign investors to gain the highest rates of return compared to returns they could have achieved by investing in developed markets. Although some data suggest that those rates started to decline, those markets still represent the most attractive market for investments. The high rates on investments have been followed by high investment risk, which was mainly caused by political instability and poor macroeconomic policies. This has influenced the local currencies volatility and has forced foreign investors to start using currency derivatives in order to hedge this risk. The aim of the paper is to present a review of currency derivatives and to point out to appropriate hedging strategies using currency derivatives that can be applicable in emerging markets. Besides, the paper provides a brief analysis of currency risk hedging practice in some of emerging market economies and its perspective.*

Keywords: *Currency derivatives; currency risk; emerging markets; investment; hedging.*

1. INTRODUCTION

Emerging markets (EMs) have grown rapidly during last more than two decades because of the potential they have been given to potential investors in almost all economic sectors. According to World Bank report (2014) equity market capitalization among emerging market economies has increased from approximately US$250 billion in 1990 to over US$12 trillion in 2012 with an annual growth of approximately 14%. This impressive increase was followed by annual growth rate of gross domestic product (GDP) of 4.9% at the end of 2012 in emerging market economies while in developed countries GDP has grown by only 1.5%.

During the specified period, international interest in emerging market local currency investments has grown sharply except for a period 2008-2009 when capital inflows in these markets have been significantly reduced. However, in 2010 according to Institute of International Finance (2013) capital inflows started to recover, so in 2012 they exceeded the size in pre-crisis period were roughly US$350 billion. This has happened despite the much higher rates of inflations in emerging market economies compared to developed countries. World Bank announced (2014) that an average inflation rate in EMs measured by consumer price index were almost three times higher than in developed markets. This can be explained by the efforts of monetary and fiscal authorities made to attract the investors, especially through capital flow barrier reduction and high rates of return on investments. In this regard, the rates of return on investments in EMs have been considerably higher than those of developed markets. For example, between 1999 and 2006, the S&P 500 returned 3.3% annually compared to 18.5%, as reported by Morgan Stanley Capital International Index (MSCI). According to AGF Investments (2014), in 2008 this return became very negative (-41.8%), but soon it recovered, so in 2013 its value was 23.4%. Between 2009 and 2013 the gap between S&P 500 and MSCI was very volatile, but the latest data suggest the narrow gap could be expected.

The aforementioned higher growth rates of return were accompanied by a higher investment risk. The sources of this risk were economic (e.g. high inflation rates, current account deficit, fiscal imprudence etc.) and political (political instability, corruption etc.). Some authors have argued that emerging market economies were exposed to risk even if they eliminate all the potential risks because of their inability to borrow abroad in their home currencies (Eichengreen, Hausman and Panizza (2003)). According to them this would lead to a much higher percentage of emerging markets‟ debt being denominated in foreign currencies than in local currencies and could become a trigger for capital outflow. However, Burger, Warnock and Warnock (2012) showed that Ems seem to have overcome this problem. The authors provided data of fast grow of local currency debt markets. Besides this, it is worth mentioning that sometimes investing risk is out of the control of country‟s financial authorities. In other words, occasional developed market investors‟ misinterpretation of the emerging markets‟ behavior could lead to dramatically reduction in capital inflows. Moreover, for Ems it could be valuable to take into consideration the following risks: credit risk, exchange rate risk, interest rate risk, maturity risk and speculative risk. Likewise, the influence of developed market‟s fiscal policies should be taken into account because of its strong influence on the emerging markets‟ currencies value. That is why some authors Calvo (2005) and McFadden (2004) have proposed to deal with these risks through policies promoted in conjunction with developed economies, such as greater supervision of financial intermediaries, compliance with international accounting standards and clear lending standards. But, even if the suggested were implemented, it could not solve the problem regarding daily, weekly or monthly fluctuations in currencies that underlie the value of emerging market prices of securities. So, it seems that one possible solution can be currency risk management.

Currency risk, also known as exchange rate risk or foreign exchange rate risk represents a possibility of loss contingent on a future change in foreign exchange rate. According to Cusatis and Thomas (2005), this risk can be defined as the risk that a company"s financial performance will be affected by exchange rate fluctuations. By hedging the risk investors in Ems can enhance their returns and/or reduce the losses. In addition, investors can obtain emerging market currency exposure though investing in local currency emerging market bonds, or through forward contracts and options. Gilmore and Hayashi (2011) claim that the risk-return profile of long investments in emerging market currencies have been historically quite attractive. Importantly, the return of emerging market currencies mostly comes from their high "carry," as they typically have higher yields than developed market currencies. Recently, however, interest rate differentials have converged across the world, making it somewhat unlikely that the historical performance of emerging market currencies will be repeated over the next decade. Because of different risk aversions in different emerging market countries followed by their fragile financial systems, hedging currency risk becomes necessity.

2. CURRENCY DERIVATIVES

Because foreign investors are involved or might be involved in operating in emerging markets, they are or they might be exposed to exchange rate risk. This risk can be used both, to capitalize or to hedge against expected exchange rate movements.
In general, a currency derivative is a term contract between two parties, a buyer and a seller, whose price is partially derived from the value of the underlying currency that it represents. Currency derivatives increase the liquidity of investments in emerging markets which usually suffer from illiquidity. Those instruments enable its user (investor) to perform (exercise) the contractual obligation at the predefined price. In this way, currency derivatives can be used not only to hedging the risk in emerging markets, but also as a tool for price discovering as well as a mechanism for dealing with counterparty risk.
As Henderson (2006) suggests, the characteristics of emerging markets influenced their specific currency management. First, liquidity risk caused by emerging market currencies less liquidity than currencies of developed markets. Second, convertibility risk because a majority of emerging market currencies are still not convertible on the capital account, and only a few are still not fully convertible on the current account. Third, several emerging market currencies still have varying degrees of exchange rate controls, which also distort exchange rate pricing and economic activity. Fourth, emerging markets have structurally high levels of inflation compared to developed markets which are usually followed by higher interest rates and resulted in high forward premiums. Fifth, capital inflows can depress market interest rates. Sixth, forward rate bias is lower in emerging markets than in developed markets, which means that emerging market currencies tend to appreciate on a real basis and then collapse to adjust for the trade balance deterioration caused by that real exchange rate appreciation. Seventh, implied emerging market volatility below developed market volatility is a buy signal. Finally, implied emerging market volatility is a very poor predictor of future exchange rates.

Currency risk can be hedged with following currency derivatives:
- Currency forwards,
- Currency futures,
- Currency options and,
- Currency swaps.

Currency forwards are contracts between two parties to buy and sell a specified amount of a currency at a specified exchange rate (forward rate) on a specified date in the future. The most common currency forwards are for 30, 60, 90, 180, and 360 days, although they are available for longer periods (up to five years). Currency forwards can be deliverable and non-deliverable.

Currency futures are standardized contracts that are specifying a standard quantity of a given currency that is to be exchanged for another currency at a specified exchange rate on a specific settlement date. By entering the currency future buyer of a contract is entitled and also obliged to pay a specified exchange rate for a foreign currency on a future date, while seller is obliged to sell a foreign currency at the same specified exchange rate on the same date in the future. These contracts are traded on organized exchanges and they are available for several widely traded currencies, but they are also available on some cross rates

Currency options represent the standardized agreements between two parties which grants one party (the option buyer) the right, but not the obligation to buy or to sell specified quantity of a specified currency at a specified exchange rate (exercise price) within a specified time period or at a specified date (expiration date). With regard to right they give to a buyer, currency options can be call (give a buyer a right to buy currency) or put options (give a buyer a right to sell currency). Currency options can be exchange traded (options on the

physical (underlying) currency obtained via brokers from an exchange) and over-the-counter options (obtained directly from banks). Exchange traded options have standardized time periods and strike prices and only a certain number of currencies are traded. As opposed to this, over-the-counter currency options are flexible instruments that enable the buyer to choose the currencies, time period, strike price and the contract size, in order to match the particular exposure requirements at the time.

Currency swaps are over-the-counter currency derivatives. They represent the agreements between two parties to exchange the principal and interest in one currency for another currency at a predefined exchange rate (i.e. swap rate) on several future dates. They are available for short-term and long-term maturities (up to ten years).

Besides those so-called vanilla currency derivatives, in practice and especially in emerging markets emerged a range of currency derivative variations and combinations, such as currency coupon swap, currency swap/fixed rate currency swap, forward swap, interest rate swap, quanto swap, swaption, exotic options etc. Currency coupon swap combines the interest rate swap and the fixed rate swap in one currency for a floating rate interest in another currency. Currency swap/fixed rate currency swap involves the purchase of a currency for spot settlement and, at the same time, the sale of the same currency for forward settlement. Forward swap represents a swap agreement that begins at a specified future date. Interest rate swap is an agreement between two parties to exchange interest payments on currency principal (notional). Quanto swap is a complex swap in which one party agrees to pay to another party the notional and interest based on the foreign currency while the notional amount is in domestic currency. Swaption represents a combination of option and swap, so it gives a buyer the right, but not the obligation, to invoke a swap at agreed-upon terms at a specified date in the future. Finally, investors in emerging markets can use a numerous different exotic currency options. These options are more complex and sophisticated than the other instruments because they incorporate special features that extend the fundamental contracts. For example barrier options are options which payoff depends on both the value of the underlying currency and the values at various intervals across the life of the agreement.

3. HEDGING WITH CURRENCY DERIVATIVES

Currency risk in emerging markets can be hedged by using all the currency derivatives. However, the use of those instruments varies among emerging market countries both in currency derivative types and variations as well as in volume, depending mainly on a financial market development and efficiency and government decrees. In this regard, hedging with currency derivatives can be classified as

(1) Hedging with currency forwards,
(2) Hedging with currency futures,
(3) Hedging with currency options, and
(4) Hedging with currency swaps.

Hedging with currency forwards provides an investor the opportunity to lock in the exchange rate at which they can buy or sell a particular currency on specified date in future. These contracts are not standardized, i.e. counter parties negotiate all contract terms. In this way contract gets the flexibility. Given that these instruments can be arranged not only for short-term, but for long-term periods also, they are frequently used in emerging markets that are relatively illiquid compared to developed markets. Long-term currency forwards can be used for hedging currency risk when investors know that they will be exposed to currency risk during the long period in the future because of their investment horizon duration.
Investors in emerging markets frequently use relatively new type of currency forwards called non-deliverable forward contract**.** Like a regular currency forward, this contract represents an agreement regarding a position in a specified amount of a specified currency, a specified exchange rate, and a specified future settlement date. However, non-deliverable forward does not result in an actual delivery of currencies at the future date. Instead, the agreement specifies that a payment is made by one party to the other party based on the exchange rate at the future date. Besides this, currency forwards can be used in at least one more form, i.e. it is possible to hedge currency risk with so-called convertible forwards. These forwards represent a combination of a vanilla calls and vanilla forwards. In other words, an investor buys a vanilla call and, at the same time, sells a down-and-in put. It converts to a plain vanilla forward during the exercise period, positioning the investor to profit from a contrarian move in the spot rate.

Hedging with currency futures enables the foreign currency owner or the owner of a security denominated in foreing currency to minimize the exchange rate exposure by establishing a fixed exchange rate that is to be applied on a specified date in future. Besides, these contracts provide a potential foreign investor a fixed rate at which he or she can buy a particular currency or foreign security.

Investors can use currency futures for currency risk control of their portfolios. In other words, investors can change the sensitivity of their international portfolios‟ value to exchange rate movements in foreign exchange market. In this regard, investors will buy currency futures if they expect increase in their home currency price. This can enable them to reduce the losses in portfolio component denominated in foreing currency. On the other hand, if investors expect a decrease in their home currency, they will sell currency futures and receive gains on portfolio denominated in foreing currency.

Currency options permit investors (hedgers) to eliminate unfavorable exchange rate fluctuations while still benefiting from favorable exchange rate fluctuations. Currency option users are banks, supranational and sovereigns (issuers of debt in foreign currencies), multinational companies, investors in foreign currency securities etc. They commonly use currency options as an investment or funding tool, as well to cover foreign exchange rate exposure or to lock in profit. Hedging with currency options can be used for hedging current or forecasted (future) open currency positions and/or positions in foreign securities denominated in foreing currency. In this regard, investors can hedge by buying currency call option if they have to create a long position in foreign securities and hedge themselves from price increase. Otherwise, investors would use put option to protect themselves from potential loss if foreing exchange rate depreciates. Hedging with currency options is more expensive than hedging with other currency derivatives because it requires the payment of an option premium when the hedge is established.
Exchange-traded and over-the-counter options are suitable for hedging purposes. Because of emerging markets low efficiency and development, hedging with over-the-counter options is more common. Within this options type there a large number of different options tailored to investors‟ special needs. In this regard, it would be useful to consider at least two hedging strategies: common hedging strategies with currency options and hedging strategies with exotic options (exotic is referred to their special characteristics regarding price, exercise etc.).
Common currency option hedging strategies are (Bogojevic Arsic (2009)): long call, long put, bull spread, bear spread, calendar spread, and long straddle, long strangle, call ratio backspread, and put ratio backspread.
Long call currency option is used when a user is very bullish (positive) on the markets, while a long put currency option can be used when a trader is very bearish (negative) on the market. Bull spread currency option is used when a user thinks the market will go up somewhat or at least is a bit more likely to rise than fall. This is a good position to have when user wants to be in the market but is unsure of the bullish expectations. On the other hand, bear spread currency option may be adequate when a user thinks the market will fall somewhat or at least is a bit more likely to fall than rise. This is a good position to be taken if a user wants to be in the market but is unsure of the bearish expectations. Calendar spread involves a simultaneous purchase and sale of call currency options that differ only in their time to maturity. These options have the advantage of allowing for modest exchange rate appreciation depending on the exercise price, which can easily occur with an emerging market currency. Long straddle currency option is frequently used when market is quiet and when there is an expectation that the market will start to move but there is uncertainty as to the direction. As opposed to this, long strangle currency option could be a better hedging tool than long straddle if market is stagnant and continues to stagnate in the future. Hedging with call ratio backspread option is desirable when the market experienced a large downside move which was followed by stagnation. Otherwise, put ratio backspread currency option is normally entered into when the last major move in the market was upside direction followed by stagnation.

Among different exotic options that can be used, in emerging market the most commonly used ones (Bouzoubaa and Adel (2010)) are: barrier currency options, average rate currency options, compound currency options, variable notional currency options, multifactor currency options and structured currency options.
Barrier options are essentially a European style options with fixed maturity, fixed call and put currencies and fixed strike price but with an additional “trigger” level. There are a number of different types of barrier options but their common feature is that they are either activated or terminated if a predetermined spot foreign exchange rate, or trigger level, is traded at any time before the expiry date. Investors in emerging markets frequently use standard knock in and knock out options (that enable reduction in the premium associated with the trigger, i.e. exchange price for a call or put options) and window options (that provide a period (“window”) during the option‟s life for which the barrier is valid). Average rate currency options are cash-settled instruments and are exercised against the average of a series of exchange rate fixings rather than the spot foreign exchange rate on the expiry date. These options are widely used for hedging because of their simplicity, cost effectiveness (less costly then entering into a series of currency options), flexibility and choice (a buyer can select any date for the fixings to take place). Compound currency options are essentially the options on options, giving the buyer the right to buy (compound call) or the right to sell (compound put) an underlying currency option with fixed parameters, at a fixed premium on or before a specified date. In return for an additional upfront premium, the buyer has a predetermined period of time (the compound period) over which to decide whether or not to purchase the underlying currency option. Thus, the compound currency

options allow the buyer greater flexibility in the timing of the hedge and reduces the upfront premium cost, in return the overall cost is greater (or the premium receipt is smaller for a compound put). The compound currency options can be used for contingent foreign exchange exposures where the upfront cost needs to be minimized, or where extra flexibility is required in the timing and level of a hedge. Variable notional currency options are differ from European style currency options in that the principal amount of the option increases by a predetermined ratio as the option moves into the money. The ratio by which the principal increases is set on the initial deal date and can be varied to suit individual requirements. These currency options are ideal hedging instruments for corporate users whose exposure increases as the currency rises or falls. Multi-factor currency options provide protection against two exposures, such as commodity prices and foreign exchange rates. Such an integrated strategy addresses a company"s major risks in a coordinated way, at a lower cost relative to a traditional European option. In the multi-factor option, payoff of the option on one asset class is dependent upon the price behavior in the other asset class.
Finally, structured currency options represent a wide group of exotics. The commonly used options of this type are forward extra currency options (essentially the European options that turn into a currency forwards if a trigger level is reached) and contingent premium options (essentially currency options whereby the premium is paid only if the options are in-the-money at expiry).

Hedging with currency swaps provide long-dated forward cover of foreign currency exposure, especially against the currency flow of foreign currency debt. The currency swaps can be used in combinations with other derivatives, such as cross-currency swap and cross-currency basis swap. Cross-currency swap (or circus swap) represents a currency swap combined with an interest rate swap (floating versus fixed rate) so that the loans on which the service schedules are based differ by currency and type of interest payment. On the other hand, cross-currency basis swap means that an investor purchases a standard currency swap while simultaneously receiving a floating interest rate in one currency for a floating rate in another currency. This position allows an investor to profit from interest rate differentials while assuming no more risk than found in a basic currency swap.

4. CURRENCY DERIVATIVES IN EMERGING MARKETS

The availability of currency derivatives in Ems is influenced by a degree of development of these markets and the openness of their governments to foreign investment and floating exchange rates. Therefore, the hedging with currency derivatives varies among these markets. Ems refers to a large number of countries all over the world, so it is possible to consider this issue by analyzing currency derivatives use in Africa, Asia, Central and Eastern Europe and Latin America.

4.1. Currency derivatives in Africa

In many African countries, financial markets are not enough developed to carry out anything beyond basic currency forwards, futures and swap. For example, in Nigeria currency forwards are subject to a maximum tenor of three years, which is considerably better compared to 180 days tenor in 2006. Authorized dealers are now allowed to engage in swap transactions between themselves or with retail/wholesale customers. These transactions with deliverable forwards and swaps are restricted to a maximum tenor of three years. The non-deliverable forward market is underdeveloped and has very poor liquidity. Unlike Nigeria, Kenya has a free-floating currency (Kenyan Shilling) that is fully liberalized and convertible. There are no restrictions on transactions relating to the current and capital accounts and no foreign exchange controls. However, most of trading occurs in vanilla currency forwards, futures and options, while there is still no available foreign exchange protection for periods longer than one year.
The most developed currency derivative market has South Africa. According to African derivatives guide book (2010), hedging can be done by using currency forwards (tenors of up to 10 years and average daily volume of US$1 billion), futures (on notional underlying swaps in 2, 5 and 10 years contracts), currency options (tenors up to 5 years and transaction average size of US$25 million), options on futures, and cross currency swaps (available for period up to 10 years).

4.2. Currency derivatives in Asia

Asian markets represent one of the world"s fastest growing regions for the development of currency derivatives. Singapore has one of the most advanced financial services industries in the region and is at par with international standards. It attracts high levels of overseas investments as it builds a reputation as an offshore financial center. Singapore has one of the most developed currency derivative markets in Asia, i.e. one of the most liquid over-the-counter currency derivative markets (after Japan). A study prepared for ISDA

(2013) suggests that investors can hedge currency risk by non/deliverable currency forwards with settlement in US dollars, currency futures, conventional and exotic currency options, and currency swaps.
The South Korean market is relatively open and attracts worldwide interest, especially after Korea Futures Exchange is launched. Financial system of South Korea is fast developing and enables sophisticated currency derivatives use, both conventional and exotic ones (such as "knock-in-knock-out" foreign exchange options for hedging against the appreciation of the local currency in relation to the dollar) (Prates and Fritz (2013.). Although currency derivatives market was stagnant in 2012 due to decrease volatility of interest rate and foreign exchange markets, in the study prepared for ISDA (2013) it is expected to grow in the future.
China is one of the fastest growing economies in the world, so is its financial market. Though the over-the-counter derivatives market in China developed quickly, the market is still immature, as measured by the number of products, liquidity, market structure, and existing infrastructure with a slightly stagnation and even decline during the last few years. In Chinese market is possible to hedge currency risk with a range of currency derivatives, such as currency forwards (deliverable and non-deliverable forwards), currency swaps (non-deliverable and non-deliverable forward swap), currency non-deliverable options and currency swaps (Zhang and Chan (2011).
Similarly, the Indian foreign exchange market has grown significantly in the last more than ten years. However, existence of government restrictions regarding currency derivatives use prevents financial market"s further grow. Despite this, in India is possible to hedge with non-deliverable currency forwards, options, swaps, forwards, swaps, forward swaps, swaptions, quanto options, and ratchet options.

4.3. Currency derivatives in Eastern and Central Europe

In Eastern Europe there is a wide variation in currency derivative developments. Among countries that belong to this region, it"s worth focusing on Russian Federation and the European Union member states (Czech Republic, Hungary and Poland).
Since the Russian government allowed ruble to float more freely in 2006, the investment in this county become sizable and led to growing currency futures use by international investors. This has influence the currency derivatives use on the Moscow Interbank Currency Exchange. Besides this, in 2013 US dollar to Russian ruble cross- currency swaps and currency swaps were introduced with maturities from intraday to five years.
The currency derivatives market of the Czech Republic is small compared to those of developed markets, but its currency derivatives market is active, stable, and tightly regulated by the Czech National Bank. Currency derivatives activity has significantly grown since 2004, when trading began to center on the euro. In particular, the volume of currency forwards has been relatively large for the last several years because international investors have sought the higher interest rates in the Czech Republic, motivating them to exchange their home currencies for the koruna to buy Czech bond issues. But, in general the currency derivatives can be used in a very basic manner, i.e. the hedging is possible with conventional currency forwards, currency futures and a few currency options.
After 2001, Hungary began to experience higher currency risk, which fostered the development of basic currency derivatives, which are traded on the Hungarian over-the-counter market. The most widely traded derivatives are based on different currencies (e.g. Euro, US dollar, Swiss franc etc.) and ad currency futures are most popular contracts. Based on these trends, it is safe to say that the market for currency derivatives in Hungary will broaden and deepen at a solid pace. The recent crisis has adversely affected Hungary which currency derivatives turnover has largely decreased between 2007 and 2010 (Mihaljek and Packer (2010), while there were difficulties exchanging Euros and Swiss francs for domestic currency in foreign currency swap markets. However, since 2009 local currency swap market has recovered.
Since 2000, Poland has advanced in its use of futures and options, beginning with the use of four currency pairs. Today there are five currency pairs used. The currency pairs serve as a basis for further developments in currency derivatives, such as currency forwards, currency options with expiration up to five years and cross-currency swaps with the maturity of at least ten years.

4.4. Currency derivatives in Latin America

Latin America are still relatively fast growing region but which is characterized by political and economic instability, across all the countries, especially among the most developed ones, such as Argentina, Brazil and Mexico.
Argentine did not get a chance to recover from the financial crisis that began in 2002, when new so-called international financial crisis occurred in 2007. In this regard, Argentina is still in recovering phase. All these have significantly affected the currency derivatives market. Non-deliverable forward contracts are available only in large amounts, which disable small investors to use them for hedging. Besides, currency risk can be hedged with basic currency futures, currency options and swaps.

Since the mid-2005 Chilean authorities have allowed freely floating of peso, which has influenced the currency derivatives growth. However, even in 2010, currency derivatives are currency forwards (which are mostly non-deliverable), futures, and swaps. The use of exotic contracts is usually avoided, although in some situations knock in and knock out options were used for hedging purposes (Avalos and Moreno (2013)
Brazil has the most advanced capital markets and most sophisticated currency derivatives market in Latin America, with both basic hedging and sophisticated instruments available. As such, the Brazilian Mercantile and Futures Exchange, where currency derivatives and other instruments are traded, are considered one of the most developed exchanges among western emerging markets. Large daily turnover in interest rate derivatives has affected the increase in currency derivatives use.
Because of the volatility of Peso and the high level of corruption in Mexico, investors have always had the incentive to hedge currency risk. Free float of peso has led to great currency derivatives market growth. Hedging can be done with all currency derivatives, while since 2002 currency options and currency swaps has become dominant instruments.

4.5 Emerging markets outlook

Emerging market economies had impressive growth rates during the period of 2003-2007. However, the global financial crisis influenced their growth rates slow down in period 2008-2010. Since 2011 growth rates of these economies started to recover and increase. According to World economic outlook (2014), the growth in emerging market economies is expected to be slightly over 5 percent in 2014 with an expectation of its further increase in 2015 and 2016 (i.e. lower than during the pre-crisis period). Africa is expected to have a moderate growth with an exception for North African countries that are expected to grow at a much slower rate (approximately 3% on average). Growth rates of the emerging market economies of Asia are forecasted to remain at 5.3% in 2014 because of tighter domestic and external financial conditions before rising to 5.7% in 2015, helped by stronger external demand and weaker currencies. China represents an exception from this because of the very high growth rate which is forecasted to remain unchanged at about 7% in 2014-2015, after a modest decline in 2012-2013. Besides, the forecast for India suggests an increase in GDP growth at 5.4% in 2014 and 6.4% in 2015 (assuming the investment and export growth after recent rupee depreciation). Only a modest acceleration in activity is expected for regional growth in Latin America, with growth rising from 2% in 2014 to 3% in 2015 which will be due mainly to growth rates in Mexico.
The past twenty years there were big changes in private capital inflows to EMs. These flows have increased substantially both in absolute terms and as a share of those markets GDP and have been characterized by large fluctuations in response to changing global financial and economic conditions. According to World Bank (2014), in the 2009 financial inflows have averaged around 6 percent of GDP in EMs. However, financial crisis has influenced the decline in capital flows, so World economic outlook (2014) provides an expectation of capital flows decline in EMs by about 0.6% of their GDP by 2016, as global asset portfolios are rebalanced toward developed market economies. Briefly, a financial crisis calming in developed markets will affect not only the decrease in capital inflows in EMs but also the increase in exports and interest rates. The increase in interest rates could cause significant damage on emerging market economies by raising domestic and external costs of debt servicing.
Inflation rates in EMs have been growing in after financial crisis period with exception for some counties in 2012-2013 in which inflation rates experienced slightly decline (e.g. China, Korea, Kenya, Poland, Romania, Russia etc.). Nevertheless, the inflation rates in these markets are expected to remain high compared to developed markets as a group.
Furthermore, in 2002-2007 the majority of emerging market currencies experienced appreciation against the U.S. dollar. According to IMF report of representative exchange rates against U.S. dollar (2014), in 2008 emerging market currencies depreciated with exception for few countries (such as Czech koruna and South African rand). In 2009-2010 the majority of emerging market currencies appreciated against the U.S. dollar with exception for a number of countries (e.g. Russian ruble in 2009 and 2010 or Czech koruna and Hungarian forint in 2010). In 2012-20103 there were both appreciations and depreciations in emerging market currencies, so it could be expected that those trends will prevail in the future. In general, in 2014-2016 the depreciation can be expected to continue in large number of emerging market economies, for exception for some Asian economies, Russia and some European economies. Finally, volatilities of the emerging market currencies have been notable dropped in 2007 compared to volatilities in 2000, while in period 2008-2013 the volatilities have grown.
With regard to currency derivatives in EMs it should account for more use of currency derivatives in future because of foreign investors need to hedge when investing in portfolios in emerging market securities, especially when direct hedging is not possible, i.e. when only cross-hedging is feasible. Besides, currency derivatives can be used to hedge currency risk in global portfolios. Finally, currency derivatives can be an efficient hedging tool for hedge funds and corporations in EMs that are strive to enhance their portfolio returns through foreign exchange (i.e. enhancing a “portable alpha”).

5. CONCLUSION

EMs have made considerable progress in last twenty years although they have been adversely affected by a number of financial crises in the world. Those markets have unique potential for further growth, but there are lot of problems waiting to be solved in the future, especially those related to trade and financial restrictions removal and free float of currencies. It should not be oversight the influence of the U.S. on the financial stability especially if economic growth slows. Furthermore, in EMs the financial as well political risk will always exist. A part of this risk can be reduced by hedging. Those markets need foreign investors‟ capital and they can be attracted by enough developed currency derivative market. Despite the projected growth rates, inflation rates, capital inflows, currencies „depreciations (appreciations) and currencies‟ volatilities, it is reasonable to expect slow improvement in emerging market economies in next two or three years. In addition, the more sophisticated use of currency derivatives can be anticipated (both in number and types) and more emerging market government incentives for investment and currency derivatives use.
Given that foreign investors will be always exposed to exchange rate risk, their need to hedge this exposure will never disappear, but will grow with emerging market growth.

REFERENCES

African Fixed Income and Derivatives Guide Book (May 2010), African Development Bank Group, p. 125

AGF Investments, MSCI All Country World Index Overview. (January 29, 2014). Ritrieved from http://markets.ft.com.

The Asian OTC Derivatives Markets – A Study Prepared for ISDA. (April 23, 2013). Celent.

Avalos, F. & Moreno R. (March 2013). Hedging in derivatives markets: the experience of Chile, Quarterly Review, 53-63.

Bogojevic Arsic, V. (2009). Upravljanje finansijskim rizikom, SZR “Kragulj”, Beograd, 2009

Bouzoubaa, M. & Adel, O. (2010) Exotic Options and Hybrids – Guide to Structuring, Pricing and Trading, Wiley&Sons, Ltd.,

Burger, J. D., Warnock, F. E. and Warnock V.C. (2012). Emerging Local Currency Bond Markets, Financial Analysts Journal 68(4), 73-93.

Calvo, G. A. (2005). Crisis in emerging market economies: A global perspective, Frank D. Graham Memorial Lecture, March 30, Princeton University, Princeton, NJ.

Eichengreen, B., Hausman, R. and Panizza, V. (2003). Currency mismatches, debt intolerance, and original sin: Why it matters, National Bureau of Economic Research, Working Paper 10036.

Gilmore, S. & Hayashi, F. (2011). Emerging Market Currency Excess Returns”, American Economic Journal: Macroeconomics, 3(4), 85-111.

Henderson, C. (2006) Currency Strategy - The Practitioner‟s Guide to Currency Investing, Hedging and Forecasting, John Wiley&Sons, Ltd..

Institute of International Finance, www.iif.com (accessed on 15th November 2013).

International Bank for Reconstruction and Development. (2014). World Development Indicator 2014, Washington,

International Monetary Fund (April 2014). World Economic Outlook: Recovery Strengthens, Remains Uneven, IMF.

IMF report of representative exchange rates against U.S. dollar. (2014). IMF.

McFadden, D. (2004). Hot money and cold comfort: Global capital movement and financial crises in emerging economies, presentation at ANEC Conference on Globalization and Development, Havana, Cuba.

Mihaljek, D. & Packer, F. (December 2010). Derivatives in emerging markets, BIS Quarterly Review.

Moscow Exchange. http://moex.com/en/derivatives. (Accessed in December 2013).

Prates, D. & Fritz, B. (October 2013) Beyond capital controls: the regulation of foreign currency derivatives markets in South Korea and Brazil after the global financial crisis, Berlin Working Papers on Money, Finance, Trade and Development, Working Paper No.07/2013.

Warsaw Stock Exchange. http. (Accessed in December 2013).

Zhang, G. P. & Chan, T. (2011). The Chinese Yuan: Internationalization and Financial Products in China, Wiley&Sons Ltd.

THE VISIBLE HAND OF STATE IN THE BUSINESS OF INSURANCE COMPANIES AND INVESTMENT FUNDS

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Abstract: *State capitalism is related to direct state interventon in the national economy and some forms of state involvment always exist, even in developed economies. Contemporary meaning of state capitalism refers to developing economies and emerging markets, as well as countries where socio-economic reforms toward market liberalisation ocurred. In those countries and economies state has key role in transition process, through founding and managing State Owned Enterprises (SOE) and providing them resoruces, but simultaneously using those enterprises for promoting political interests of ruling party. In addition to explaining term and examples of state capitalism worldwide, in this paper will be presented forms of direct and indirect state intervention in the business of insurance companies and investment funds, as institutional investors on financial market. Global investment phenomenon of sovereign wealth funds will be particularly explained. The aim of this paper is to identify and clarify situations in the business of insurance companies and investment funds, when state intervention is needed, as well as to point out consequences of excessive interference of state in the economy and financial market, disturbing laises faire principle.*

Keywords*: insurance, investment funds, state capitalism*

1. INTRODUCTION

The model of state capitalism that has been applied in the last twenty years in emerging economies and markets such as China, Russia and Brazil is a slightly different model of direct state intervention compared to models realized in the last fifty years in OECD (Organization for Economic Cooperation and Development) countries and across Europe, Japan and other countries destroyed by The Second World War. The modern meaning of state capitalism has appeared along with the socio-economic reforms toward market liberalization, that occurred in countries still governed by Communist Party (e.g. in China), or carried through privatization processes (e.g. Soviet Union and other South East Europe – SEE countries), as well as in „petrostates“ such as United Arabian Emirates, governed by royal families. The common characteristic of all those countries is that economic decisions have been made and resource have been allocated by leading political establishment, not by free market. Having in mind global financial crisis in 2008 and its consequences, free market model showed its shortcomings and this is the reason and alibi why governments of many countries have been intensified their entanglement in the free market. According to the definition of The United Nations Conference on Trade and Development in a state-owned company the state owns at least 10 percent of the share capital and has significant control through: full, majority or significant minority ownership (Sprenger, 2008). In some countries, such as Russia, government is a minority shareholder in the equity of some companies, but owns golden shares and has main role in making decision and allocation of company's resources. Economic and strategic decisions of State Owned Enterprises (SOEs) influence not only performance of these enterprises and domestic market, but global market too. SOEs in China and Russia participate the most in the stock market capitalization in those countries. The other side of medal is that SOEs are usually misused by leading political party in order to promote and realize its political gains and interests and to strengthen its ruling position.

2. STATE CAPITALISM AS GLOBAL PHENOMENON

The well known and the richest companies owned by government are oil companies. Among world's largest oil companies, measured by their reserves, 13 of them [1] are owned and operated by governments and they control more than 75 percent of global oil reserves and oil production. At the same time, private multinational oil companies hold just three percent of the global oil reserves and produce just ten percent of the total oil production (Bremmer, 2009).

[1] some of those companies are Saudi Arabia's Saudi Aramco, the National Iranian Oil Company, Petróleos de Venezuela, S.A., Russia's Gazprom and Rosneft, the China National Petroleum Corporation, Malaysia's Petronas, and Brazil's Petrobras.

In some countries, usually developing, governments realize their political interests through privately owned national champions. These companies have private equity, but gain competitive advantage on the base of preferences given by government in form of favorable credits, contracts or subsidies, not on the base of increasing productivity and efficiency. Positive aspect of fostering national champions is that they can be considered as special joint venture, combined of state resources and the most valuable knowledge and experience of the best multinational companies and their management. There are couple of examples in the China's automobile industry and electronic industry, where China's national champions took over the global car maker *Volvo* and giant of electronic industry *Siemens*. Although national champions are private companies and a lot of them, especially in emerging markets are listed on the Fortune Global 500, they are in more favorable position compared to other private companies as their competitors. On the Fortune Global 500 list, according to revenues in billions of US$, there are a lot of Chinese government companies, such as Sinopec group (4th place), China National Petroleum (5.), State Grid (7.), Industrial and Commercial bank of China (29.), China Construction Bank (50.), Agricultural Bank of China (64.), Bank of China (70.), China Mobile Communication (71.), China State Construction Engineering (80.), China National Offshore Oil (93.), China Railway Construction (100.), China Railway Group (102.) and other state owned companies. There are also a couple of Russian state companies on the Fortune Global 500 list, such as Gazprom (21.), Rosneft Oil (99.), Sberbank (228.). [2]

Besides the remarkable financial results of these companies and their importance for the national economy and financial market, it has to be noticed that those results are mainly achieved due to the government support and those companies are used as an instrument of manifesting power of political establishment and realizing political interests. According to McKinsey, in 2013 there were 8000 companies worldwide whose revenue exceed US$ 1 billion, and 75 % of those companies came from developed countries. McKinsey forecasts that by 2025, there will be additional 7000 companies with revenue above US$ 1 billion and 70 percent of those companies will come from emerging markets, with dominant position of China's companies.[3] Regarding this forecast and development of state capitalism in the last twenty years, similar trend can be expected in the next decade, which means a considerable number of companies from the emerging economies, have revenues above billion of US$ and are owned by state and governed by professional management. Empirical evidence from China suggests that SOEs are more successful in the realization of infrastructure projects, such as railways and airports, than in the boosting of innovation. There are also negative effects of favoring private champions and SOEs that are reflected in the repression of private sector and decreased productivity and efficiency, whereby costs of subsidies and credits given to the national champions and SOEs, are transferred to the final consumers through higher prices of goods and services.

Regardless evidence of using SOEs as a tool of ruling political party, different forms of direct state intervention in economy has been existed since the ancient societies, and were especially popular in the 20th century in conditions of Great depression and other global financial crisis. It indicates that SOEs are not exclusively related to developing or emerging economies. The role of government and its interference in the economic sectors was particularly necessary after The Second World War and reconstruction processes throughout the Europe, Japan and other countries destroyed by the War. SOEs as a manifestation of visible hand of government are usually founded in energy sector (oil, gas, electricity, coal), telecommunication and mass media, railway, air transport, financial and banking sector. Ten years ago according to the OECD data, SOEs in France and Italy had the biggest asset value and total equity vale compared to SOEs in other OECD countries. According to the number of SOEs employees as a percentage of total employment, France was at the fourth and Italy was at the ninth place. French government has 85 % of shares in EDF (energy company), Japan has 50 % of shares in Japan Tobacco, Germany has 32 % of shares in Deutsche Telekom. Total value of SOEs in OECD countries is nearly US$ 2 trillion, with the workforce of 6 million people. [4] Governments of some countries use direct state intervention as an instrument of realization developing strategies and goals in order to boost development of some sectors, industries, regions or national economy as a whole. Through SOEs government realizes some measures of fiscal policy and supports achieving of socio-economic goals such as decreasing rate of unemployment, especially of population under thirty. Having in mind importance of SOEs for national economies and their influence on the global market, even more OECD countries are interested in reforms and professionalization of SOEs board of directors. It requires higher level of autonomy and competence of members of boards in SOEs and less political influence reflected in the political representatives in boards. There are also some countries without state representatives in SOEs boards, such as Norway, Denmark and Netherland. Number of state representatives in the SOE's board depends on the ownership model (sector, dual, centralized) that is applied in a country. System of fees and incentives has to be properly set for the members of SOEs boards similar to remuneration systems in private companies. In many OECD countries there is a trend of revision of

[2] http://money.cnn.com/magazines/fortune/global500/index.html
[3] http://www.smartplanet.com/blog/bulletin/half-of-fortune-500-companies-will-soon-come-from-emerging-countries/
[4] The Economist, January 2012, Something old, something new - A brief history of state capitalism http://www.economist.com/node/21542922

fees and incentives of SOEs boards' members in order to harmonize their incentives with same items in private sector. Members of SOEs boards should also be focused on creating and increasing value of SOEs, such as they are members of board in some company with private equity. It is hard to expect that these principles of corporate governance that have already been implemented in SOEs in OECD members countries, will be soon applied in the governance of SOE's in China, Russia, Brasil and other emerging economies.

Regardless obvious state support and unequal treatment of SOEs and enterprises with private equity in terms of availability and price of financial sources as well as other business conditions, return on equity (ROE), productivity, efficiency, cost control, innovative activities of SOEs are still below the same performance measures of private sector's enterprises. In the period 2001-2009 in China average return on equity of SOEs was only 1.47 percent, a several times less than ROE in private sector. Some older studies indicate that the higher state participation in the equity is, the lower productivity is. There are also some exceptions such as *China Mobile* and *China National Petroleum Corporation* that achieve excellent financial and business results, although Chinese government has majority ownership in these enterprises. [5]

3. STATE INTERVENTION IN THE BUSINESS OF INSURANCE COMPANIES AND INVESTMENT FUNDS

Free trade is the base of useful division of labor worldwide. Through regulations state may affect the restriction of free trade of goods and services and cause violation of the basic postulates of free and competitive trade. Theoretically, state intervention is justified in situations of market or regulatory failure, such as: natural monopoly (e.g. oil, gas), public goods (e.g. law, order), merit goods (e.g. health, education) and externalities (positive or negative outcomes of activities that influence a lot of community members (OECD comparative report on corporate governance of state-owned enterprises, 2005, p. 9).

There are a couple of arguments justifying the role of the state in the implementation of protectionist policies in the insurance market. One of the reasons is potential threat of domination of foreign insurance companies in the domestic insurance market. If domestic insurance companies do not have sufficient market power, capital, and expertise they could not compete with global insurance companies that have significant financial resources, a strong market reputation and experience. These restrictions are generally introduced by developing countries in order to facilitate the development of domestic insurers. There are also macro-economic and political reasons, as well as protecting national security. The key justification for preventing the entry of foreign insurers and reinsurers is to prevent the outflow of premium abroad which can be a real threat regarding that insurance companies with foreign capital tend to realize as many activities in their origin countries.

Government can use some measures in order to restrict free trade which has a negative impact on the competitiveness of the national markets and those measures are known as protectionist. For insurance and reinsurance companies which intend to enter new markets or already doing business in markets besides their national market or out of their centrals, different customs and non-tariff barriers may have negative impact. Those protectionist measures are usually in the form of tariffs, quotas, subsidies and public procurement. Customs have a protectionist effect on the domestic insurance sector in the country in which they are introduced, with positive impact on the balance of payments and increase of state revenues, but their summary effect is negative, as it reduces competition and thus exert a direct negative effect on both the market and consumers.

Customs are rare in the insurance, but different tax treatment of domestic and foreign insurers could be classified as tariff barrier. Non-tariff barriers are informal or indirect restrictions or regulations that hamper the free trade and thus directly limit fair competition. The most important non-tariff barriers are subsidies. Subsidies can be targeted directly towards favoring domestic insurers. Subsidies can be in the form of direct government incentives to obtain insurance coverage of domestic insurers, as well as in the form of tax refunds or tax incentives. For example, in Switzerland domestic insurers are allowed to form reserves in case of catastrophic damages. The way of realization of public procurement has a significant impact on business of insurance companies, while practices of favoring domestic companies were not subject of review under the General Agreement on Tariffs and Trade (GATT) [6]. For example in the U.S. is allowed a preference of

[5] The Economist, January 2012, Mixed bag - SOEs are good at infrastructure projects, not so good at innovation http://www.economist.com/node/21542929

[6] GATT is transformed to the World Trade Organization (WTO) in 1995; one of the basic goals of WTO is reduction of tariffs and other non-tariff barriers.

domestic companies in the sectors of products or services, until their price does not exceed the amount of more than 12 % of the price offered by the foreign company.
Restricting access to the market is not in accordance to the fundamental principles of free and fair international trade and there are numerous different examples. It is required in some countries that insurance and reinsurance companies have majority of domestic capital. Some countries may restrict the access to foreign insurers in all cases except when a specific type of insurance cannot be obtained from domestic insurers. Finally, there is also limitation in terms of risk transfer to reinsurers, which appears in the form of obligatory assignment of risk to domestic reinsurers first.

In addition to these differences in the tax burden, preference in public procurement and the introduction of quotas for the foreign insurers, there are also possible differences in regulations regarding the types of activities that are permitted to domestic and to foreign insurance companies, then it is possible to introduce higher capital requirements in the regulation of solvency for foreign insurers or to restrict them access to the national trade associations.

3.1. Direct state intervention on the insurance market

On the insurance market, in addition to creating regulatory framework, state usually participates in promoting insurance and its importance, as well as improving confidence in the institution of insurance. The role of the state in the providing of social insurance is present in all countries, with some variability in the volume of services. Social security provides protection of incomes of individuals and their families in the old age, in case of death, disability, impairment of health, maternity, unemployment and injuries and it is an important instrument of state policy.

It is common that the social security system included 1) the pension and disability insurance, 2) health insurance and 3) unemployment insurance. In addition to the social insurance state traditionally has a role in providing other forms of insurance for which private sector is not interested. In group of insurance for which there is no initiative of private sector, especially important are deposit insurance and export insurance. The role of government in providing social insurance is important in most countries, including the developed as well as the UK. In this country, for example, the cost of health insurance provided by the state or the national health service exceeding one hundred billion pounds while total premiums of voluntary health insurance starts at around 4 billion pounds.

Increased probability of catastrophic events over the last decade drew attention to the limits of insurability within a market economy. Through the institutions that personify state, the state is interested to provide insurance protection for all risks and all insureds and when private insurance companies do not offer insurance for catastrophic risks, the state usually directly involves in the insurance business (Njegomir, 2011). The direct role of the state in the insurance market is realized through the founding of state insurance companies or through financial support to the private sector when the state has a role of (re)insurer of the last instance, similar to the role of central bank that appears as a last resort in order to provide liquidity in the banking system. Through its institutions, state may appear in the role of (re) insurer of last resort when it can provide reinsurance coverage for the private insurance sector. For example, in the region insurance companies achieved poor results in the insurance of agriculture (Njegomir, Pejanovic, 2011) and government intervention in the form of subsidies for insurance premiums is required. However, a direct state intervention in the form of compensation that occurs in the region is not justified, regarding the little interest in insurance, which should be the primary form of protection of agriculture (Njegomir, 2011).

The role of the state as an insurer of last resort the most efficiently can be achieved through the establishment of national pools. National pools are pools of insurance and reinsurance companies, with the state support. These pools are formed to secure insurance coverage for major risks, such as earthquakes and floods, which are considered fundamental and which are beyond the control of individuals or groups and have extremely negative consequences for the entire population, economy and infrastructure. In the UK there is a state-sponsored program of support in the form of Pool Reinsurance Co. Ltd. In Spain there is Consorcio de Seguros for terrorism insurance, in France there is state-supported pool GAREAT for terrorism insurance. In Germany there is a typical pool with state support, for reinsurance of risks of terrorism, consisted of 16 insurers and reinsurers and called EXTREMUS.

Mega catastrophes that emerge with increasing probability in recent years, are beyond the capacity of the insurance market, but even the states, which indicates the need for the partnership between the public and private sectors on the global level, and Organization for Economic Cooperation and Development – OECD has very important role in it (Messy, 2005).

Finally, the extreme situation of the direct role of the state in the insurance market is the nationalization of the entire insurance sector, as was the case in the former socialist countries. Through the process of transition to the market system, followed by collapse of the socialist socio-economic system in the late eighties and early nineties, insurance sector was privatized. Completely planned and by state regulated insurance sector is inferior in comparison to the private insurance sector In countries where the insurance sector was systematically state directed, insurance companies are considerably smaller, with less developed organizational structure, smaller volume and diversity of services within insurance coverage and usually they not operate on international insurance market, unlike insurance companies from market oriented economies. Also, a key reason against the government interference in the business of insurance companies, except in circumstances where it is absolutely necessary, is a lack of positive investment effect that private insurance companies realize on the capital markets (Dorfman, 2008, p. 75).

3.2. Sovereign wealth funds as a state visible hand on the financial markets

Sovereign Wealth Funds (SWF) are state owned investment funds with diversified portfolio of government bonds, shares in domestic and international companies, real estates, precious metals. Although some state owned investment funds have been founded in the fifties of the twentieth century (Kuwait Investment Authority in 1953), influence of SWFs on the global market has become even stronger from 2005. Having in mind relationship of SWFs, state capitalism and emerging economies, from 2005 have started some kind of financial race between SWFs and investment funds that come from USA and Europe. Financial crisis of 2008, that especially hit financial markets of USA and Europe, additionally spurred performances of SWFs and emerging markets.

Countries that continuously have high export revenues and surplus in foreign exchange, establish SWF in order to realize and maximize long term return on investments, but at the same time to promote political interests of leading party. This is the way how some countries form huge pools of capital available for financing business of SOEs and national champions as well as for foreign direct investments (FDI), but simultaneously sustain stability of national currency, prevent increase of inflation rate and avoid direct budget financing of SOEs. Nowadays the biggest SWF is The Abu Dhabi Investment Authority with capital of US$ 627 billion that is equal to some of the largest US mutual funds, which indicates their size and importance on the global financial market. The biggest ten SWFs are shown in the table 2:

Table 1: Top ten global SWFs and their assets (in billion of US$) in 2013

Country	SWF name	Assets (billion of US$)	Inception	Origin
Norway	Government Pension Fund - Global	838	1990	oil
UAE – Abu Dhabi	Abu Dhabi Investment Authority	773	1976	oil
Saudi Arabia	SAMA Foreign Holdings	675,9	n.a.	oil
China	China Investment Corporation	575,2	2007	Non-commodity
China	SAFE Investment Company	567,9	1997	Non-commodity
Kuwait	Kuwait Investment Authority	410	1953	oil
China – Hong Kong	Hong Kong Monetary Authority Investment Portfolio	326,7	1993	Non-commodity
Singapore	Government of Singapore Investment Corporation	320	1981	Non-commodity
Singapore	Temasek Holdings	173,3	1974	Non-commodity
Qatar	Qatar Investment Authority	170	2005	Oil and gas

Source: Sovereign Wealth Fund Institute http://www.swfinstitute.org

Data in table show that the SWFs are concentrated in the Middle East (UAE, Saudi Arabia, Kuwait and Qatar). According to the fund source, for 59 % of SWFs fund sources are oil and gas export revenues. Chinese and Singapore SWF are also among global top ten funds. According to the region, 40 % of SWFs come from Asia, 35 % from Middle East, 17 % from Europe, 3 % from Africa and 3 % from America

(Sovereign Wealth Fund Institute). All SWFs can be divided into stabilization funds and saving funds. Stabilization SWFs have main purpose to reduce the volatility of government revenues, while typical saving fund is Government Pension Fund of Norway, global number one SWF according to the assets value (US$ 838 billion) and that is not used for promoting political interests of Norway government. SWF Temasek that comes from Singapore is also represent of favoring financial instead of political interests through its business. Some funds can be characterized as development funds, with the main goal to promote development of some regions or industries (e.g., IT sector). In 2007 total net value of SWFs was US$ 4000 billion. In March 2014, market size of SWF is US$ 6357 billion, comparing to their market size in December 2013, which amounted to US$ 6106 billion. Although International Monetary Fund (IMF) requests from SWFs to increase their transparency, SWFs mainly ignore those requests. Even more, the recent trend among SWFs from emerging economies is that they create joint ventures (China Investment Corporation and the Qatar Investment Authority in 2009) and consortiums (Government of Singapore's Investment Corporation, China Investment Corporation, Abu Dhabi Investment Council and six other SWFs signed agreement in 2010) and ignore the most important western financial intermediaries.[7]

3.3. Indirect role of state on the insurance market

By definition the role of government is to protect its citizens and property from the destructive forces of nature and the risks associated with human activities and to create conditions for the undisturbed operation of the private sector and to support economic activities based on market principles. Regarding that state intervenes directly and indirectly on the insurance market.

Indirect state intervention is realized through the regulation conditions of business of insurance companies in order to protect the insured. Government intervention in the insurance sector is also necessary because of the problem of information asymmetry. On the insurance market problem of asymmetric information appears on the side of the customers or insureds and the insurers, too. On the one hand, insureds are less familiar with the characteristics of individual insurance products as well as the adequacy of the insurance companies in terms of their ability to ensure solvency, or to be a guarantor of undertaken obligations if insurance cases are realized. On the other hand, insurance companies do not always have enough information about the object of insurance as well as the risk, which causes emerging of situation of adverse selection, moral hazard and insurance fraud. The role of government is to promote symmetry of available information, particularly with regard to the insurer. Having in mind fact that insurance companies are professionally engaged in insurance activities, which means their favorable position in relation to the insureds, the state regulates the activity of insurance in order to protect the insured.

Numerous examples of bankruptcy of insurance companies imply the necessity of the state regulation of insurance sector. Identifying and understanding the factors that affect the problems of insurance companies helps in improving regulation. Analyzing the market failures of insurance companies in the United States between 1969 and 2010, rating agency AM Best came to the conclusion that the key causes of bankruptcies of insurance companies inadequate approach to insurance risk management, whether in terms of inadequate reserves, rapid growth or impact of catastrophic damages. Results of the study are presented in the table below.

Table 2: Causes of market failure of insurance companies in USA, period 1996-2010

Period	Participation in total number of companies
Inadequate reserves	40,3%
Rapid growth	13,6%
Frauds	7,8%
Problems with related persons	7,8%
Investment problems	7,3%
Catastrophe damages	7,1%
Considerable changes in business	4,0%
Problems in reinsurance (realization of credit risk)	3,6%
Other	8,6%

Source: 1969-2010 P/C Impairment Review, Best's Special Report, A.M. Best, May 2, 2011

[7] The Economist, January 2012, New masters of the universe - How state enterprise is spreading http://www.economist.com/node/21542925

The role of government in a market economy is necessary regarding that Smith's "invisible hand" is not absolutely capable to provide the best allocation of resources in each case, especially in order to improve the efficiency at the level of society. The absolute dominance of the "invisible hand" is limited by the market failures which were first identified by Keynes who analyzed the causes of the Great depression in the thirties of the twentieth century.

Taking into account the identified causes of market failures as well as bankruptcies of the insurers, key reasons for the regulation of insurance sector directed towards the protection of the insureds as consumers, that are mentioned in the literature are: 1) prevention the insolvency of the insurance companies, 2) protection of the insured due to their lack of information and bargaining power in relation to the insurer, 3) ensuring fair insurance premium, given the imperfections of the market mechanism of premiums regulation, and 4) the achievement of social objectives and benefits by providing a wide availability of insurance coverage (Njegomir, 2011, p. 211).

Indirect role of the state, or its agencies, on the insurance market are related to regulation of insurance business or creating a regulatory framework that will ensure the effective and efficient business of insurance companies. Areas of regulation include: founding of insurance companies; determining allowable organizational forms; solvency; application of accounting standards in the assessment of assets and liabilities; insurance premiums; market behavior, including corporate governance, consumer protection, the level of competition and licensing of brokers and insurance agents; taxation and abandonment the market, including liquidation, restructuring and abandonment some segments of the insurance business.

Through completely free market mechanisms could not be established insurance premium high enough to cover costs and provide a reasonable profit to insurers, but also low enough to be available to insureds. State intervention in order to ensure fair insurance premium is required and it is achieved in two ways: 1) indirectly, through regulation of solvency is prevented the uncontrolled and unfair competition and 2) directly, by approving the tariffs of insurance premiums. Bearing in mind that priority to the market mechanisms should always be given and interventions should be applied only in case of inefficiency of market mechanisms, big insurance companies are indirectly favored, because of lower relative share of the costs of regulation in total revenue of big in comparison with smaller insurers. Increasing cost of regulation cause additional adverse effect manifested in reduced funds for innovations that are necessary in terms of continuously changing environment and the emergence of new risks.

Regulation of insurance can be directed towards the need to achieve social goals, especially the wide availability of insurance services for all who need insurance. In some situations, the regulatory authorities may force insurers to accept insureds that otherwise would not be accepted and to lower insurance premiums. Examples of regulatory pressures on insurers are known throughout the world and commonly associated with forcing insurers to offer insurance services at regular premiums in areas that were exposed to catastrophic damages. Such measures can cause the abandonment of certain types of insurance and the necessity of state intervention as insurers.

3.4. Indirect state intervention in the business of investment funds

Indirect role of the state in the sector of investment funds is realized by creating a regulatory framework, the adoption and implementation of laws and regulations. On the financial markets of the USA, as the most developed and the most important world's market of investment funds in terms of their numbers and diversity, as well as the interest of shareholders to invest in the funds, Securities and Exchange Commission (SEC) is the central supervisor institution for the entire financial market. All countries with regulated financial markets, regardless of the level of market development, have central supervisor institution such as SEC on the USA financial market. In the countries of our region, the regulatory and legal framework for the business of investment funds has been created 10 to 15 years earlier than it was done in Serbia and thus investment funds industry in those countries is more developed and potential investors are more aware and informed about possibilities of investing in funds. Investment funds on these markets have suffered significant consequences of the global financial crisis of 2008 and some financial markets are still being recovering. In Serbia, in 2006 was adopted and entered into force the Law on Investment Funds, then the Law on market of securities and Law on Capital Market in 2011 (Službeni glasnik 46/2006, 47/2006, 51/2009, 31/2011) and the regulatory framework for the business of mutual, closed and private investment funds has been completed. Republic of Serbia Securities Commission is supervisory institution that grants, suspends or withdraws licenses and keeps registers of Investment fund management companies, approves membership of their boards of directors and supervises operation of those companies and their funds. Financial reports and auditor reports of Investment fund management companies and each fund have to be submitted to the Securities Commission.

4. CONCLUSION

State capitalism as a recent global phenomenon has appeared twenty years ago along with the socio-economic reforms toward market liberalization. The leading representatives of state capitalism are China, Russia, Brazil, as well as Middle East countries, rich in oil and governed by royal families. They have main characteristic that leading political establishment decide about economy and resource allocation, denying free market. Global financial crisis of 2008 that especially hit western economies gave tail wind to the emerging economies that continuously mark growth and their state owned enterprises and national champions are generators of country's development and progress. Although in state capitalism government uses SOEs and national champions for promoting its political interests, a lot of Chinese and Russian SOEs are listed in Fortune Global 500 index, even in top ten companies according to the revenue. The adverse by-side effect of state capitalism is repression of private sector that cannot compare to the SOEs that have privilege treatment and government support in terms of resources, prices, interest rate, etc. Nevertheless productivity and return on investments of private sector are still above the same indicators in the business of SOEs.

In business of insurance companies and investment funds, as institutional investors, state intervention is represented in form of direct or indirect state interference in the free market. Indirect state intervention is manifested in creating regulatory framework for business of insurance companies and investment funds. Through the regulation state should provide safety of business of insurance companies in order to protect insureds, as well as fair market competition. Similar situation is related to the business of investment funds, having in mind that investors and capital are usually looking for secure zone for investments.

On the insurance market, in addition to creating regulatory framework, state usually participates in promoting insurance, as well as improving confidence in the institution of insurance. Direct state intervention in the insurance sector is also indispensable in providing social security which means protection of incomes of individuals and their families in the old age, in case of death, disability, impairment of health, maternity, unemployment and injuries and it is an important instrument of state policy. State usually directly involves in the insurance business in order to provide insurance protection for all risks and all insureds in situations when private insurance companies do not offer insurance for catastrophic risks. Through its institutions state can have the role of (re)insurer of last resort by providing reinsurance coverage for the private insurance sector.

Sovereign Wealth Funds (SWF) are state owned investment funds that have become global investment phenomenon in the last decade and expression of visible hand of state on the financial market. They realize remarkable returns despite the global financial crisis of 2008 and its consequences. SWFs are particularly related to emerging markets and economies, but their role and importance on the global financial market have been changing and they even more threat to key financial institutions and investors on the markets of USA and EU.

All these indicate that visible hand of state in the business of insurance companies and investment funds is welcome in the setting regulatory framework and enriching supply of these institutional investors in case when private sector is not interested or cannot profitably operate. In other cases, state represses fair competition and private sector and slow down its development, that have negative long term consequences for the financial market and the entire society.

REFERENCES

Bremmer, I, (2009). The end of free market? Retrieved from http://www.foreignaffairs.com/articles/64948/ian-bremmer/state-capitalism-comes-of-age

Dorfman, M. S. (2008). Introduction to Risk Management and Insurance. Upper Saddle River, NY: Pearson Education International

Messy, F.-A. (2005). Catastrophic Risk and Insurance. Paris, France: Organisation for Economic Co-operation and Development.

Njegomir, V. (2011). Osiguranje. Novi Sad: Ortomedics book.

Njegomir, V. (2011). Tržište osiguranja i uloga države - stanje i perspektive finansiranja katastrofa. Finansije, Vol. 66 (1-6), pp. 256-288, Beograd.

Njegomir, V., Pejanović, R. (2011). Importance and current issues in agricultural insurance in Serbia, Contemporary Agriculture, Vol. 60 (1-2), pp. 38-45, Beograd.

OECD comparative report on corporate governance of state-owned enterprises – A survey of OECD countries, (2005).

Sovereign Wealth Fund Institute, Retreived from http://www.swfinstitute.org

Sprenger, C., (2008). State-Owned Enterprises in Russia - Presentation at the OECD Roundtable on Corporate Governance of SOEs.

EMPIRICAL EVIDENCE ON EFFICIENCY OF TRADITIONAL VERSUS BEHAVIOURAL ASSET-PRICING MODELS: AN OVERVIEW

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Abstract: *Security analysis evolved through decades, and introduced various asset-pricing models for stock selection. Developments in theory and modelling varied from efficient markets with rational investors to inefficient markets with irrational investors. This paper aims to present different asset-pricing models and to review empirical findings on their effectiveness in explaining expected returns. Based on the review of contemporary researches, this paper provides the insight into important macroeconomic and microeconomic factors, which have influence on the cross-section of expected returns.*

Keywords*: Valuation, asset pricing models, CAPM, APT, investor sentiment*

1. INTRODUCTION

What is the value of a certain asset and what return it will generate? These are the most challenging questions for various market participants such as investors, regulators, and portfolio managers. The answers to these questions will either fulfill investment objectives, or fail them. Valuation represents an estimation of an asset's value that can be based on variables assumed to be in relation with future returns. Estimation of value can also be obtained by comparison with similar assets. Investments analysts use different valuation concepts and models to select stocks, infer market expectations, evaluate corporate events, to render fair opinion, evaluate business strategies and models. Main use of different concepts and models is for stock valuation. Valuation can be performed as a part of an overall portfolio management process. In the planning phase of a portfolio investment process investor identifies investment objectives, constraints, and an investment strategy. Different investment strategies can either use those concepts and models, or do not. With indexing strategies analysts just try to replicate an index, there is no requirement for judgment of individual securities. Valuation is crucial for active investment strategies, where analyst is trying to produce superior risk-adjusted returns with a portfolio different than some benchmark. Valuation of a particular company is a task within an overall portfolio management process. Valuation process assumes understanding of the company that is being valued, forecasting its performance, and selection of an appropriate valuation model for a particular valuation task (Stowe et al., 2007).

Empirical researchers examined market efficiency of both developed and emerging markets. Evidences found in these studies are opposite. Market efficiency usually depends on the sample that is taken or it is associated with a certain situation. Hence, nature of markets is difficult to determine. This results in that that it is very challenging to pick the right asset pricing model for a specific market. Applicability of the known asset pricing models is connected with rational investor assumption, where expected return represents fair value of investors' portfolio. This is just an assumption, which does not hold in the real market setting. It is frequently argued that investors are following sentiment. Hence, sentiment could be factor that would help in return predictability (Majumder, 2014).

This paper is going to present different models that are available to investors, and to discuss empirical findings of recent research, and discuss its applicability. In the second part of the paper, theoretical foundations of different valuation models will be presented. Third part, will give insight into empirical evidence of performance of modern finance models. Also, in third part of the paper, important behavioral factors that drive expected returns will be presented. Fourth part will provide concluding remarks.

2. SECURITY VALUATION PROCESS AND MODELS

Each security valuation represents a process that consists of few steps. First step assumes understanding and evaluation of an industry as a whole, assessment of company's competitive position and its strategies. In order for us to be able to understand company, it is important to analyze corporate economic and industry context in combination with management strategic responses to it. Second step assume forecasting of company's performance from two perspectives, company's economic environment and its financial

characteristics. In this step macroeconomic analysis is integrated with financial statement analysis, and numerical forecasts are created. Besides quantitative factors it is important to create some qualitative forecasts as well, where assessment of quality of earnings is one of the essential ones. Forecasts represent inputs in value estimation. Third step is a step when appropriate valuation model is selected. There are several value perspectives that can be used as a base for different valuation models. The most important value concept is intrinsic value (Stowe et al., 2007).

Valuation is an integral part of an effort to produce positive excess risk-adjusted return or abnormal return or alpha. If there is a difference between estimates of intrinsic value and the market price of an asset, that means that any recognized mispricing will be part of the holding-period return estimate which represents forecast of the total return. An expected holding-period return represents the sum of the expected capital appreciation and investment income. Therefore, assets alpha in a forward sense represents, the difference between expected holding-period return and fair return on the asset given its risk. Mispricing raises questions about market efficiency. In the traditional efficient markets formulation, the best available estimate of an intrinsic value is assumed to be assets market price. The rational efficient markets formulation assumes that no rational investor will incur expenses of gathering information except if he expects to receive higher return. Furthermore, if trading costs are taken into consideration than market price can even more deviate from assets value. Moreover, rational investor assumption was often challenged and new valuation approaches are formulated. Forth step, of a security valuation process, is a conversion of forecasts into a valuation, and a fifth step is giving recommendation to the investors (Stowe et al., 2007).

2.1. Valuation models

Third step of security valuation process assumes model selection. Stowe et al. (2007) distinguish between two broad types of valuation models, absolute and relative valuation models. An absolute valuation models produce a point estimate of intrinsic value that can be compared with market price of an asset. Present value models, as a type of absolute valuation models, assume that the value of an asset must be related to the returns, or asset's cash flows. Present value models based on dividends are dividend discount models. Besides dividends, cash flows can also be defined at company level. Hence, present value models used for valuation of corporate cash flows are free cash flow models and residual income models. The application of present value models for common stock valuation engages uncertainty, that stem from inputs in these models, mainly cash flows and discount rates. Corporations can also be valued with another type of absolute valuation models, called asset-based valuation models . These models assume that company can be valued based on the market value of its assets/resources. Relative valuation models give assets value relative to the value of an another asset. Rationale for these type of models is that similar assets should have similar prices. This type of valuation is implemented using different price multiples, like price-earnings (P/E) multiple (Stowe et al., 2007; Bogojevic, 2004). Bogojevic (2009) distingueshes two approaches for determining cost of equity capital, approach based on the dividend discount model (which can be used in fundamental analysis) and approach of the Capital market line. Also, basic models of risk and return are CAPM and APT. In time, many of their extensions were created in attempt to overcame to drawbacks of those basic one's.

Haugen (2001) distinguishes between different periods of evolution of academic finance, the old, the modern, and the new finance. Summary of Haugen's view of the evolution of security analysis is presented in table 1. In the old finance period, security analysis was focused on accounting statements and law. Introduction of new finance era came with Harry Markowitz portfolio optimization and Capital Asset Pricing Model (CAPM) (Sharpe, 1964), and is completed with the efficient market hypothesis. These building blocks of the modern finance assume rational investor behaviour. Stock prices change randomly from one period to another, and they are responding instantly and accurately to the new information. Risk of an individual stock can be measured with beta, which represents the sensitivity of a security's periodic return to changes in the periodic return to the market index. Modern finance thinking was challenged with discovery of myriad of market anomalies, such as January effect, or small stocks premium. The new finance paradigm dismisses rational investor's behaviour, and assumes that markets are inefficient. It is necessary to measure the behaviour first, and then to try to find reasonable explanations for it. Hence, stocks with particular characteristics are more likely to yield premium returns.

Table 1: Summary of Haugen's view of evolution of security analysis

Evolution of security analysis		
Old finance	Modern finance	New finance
Financial statement analysis	Rational investors'	Irrational investors'
Law	CAPM	Behavioural asset pricing

Capital market theory extends portfolio theory and introduces CAPM which allows pricing of all risky assets. CAPM is used for calculating the required rate of return which can be compared with an estimate of the assets expected rate of return during specific investment horizon. Based on the result obtained it can be observed that asset is undervalued, properly valued or overvalued. CAPM gives required or expected rate of return when risk-free rate is enhanced for risk premium, and this transition is helpful when one wants to value an asset because it provides a discount rate which can be used in any valuation model. CAPM is a single risk factor model which takes into account volatility inherent in an individual security or portfolio of securities. Only relevant risk is a covariance of the asset with the market portfolio (Reilly & Brown, 2002). Due to unrealistic assumptions of CAPM there are several extensions of this model and one of them is inter-temporal capital asset pricing model.

The arbitrage pricing theory (APT) assumes that there are several risk factors or indexes, but it does not specify how many of them are there or what precisely are they (Ross, 1976). The APT assumes that stochastic process that drives asset returns can be represented as K factor model. Risk factors used in APT that influence returns can be either macroeconomic or microeconomic (Reilly & Brown, 2002). There are several multifactor models used in practice such as Chen, Roll, and Ross (1986), Fama and French (1993), Carhart (1997) extension of Fama and French model, and BARRA model.

Models of new finance are behavioural pricing models. Behavioural finance presents mixture of behavioural and cognitive psychological theory and conventional economics and finance. This field of finance emerged due to inability of efficient market theory to explain different empirical patterns. The underlying assumption of behavioural finance is that individual investors' decisions and market outcomes are systematically influenced by information structure and characteristics of market participants. Humans behave in irrational manner, and therefore make forecast errors and also, do not follow risk aversion concepts. Such behaviour has influence on the efficiency of capital markets and performance of corporations (Baker&Nofsinger, 2010). It is complex to incorporate investors' behaviour into valuation of assets. Szyszka (2010) gives an overview of different classes of behavioral asset pricing models. They can be classified into belief-based models and preference-based models. Belief-based models are models of investor sentiment, DHS model, and Hong and Stein's Model. Preference-based models are Models of Shifting Risk Attitude and Probability Misperception Model.

Model of investor sentiment suggest that attitudes of investors match to two behavioral patterns. First pattern, suggest that investors believe that profitability of a corporation oscillate around some mean value. If company would report increased profitability, investors would react adversely in fear that such news would be eliminated in the next period. Hence, price adjusts to the new information with delay. Humans tend to change their beliefs slowly when encountered with new information; they would need confirmations by successive results. Barberis et al. (1998) associate such investor behaviours with cognitive conservatism. Second pattern, correspond to the belief that profitability of corporations follow specific trend. In this case investors put emphasis on the latest results (Barberis et al., 1998). Barberis et al. (1998) associate this attitude with the representativeness heuristic. This means that investors give probability to the specific event based on the similarity with the precise characteristics of the sample, which will lead to an error. The weight of individual characteristics, which comply with some pattern, will be overstated, and the real statistics will be understated. Thus, their conclusions are based on the short series error.

Daniel et al. (1998) model (DHS) is based on the assumption that investors can be either informed or underinformed. Underinformed traders do not have any influence on the market. Informed traders are overconfident and because of that, their decisions can have an impact on the market. These types of traders are subject to calibration bias. Investors assume that their analysis is more precise than regularly available market information. Model of investor sentiment suppose that investors overreaction is due to a sequence of signals of similar significance and underreact to the new information. DHS model distinct overreaction and underreaction depending on whether information is public or private. DHS model does a good job in explaining short-term continuations, long-term trend reversals, as well as long-term continuations. However, this model assumes that investors' reaction is incomplete when new information is published for the first time (Szyszka, 2010).

Hong and Stein (1999) also assume that there are two types of investors in the market, and they have bounded rationality. First type of investors is the type who uses fundamental analysis, and they track new information which can affect the value of a company. Second type of investors is momentum trader, who favors short-term price trends. All investors analyze only certain subset of publically available information. Fundamental information reaches investors slowly, causing certain delay in their reaction. They are focused on forward looking information, ignoring historical trend. Momentum traders only care about price movements.

Barberis, Huang, and Santos (2001) propose preference-based model, based on three ideas. Investors are interested in the level of their wealth and they are concerned with fluctuations in its value, also they are more stressed with reduction in the level of their wealth than to its enhancement. Investors are risk takers after they have realized gains, and they are risk averse when they have experienced losses. This model is trying to explain investors' behavior when capital markets are analyzed from an aggregate level. Dacey and Zielonka (2008) proposed another preference-based model. Investors want to maximize their personal utility, and therefore they are prone to two types of errors. An error may occur due to the investors' faulty estimate of the probability of the events. Errors may arise when investors assign inaccurate weights to the estimated probability level in the weighing function of prospects theory. Furthermore, there are two types of investors rational and quasi-rational. There are fewer rational investors' in the marketplace and they correctly assign probabilities to the potential changes in assets prices. Reversely, quasi-rational investors make wrong estimates.

3. EMPIRICAL EVIDENCE OF PERFROMANCE OF ASSET PRICING MODELS

There is a vast number research that test efficiency of the capital markets. Also, in pursue of adequate model for stock selection, researches investigate the efficiency of both traditional and behavioural asset-pricing models.

3.1. Facts about modern finance models

Kim et al. (2012) tested CAPM, APT-motivated models, the consumption-based CAPM, inter-temporal CAPM, and Jagannathan and Wang conditional CAPM model in the Korean stock market. They found that the Fama-French five factor model gave the best results in explaining the inter-temporal and cross-sectional returns.

Hammami and Lindahl (2014) found that bank credit growth is relevant factor in stock pricing based on the US sample. They have included bank credit growth variable into ICAPM and determined that as a state variable it explains 94% of the cross-section of the average returns. Bank credit growth is priced in the expected stock returns. This state variable is important since it can predict business cycle variables and future labor income growth, and also according to them cross-section of expected returns. Marquering and Verbeek (1999) extended ICAPM by adding transaction costs and habit persistence. Habit persistence can be defined as high consumption in previous period followed with high consumption in the next period. Consumers that are used to high consumption levels would desire such level of consumption to persist. Introduction of transaction costs in consumption-based model did not show good results. However, when habit persistence was included in the model results obtained were improved significantly.

Mouselli et al. (2013) investigate the relevance of accruals quality to asset pricing, by introducing this factor to the Fama-French three factor model. Investors recognize the quality of financial reporting, and more precise accruals quality. Stocks with lower accruals quality exhibit on average higher returns than stocks that have higher accruals quality. Reasons for such findings are not attributable to size or book-to-market effects. Furthermore, costs of capital are influenced with accruals quality. However, Mouselli et al. (2013) concluded that accruals quality is not a good proxy for determining the information risk or it can be captured with other risk factors. This study found no evidence that accruals quality is a priced risk factor. However, this finding does not imply that earnings management is irrelevant; maybe different proxy for such actions should be considered.

Cowman and Joutz (2006) tested economic factors significance in multifactor asset pricing models. They have created Bayesian learning model under which unobserved components can be estimated using Kalman filter. They concluded that economic factors can be useful when pricing risk, and that industrial production and unexpected inflation make inference across financial markets.

Chou et al. (2012) found that well known asset pricing models are not able to explain industry returns. Hence, either efficient or inefficient theories cannot clarify industry returns. They have based their conclusions on the analysis of two industry asset pricing models, industry-based five-factor model and industry-augmented five-factor model which they compared with CAPM, Fama-French three factor model, and momentum augmented four-factor model. They found that economic fundamentals and information about industries help to predict stock markets. Furthermore, empirical results show that asset price anomalies (small firm effect, book-to-market effect, momentum effect) are related to industry classification.

3.2. Evidence of different behavioural aspects on asset pricing

Chan et al. (2004) tested effects of two psychological biases, representativeness and conservatism, on stock price behaviour. They based their research on trends and consistency of performance of the accounting data. Generally, biases are formed when investors analyze past information about companies, and based on those biases, investors can form expectation about company's performance and they can be satisfied or unsatisfied with their forecasts. They found evidence that behavioural theories based on representativeness are not sustainable. On the other hand, behavioural theories based on conservatism biases have some influence on the stock pricing. They found no evidence that past accounting performance trends over multiyear periods generate future return reversals. Their evidence weakens the likelihood that market inefficiencies stem out of representativeness and conservatism, based on different metrics and horizons.

Many studies have reported that investor sentiment and stock market returns are related. Such findings dispute classical asset pricing models (Kim et al., 2014). Sentiment can be defined as optimism or pessimism regarding future stock returns. Therefore, periods of high sentiment, represent periods in which majority of economic agents believe that future performance of stocks is going to be high (Berger & Turtle, 2012). Dergiades (2012) has found the evidence that investor sentiment is significant for predicting stock returns, mainly because of conditional variance of stock returns. Research is conducted for US stock market. Yang and Li (2013) also report an evidence of systematic and significant impact of investor sentiment on asset prices. However, general sentiment based asset pricing model still does not exist, and research is in an explanatory stage.

Changsheng and Yongfeng (2012) explored the impact of investor sentiment on asset valuation based on Chinese stock market data. They found that stocks with low book-to-market value and high P/E ratio are sensitive to investor sentiment. Therefore, investor sentiment has explanatory power for hot and value stock. Thus, investor sentiment should be taken into account in asset pricing, which is consistent with behavioral theory.

Proponents of investor sentiment theory argue that market sentiment and behavioural biases affect aggregate and individual returns. There are several sentiment matters, and among them is disagreement between investors. Investors can be optimistic or pessimistic, where their pessimism is not easily seen in market prices due to short-sale restrictions. Numerous studies reported that under short sale limitation, disagreement between investors' result in overpricing. Kim et al. (2014) investigated relation between such disagreement and stock market returns, with time-varying level of investors' sentiment. They found that higher level of disagreement among investors lead to lower returns during high sentiment periods. During low sentiment periods, there is no relation between disagreement and stock returns.

Information validity has great significance when valuing risky securities. When information about stocks is not transparent, investors could require additional compensation to buy those stocks. If this is the case those stocks would be more sensitive to the market sentiment. Berger & Turtle (2012) found evidence that stocks that are volatile, small, young, and intangible exhibit greater sensitivity to the market sentiment. There is inverse relation between known investor sentiment and marginal performance of non-transparent stocks. Stocks with transparent information display little variability in performance during different levels of market sentiment.

Chung et al. (2012) examined how well investor sentiment predicts cross-section of stock returns if different states of economy are considered. They found that predictive power of investor sentiment is only significant in the expansion state of the economy. In a recession state, investor sentiment has no predictive ability. In the expansion state of the economy has predictive power for portfolio returns which are based on the size, book-to-market ratio, dividend yield, earnings-to-price ratio, age, return volatility, asset tangibility, growth opportunities, and several anomalies. Their findings are based on in-sample and out-of-sample data.

Chen et al. (2013) examined asymmetric effects of local and global sentiment on the expected industry returns, in the Asian stock markets. They found that global optimistic views makes industry returns to be overvalued, and pessimistic view leads them to undervaluation. Furthermore, higher local sentiment increase returns of several industries, like basic materials, telecommunications, and utilities. Likewise, high sentiment makes industries attractive to optimists and speculators.

4. CONCLUSION

Is there a perfect asset-pricing model? Search for an answer to this question is like a quest for a holy grail. Fama-French extended model gave good results in explaining movements in Korean market. Cross-section

of expected returns was better explained with ICAPM when bank credit growth or habit persistence was included. However, traditional models are not found to be efficient in explaining industry returns. Investor conservatism has some influence on stock pricing. Furthermore, investor sentiment is found to be very important factor in explaining returns, in both developed and emerging stock markets. Its explanatory power is significant only in the expansion state of the economy. Also, there is a difference in a significance of global and local sentiment in explaining returns of companies from different industries. Further research is needed to be able to shed light on additional risk factors and biases that are necessary for inclusion in a sustainable asset-pricing model.

REFERENCES

Baker, H. K. & Nofsinger, J. R. (2010). Behavioral Finance: An Overview in Behavioral finance: investors, corporations, and markets, Baker, H. K. & Nofsinger, J. R. (eds.), Hoboken, New Jersey: John Wiley & Sons, Inc.

Barberis, N., Huang, M. & Santos, T. (2001). Prospect theory and asset prices, Quarterly Journal of Economics, 116(1), 1–53.

Barberis, N., Shleifer, A. & Vishny, R. (1998). A model of investor sentiment, Journal of Financial Economics, 49(3), 307–343.

Berger, D. & Turtle, H. J. (2012). Cross-sectional performance and investor sentiment in a multiple risk factor model, Journal of Banking & Finance, 36, 1107–1121. doi:10.1016/j.jbankfin.2011.11.001

Bogojevic Arsic, V. (2009). Upravljanje finansijskim rizikom, Beograd: Kragulj.

Bogojevic Arsic, V. (2004). Tržište hartija od vrednosti, Beograd: Fakultet organizacionih nauka.

Carhart, M. M. (1997). On Persistence in Mutual Fund Performance, Journal of Finance, 52(1), 57–82.

Chan, W. S., Frankel, R., & Kothari, S. P. (2004). Testing behavioral finance theories using trends and consistency in financial performance, Journal of Accounting and Economics, 38, 3–50. doi:10.1016/j.jacceco.2004.07.003

Changsheng, H., & Yongfeng, W. (2012). Investor Sentiment and Assets Valuation, Systems Engineering Procedia, 3, 166 – 171.

Chen, N-F., Roll, R., & Ross, S. A. (1986). Economic Forces and the Stock Market, Journal of Business, 59 (3), 383–404.

Chen, M-P., Chen, P-F., & Lee, C-C. (2013). Asymmetric effects of investor sentiment on industry stock returns: Panel data evidence, Emerging Markets Review, 14, 35–54. http://dx.doi.org/10.1016/j.ememar.2012.11.001

Chou, P-H., Ho, P-H., & Ko, K-C. (2012). Do industries matter in explaining stock returns and asset-pricing anomalies?, Journal of Banking & Finance, 36, 355–370. doi:10.1016/j.jbankfin.2011.07.016

Chung, S-L., Hung, C-H., & Yeh, C-Y. (2012). When does investor sentiment predict stock returns?, Journal of Empirical Finance, 19, 217–240. doi:10.1016/j.jempfin.2012.01.002

Cowan, A. M. & Joutz, F. L. (2006). An unobserved component model of asset pricing across financial markets, International Review of Financial Analysis, 15, 86– 107. doi:10.1016/j.irfa.2004.10.004

Dacey, R. & Zielonka, P. (2008). A detailed prospect theory explanation of the disposition effect, Journal of Behavioral Finance, 9(1), 43–50.

Daniel, K., Hirshleifer, D. & Subrahmanyam, A. (1998). Investor psychology and security market under- and overreactions. Journal of Finance, 53(6), 1839–1885.

Dergiades, T. (2012). Do investors' sentiment dynamics affect stock returns? Evidence from the US economy, Economics Letters, 116, 404–407. doi:10.1016/j.econlet.2012.04.018

Fama, E. F., & French, K. R. (1993). Common Risk Factors in the Returns on Stocks and Bonds, Journal of Financial Economics, 33(1), 3–56.

Hammami, Y. & Lindahl, A. (2014). An intertemporal capital asset pricing model with bank credit growth as a state variable, Journal of Banking & Finance, 39, 14–28. http://dx.doi.org/10.1016/j.jbankfin.2013.10.008

Haugen, R. A. (2001). The Inefficient Stock Market: What pays off and why? (2nd ed.),Prentice Hall.

Kim, J. S., Ryu, D., & Seo, S. W. (2014). Investor sentiment and return predictability of disagreement, Journal of Banking & Finance, 42, 166–178. http://dx.doi.org/10.1016/j.jbankfin.2014.01.017

Kim, S-H., Kim, D., & Shin, H-S. (2012). Evaluating asset pricing models in the Korean stock market, Pacific-Basin Finance Journal, 20, 198–227. doi:10.1016/j.pacfin.2011.09.001

Majumder, D. (2014). Asset pricing for inefficient markets: Evidence from China and India, The Quarterly Review of Economics and Finance, ARTICLE IN PRESS. http://dx.doi.org/10.1016/j.qref.2013.12.007

Marquering, W. & Verbeek, M. (1999). An empirical analysis of intertemporal asset pricing models with transaction costs and habit persistence, Journal of Empirical Finance, 6, 243–265.

Mouselli, S., Jaafar, A., & Goddard, J. (2013). Accruals quality, stock returns and asset pricing: Evidence from the UK, International Review of Financial Analysis, 30, 203–213. http://dx.doi.org/10.1016/j.irfa.2013.08.006

Reilly, F. K., & Brown, K. C. (2002). Investment Analysis and Portfolio Management (7th ed.), South-Western.
Ross, S. (1976). The arbitrage theory of capital asset pricing. Journal of Economic Theory, 13, 341-360.
Sharpe, W. (1964). Capital asset prices: a theory of market equilibrium under conditions of risk, Journal of Finance, 19(3), 425-442.
Shleifer, A. (2004). Inefficient Markets: An Introduction to Behavioral Finance (2nd ed.), United States, New York: Oxford University Press Inc.
Stowe, J. D., Robinson, T. R., Pinto, J. E., & McLeavey, D. E. (2007). Equity asset valuation *(*2nd ed.), Hoboken, New Jersey: John Wiley & Sons, Inc.
Szyszka, A. (2010). Belief- and Preference-Based Models in Behavioral finance: investors, corporations, and markets, Baker, H. K. & Nofsinger, J. R. (eds.), Hoboken, New Jersey: John Wiley & Sons, Inc.
Yang, C. & Li, J. (2013). Investor sentiment, information and asset pricing model, Economic Modelling, 35, 436–442. http://dx.doi.org/10.1016/j.econmod.2013.07.015

LOAN PORTFOLIO MONITORING

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Abstract: *Risk is inherent in all lending. Portfolio management is a tool that is used when a loan is approved so as to manage that risk. Knowing the client and his business very well represents a base of quality lending bank business. Therefore, upon granting the loan, every bank monitors i.e. follows all granted loans. A monitoring goal is perception of total lending portfolio quality, as well as of each loan quality and detecting all problematic loans in the business bank assets structure. Problematic loans have a direct influence on credit portfolio. Problematic loan managing is one of the most important areas in banking but, in the same time, this is the biggest challenge. For sustainability and competitiveness of banking sector in Serbia, a long-term collaboration between banks and enterprises is required.*

This paper goal is to point on importance of management active portfolio, place and role of an independence monitoring function and in recognition all early signs warning on possibility of problematic loans appearance. As the level of problematic loans grows in Serbia, this work will show all possible measures and corrective actions for raising the loan portfolio quality.

Keywords: *loan portfolio, monitoring, loan risk, problematic loans*

1. INTRODUCTION

Most commercial banks consider lending as their principal business activity.
Nowadays, the banks perform their business in very unstable business surrounding in which they face different kinds of risks. There is no loan without any risk. On one side, the banks try to create a loan portfolio to be large as much as possible, in order to achieve satisfactory returns; on another side, company worthiness right estimation and granted loans monitoring are very important in the process of granting loans. Failure to perform obligations by the company, results in loss of a part or whole receivable. If several key clients of the bank failure to service their obligations on time, it may retract the bank in insolvency.

Profitability realization, in conditions of growing competition and rising risk, becomes a challenge for modern banking management. Therefore, procedure of collaboration between the client and the bank doesn't finish with granting the loan, but it's being actively continued until the loan is returned.
Loan monitoring is one of the most important elements of a strong portfolio management system. Experience has revealed that although annual audits of loan portfolios may address these risks, the preferred approach is continuous monitoring of the portfolio.

Since early signs and warnings should point to potential problems, even in those clients still being out of the phase of delay repayment, monitoring represents a significant segment of credit portfolio management which will be discussed in the following chapters.

2. LOAN PORTFOLIO GOALS

Loan portfolio comprises a group of loans, being classified by the bank management according to the loan users in several groups:

- commercial,
- investment,
- mortgage,
- agricultural,
- residential ,
- consumer.

Each loan portfolio consists of a wide range of short-term and long-term loans intended to legal and natural persons, economy, population, budget and other organizations.

According to Vunjak and Kovačević (2011, p.200), credit portfolio needs to have the following elements:

- type and maturity of the loan,
- interest rate structure and level,
- security (collateral) of the loan,
- protective clause in loan agreements.

Specific and measurable goals for the portfolio are established as loan portfolio objectives. The loan portfolio goals include the following:
- scope of portfolio,
- structure of portfolio,
- loan services,
- collection of loans,
- price of loan,
- achieved profit.

Implementing actions based on these objectives for most banks requires medium and long-term strategic plans and objectives for the loan portfolio. These strategic plans need to be consistent with the strategic direction and risk tolerance of the bank. They also must be periodically reviewed and appropriately modified thereto.
Determined loan policy and procedures being introduced to the employees in a quality manner, in written, represent a key instrument of management and provide a controlled growth in risk assets. Except of adopted loan policy and strategy for credit portfolio management, the bank also has to have a defined policy of credit risk management in all phases of granted loans.

According to Đukić (2011, p.114), quality procedures should cover the following:
- Respecting suitable criterion, policies and procedures for granting loans;
- Granting loans with an adequate mortgage or other mode of security that the bank may implement if a debtor fails to realize its obligations;
- Permanent monitoring of the loan portfolio being granted in order to monitor all problematic loans;
- In the case of problematic loans appearance, it is required to undertake all measures related to the loan restructuring, their collection or selling of receivables as well as realization of security offered.

In addition to respect of the principle of caution while granting the loan, diversification of loan portfolio mainly comes from obligations stipulated for the banks by regulatory bodies (Horne and Wachowicz, 2007).
Banks need to understand both the risk created by every credit they issue and how they are interrelated in the overall picture of their portfolios in order to successfully manage their portfolio. Historically, supervision of these individual loans has been the banks' focus when managing the overall risk, but, although this is an important approach, banks must also manage the risk in portfolio segments and the overall portfolio.
Credit risk management at the bank level, covers the loan risk identification, monitoring, bank exposure measurement and calculation of capital needed, as well as organization of adequate control function. Therefore, the banks make an effort in forming quantitative and qualitative approach for exposure measuring, i.e. capital costs calculation.
According to author's illustration, next figure represent differences in risk management approach:

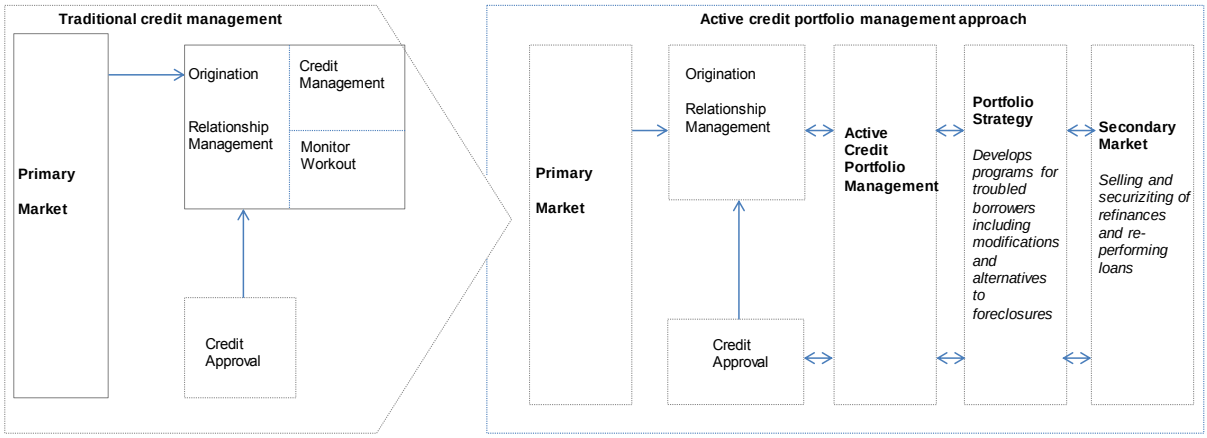

Figure 1: Credit portfolio management as a business model

Unlike the traditional approach to risk management focusing only on assets and liabilities of the bank balance, a modern approach considers the risk management growing from wide range of off-balance bank activities, integrating in this way the risk management at the level of the bank, as a whole.

The focus in traditional credit risk management is underwriting the loans measuring the risk. The bank needs to perform a system of monitoring in order to calculate the occurrence of default. Active portfolio management, however, identifies the concentrated risk on the basis of economic capital lost. The steps that could be taken to mitigate the concentration of risk are sell the loan, buy a form of protection against defaults or securitize the loan asset.
Loan policies, guidelines for underwriting and other bank procedures need to ensure the strategic objectives for the portfolio can be met. Banking represents taking risk, but at the same time making a profit so loan portfolios must reflect the risks and profits accordingly. Management roles and responsibilities are therefore a must for all banks. According to Fiordelisi and Salvatore Mare (2014), size is positively related with bank stability meaning that larger cooperative banks are better able to diversify their portfolio in that increasing bank soundness. Also, diversification may reduce a bank's collateral requirements, giving rise to a kind of scale economy in lending (Neuberger, 1995).

The goal of credit business control is to minimize the bank loses based on the loans, by performing a regular and systematic terrain checking of quality in all departments and affiliates of the bank whose affairs consider a loan risk for the bank.

Quality of credit portfolio depends on the credit risk level. According to Vunjak and Kovačević (2011), credit risk may be expressed as a relationship of potential loses and total credits. According to National bank of Serbia, credit risk also represents possibility of occurrence negative effects on financial result and capital as a consequence of default (Decision on Risk Management by Banks, 2013). There are 2 types of credit risks. One is connected to return on equity, and another one is related to paying interest, as an income to placed credit assets. The loan portfolio exposure to the credit risk considers greater engagement of the management.
Based on credit portfolio analysis, all credits may be divided on standard and problematic ones.

Problematic credits may be divided on the following categories, Ćirović (1995, p.131):

1. Substandard credits;
2. Suspicious credits and
3. Credits with loses.

In standard credits, capacity of the debtor looks like there are no any difficulties to be expected in returning that credit.

Substandard credits include those items where the debtors delay to pay their obligations at least 90 days, as well as restructured loans.

Suspicious credits have an increased risk of not being collected. They include the items of assets in which the debtor delays his payment obligations at least 180 days.

Credits with loses cover those credits being written off at the bank because they are considered as uncollectible.
Because of the credit portfolio important quality, bank management should be informed on conditions and quality of portfolio, as well as on poor-quality i.e. problematic credits. Credit portfolio analysis is done within a special department performing portfolio monitoring continuously.

3. LOAN PORTFOLIO MONITORING

Knowing the client and his business very well represents a base of quality lending bank business. Therefore, upon granting the loan, every bank monitors i.e. follows all granted loans. Monitoring goal is in perception of total lending portfolio quality, as well as of each loan quality and finding of problematic loans in the business bank assets structure.

Monitoring may be organized within credit department as a separate function or within department for risk management, but it is important to provide an independence and objectivity in portfolio quality analysis.

According to Vunjak and Kovačević, (2011, p.201), monitoring process provides:

- Quality credit portfolio;
- Consistent application of credit policy;

- Finding of problematic credits;
- Discovering of failures in releasing credits;
- Objective forming of reserves of the banks that are in the function of credit loses covering.

The goal of monitoring function is to find risk credits as soon as possible, as well as to inform the top management on quality of credit portfolio in whole and per credit groupings.

We differ a total credit portfolio monitoring and individual credits monitoring. **A total credit portfolio monitoring** covers the bank claims based not only on credit but also on factoring affairs, guarantees, letters of credit and credit cards. The aim of credit portfolio quality estimation is an evaluation of possibility that certain credit won't be paid off. Via credit monitoring, the bank estimates how large reserves should be formed in order to cover any potential loss.

Also, a classification of credit is checked according to Regulative of National Bank of Serbia (taking into consideration that each bank has right on internal classification, in accordance with International Financial Reporting Standards), possible changes in classification are monitored, a new classification of the debtors is determined if needed, quality of security offered is checked, as well as cash flows for the credit to be paid off etc.

According to Đukic (2011, p.24), the credit portfolio estimation should include app. 70% of credit amount and 30% of number of credits being covered. Credits with maturity more than 1 year are included completely.

In problematic credits, corrective actions are immediately undertaken through credits restructuring, requirements for additional security etc. according to Decision on the Classification of Bank Balance Sheet Assets and Off-balance Sheet Items (National Bank of Serbia, 2013), criteria being observed in classification of the debtors are as follows:
- Timeliness, i.e. delay in settlement of liabilities towards the bank;
- Financial state and creditworthiness estimation;
- Quality of security offered.

In order to determine all expected loses (EL) at the level of portfolio, it is required to determine all expected loses of each individual credit and those are calculated according to following parameters:
- Probability of default (PD)
- Loss given default (LGD)
- Exposure of the bank (E)

Expected loss in individual credit is calculated according to the following formula:

$$EL = E \times PD \times LGD$$

The bank calculates possibility of failure in performing liabilities of each individual client, while the rest of parameters may be calculated or standard coefficients may be taken. Expected loss at the level of portfolio is obtained as a sum of expected losses of individual clients.

Individual credits monitoring represents already granted credits control, with the purpose in giving information on situation development and changes in the company in the period of time from the date of granting credit or the credit previous regular analysis, followed by an analysis of all new financial data. This analysis should underline an influence of change to the main risks of the credit and sources of paying off.

Loan reviews:
- Analyse and evaluate individual loans, including risks of default or insufficient repayment;
- Evaluate lending policies and procedures compliance;
- Determine problems with faulty documentation;
- Suggest priorities for credit risk management;
- Recommend steps and establish procedures to overcome difficulties.

These types of estimations rely mostly on analysis of the debtor's creditworthiness. The goal of this check is that the bank needs to be sure in following:
- That economic and financial situation of the debtor isn't going worse;
- That the value of collateral isn't going down;
- That the credit is used with the purpose.

Warning signs indicating non performing loans and poor loan policy, regardless the size of some company, may be systematized in the following way, Rose and Hudgins (2005, p.545):

1. Unusual delay in financial reports receiving and in payment or in communication with the bank's staff;
2. When business loans are in charge, any sudden changes in methods used by the borrower on account of amortization, when paying pension contributions, the stock value, with respect to taxes or obtained income;
3. When business loans are in charge, outstanding debt restructuring or elimination of dividends or changes in the debtor creditworthiness;
4. Negative changes in prices of shares of the client to be debited;
5. Losses per net incomes in one or more years;
6. Negative changes in the borrower capital structure (coefficient of share capital /debt), liquidity (current coefficient) or at the levels of activity (selling coefficient in relation to the stock);
7. Deviations regarding the real selling or cash flows in relation to envisaged in time of application of the request for granting the loan;
8. Sudden, unexpected and inexplicable changes in balances of deposits held by the client.

It is very often that the company orderly settles its obligations but doesn't use the credit with the purpose. In that case the bank has the right to ask for the credit to be returned. A special attention should be directed to the new clients who are granted with long-term credits.

If untimely repayment of the credit occurs, the bank firstly considers the reasons that have led to this situation. If they are reasonable, the bank may extend deadlines for returning. If they are not reasonable, the bank may undertake the payment by security instruments activation or by judicial proceeding.

Monitoring importance is in the fact that it is not enough only to take care if the client delays with payment and then undertake some measures but there must be built such a system that will be able timely to recognize problems and to undertake all steps for preventing or decreasing the scope of damage before it happens. According to Chava and Purnanandam (2011), the positive correlation between bank-health and client performance is an outcome of the client’s health affecting bank performance and not the reverse.

4. NON PERFORMING LOANS MANAGEMENT

Despite all measures of caution envisaged by numbers of banks in their credit policies, some credits become problematic which means that the company failures its payment obligations in time or values of security, given as a collateral for loan, have been decreased.

Credit policy defines ways in which a bank can deal with non performing loans (NPL), since working out problem loans involves identifying problem areas and negative trends early, in order to better deal with the issues.
In the case that the bank doesn't charge the loan and interest within 90 days form maturity day, it is considered that problematic credit is in charge which requires a special treatment. When determined that non performing loans exist, they must be given to the referent for solving credits, who must find the reasons for problems and, together with the company, try to find some solution for collection of funds. A well trained referent who knows his/her client very well, will recognize all signs of warning pointing that external factors or bad management negatively influences the credit quality.

In non performing loans, it is required immediately to undertake corrective actions through the loan rescheduling, additional security, searching for new information etc. Credit rescheduling is an option which should be chosen by the bank only if it firmly believes in long-term future of the company. In the case of successfully performed suggested action measures, the client is to be excluded from the list of problematic loans.

Banking sector of Serbia, upon global economic crisis, is loaded, among other things, also with non performing loans.

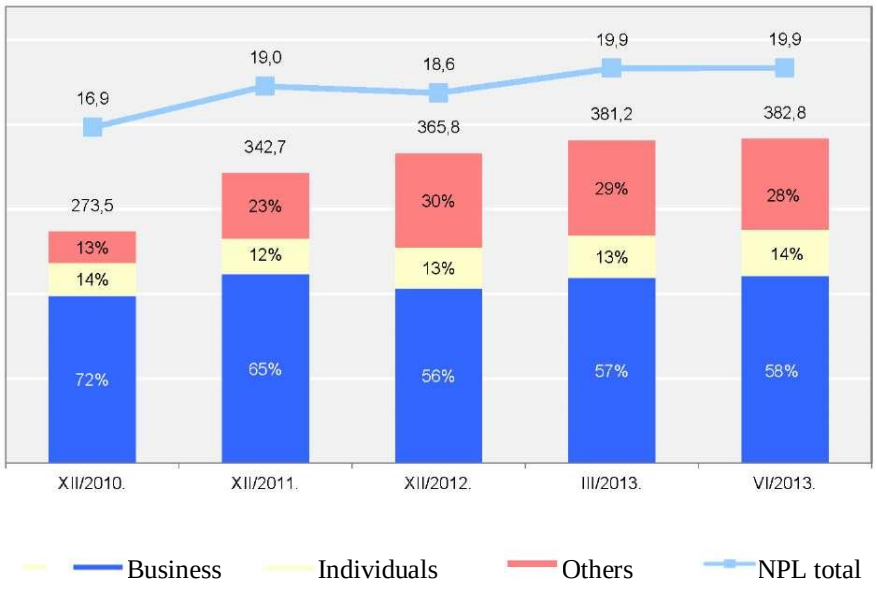

Figure 2: Non performing loans

As shown by the previously graph, according to the last data of National bank of Serbia related to the second trimester of 2013, (Banking sector in Serbia, Second Quarter Report 2013, p.14), total gross credits of banking sector with delay in repayment longer than 90 days, amounted 382,8 billion of RSD and made 19,9% of totally granted loans.

At the end of the second quarter of 2013, a share of NPL in economy amounted 58% and in population 14%. Observing the end of 2012 and first two quarters of 2013, a slight growth of NPL can be seen.

The main reason of NPL growth in Serbia is economy whose gross indicator increased from 18,6% at the end of 2012 to 19,9% in Jun of 2013. According to data of National bank of Serbia, branches with the greatest participation of NPL, with the date of 30.06.2013, are construction, business with real estate and education, processing industry and trade.

In addition to high participation of NPL, stability of banking sector in Serbia is not threatened taking into consideration high amounts of reserves of the banks for those purposes and according to international standards and domestic regulations. At the end of 2012, the NBS changed its regulative in order to provide

conditions for decreasing NPL in a banking sector. Certain limits have been eliminated in relation to the transfer of claims from the legal persons.

Although the NBS has brought the measures in the purpose of NPL decreasing, economic recovery and efficiency of legal system are even important. By decreasing an amount of NPL, the growth of credit activity is provided whose real realization will depend on existence of enough quality projects and clients.

Taking into consideration all stated data, an importance of monitoring relating to following the credits and timely spotting the potential problems, becomes more significant.

5. CONCLUSION

Each credit portfolio is consisted of the wide spectrum of short-term and long-term credits, intended to the natural and legal persons. The risk represents an unbreakable component of each credit business. Together with an increase of banking business, the credit risk is also to be increased. In narrower sense under credit risk we consider a possibility that the loan wont' be returned in maturity deadline, including interests. Timely repayment of the credit depends on possibility and will of the debtor to return the credit, which also depends on many factors, both those under control of the debtor and those under out of the debtor's control. It is not possible absolutely to avoid the risk, but it is possible to decrease it to minimum due to detailed estimation of creditworthiness and solvency of the company, and later with continued monitoring of the client's business.

By the business bank credit portfolio we define the strategy of risk management from the aspect of individual credit and total credit activity of the bank. Loan portfolio monitoring represents a quality observing and

continuous analysis of granted credits. For the function of monitoring is very important to be independent from other business functions in the purpose of objective perceive of problems and to inform the bank management on all kinds of issues.

Early signs of warning should indicate possible problems, even in those clients who are still out of delay phase, with the purpose in preventing the growth of bad placements and provide the credit portfolio to be qualitative as much as possible.

In this work there are stated the methods of discovering of potential problematic debtors, as well as early signs that can lead an experienced banker to make a more detailed analysis of certain part of the credit portfolio and to make possible every identification of possible problems in claims collection.

The identified problem areas in a loan review affect the whole process of portfolio management and signify the necessity for more detailed reviewing of these areas.
Successful collection of claims represents a mirror of one bank credit policy, its value and the credit portfolio value. However, despite all preventive measures, non performing loans happen. In the case that the bank is not able to collect its claims i.e. the credit and interest within 90 days from the day of maturity, it is considered that a non performing loan is in charge which requires a special treatment. In that case, it is needed immediately to undertake all corrective actions through rescheduling of the credit, additional security, searching for new information etc.

Banking sector in Serbia is also loaded with non performing loans. Observing the end of 2012 and first two quarters of 2013, a slight growth of NPL can be seen, but due to a high level of the banks reserving for those purposes and according to international standards and domestic regulations, stability of the banking sector is not jeopardized.

In order to make the portfolio management processes more effective, a review of policies for lending and underwriting criteria need to be performed as well, in a longer time stretch. Before implementing any proposed changes to policies or standards, management need to take into consideration their potential effect on risk tolerance limits, the complete risk profile of the bank, and the bank's ability to meet its portfolio objectives.

REFERENCES

Chava, S., Purnanandam, A. (2011).The effect of banking crisis on bank-dependent borrowers, Journal of Financial Economics, 99 (1): 116–135

Ćirović, M. (1995). Bankarski menadžment, Ekonomski institut, Beograd

Đukić, Đ. (2011). Upravljanje rizicima i kapitalom u bankama, Ekonomski fakultet, Beograd

Fiordelisi, F., Salvatore Mare, D. (2014). Competition and Financial Stability in European Cooperative Banks, Journal of International Money and Finance: 45, 1–16

Horne, J.C., Wachowicz Jr, J.M. (2007). Osnovi finansijskog menadžmenta, Data status, Beograd

National bank of Serbia (2013). Decision on Risk Management by Banks, Službeni glasnik RS, Beograd, No. 92/2013, retrieved from http://www.nbs.rs/export/sites/default/internet/latinica/20/kpb/upravljanje_rizicima.pdf, 20.03.2014.

National bank of Serbia (2013). Decision on the Classification of Bank Balance Sheet Assets and Off-balance Sheet Items, Službeni glasnik RS, Beograd, No 113/2013, retrieved from http://www.nbs.rs/export/sites/default/internet/latinica/20/kpb/klasifikacija_bilansne_aktive.pdf, 20.03.2014.

National bank of Serbia (2014). Banking sector in Serbia, Second Quarter Report 2013, retrieved from http://www.nbs.rs/export/sites/default/internet/latinica/55/55_4/kvartalni_izvestaj_II_13.pdf, 15.03.2014.

Neuberger, D. (1995). Diversification, collateral and economies of scale in banking: lessons from a continuous-time portfolio approach, International Review of Economics & Finance 4 (3): 253–265

Rose, P., Hudgins, S. (2005). Bankarski menadžment i finansijske usluge, Data status, Beograd

Vunjak, N., Kovačević, Lj. (2011). Bankarstvo - bankarski menadžment, Ekonomski fakultet, Subotica

SELECTION OF UNIVERSAL SERVICE FINANCING MODEL USING FUZZY MCDM

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Abstract: *In this paper has been considered sustainability of the universal service in postal traffic. We analyzed certain models of financing and introduced fuzzy MCDM method for the selection of an appropriate financing model. After analyzing we adopted a regional approach to funding and shown an example of the application of the proposed model, implemented in the appropriate region.*

Keywords: *universal service, postal sector, MCDM, AHP, fuzzy, TOPSIS*

1. PROBLEM OF SUSTAINABILITY OF UNIVERSAL SERVICE

Number of competitors in the postal sector has increased. Based on the available empirical research, there is an increase of courier, express and parcel services (CEP services), while classic postal services stagnate or even decline (Dieke et al., 2013). Competition to public postal operator is most common in CEP services, and rarely in the field of universal service and the consequence is a decline in revenue for public operator. On public postal operator has also been imposed an obligation of providing universal service throughout the entire state territory. The concept of universal service corresponds to a set of postal services of a defined quality, the provision of which is ensured by the state laws at all points of the territory at affordable prices (Directive 97/67/EC, Directive 2002/39/EC, Directive 2008/6/EC).

The question that occurs in many countries is whether it is possible to further liberalize the postal market, increase efficiency and reduce the required additional financing of universal service, and provide reliable service to the entire population and the economy? Another question that arises is: how will the existing implemented strategy of providing universal services affect the economic development of the society and whether it will support balanced development of all regions in a country?

A considerable amount of research was conducted in order to analyze trends in the provision of the universal postal service (Gautier and Paolini, 2010; Jaag and Trinkner, 2011; Gautier and Wauthy, 2010; Jaag, Trinkner, Lisle, Waghe and Van Der Merwe, 2011). Results of these researches speak about the problems in the full opening of the postal service. From these studies it can be concluded that for the purposes of providing the universal service, there is a use of the methodology and methods of providing universal service in other sectors (telecommunications, electric distribution, etc...). The problem of providing reliable and efficient universal postal service and the implementation of the strategy, which will ensure this, is a challenge of great social importance. However, stated social significance is not in proportion to the existing research in this area. In many countries, there is no systematic approach to solving this problem. Greater importance is given to other forms of communication (telecommunications, information society, etc.).

Countries that have defined the strategy of postal services used their own experiences in other industries and sectors of the economy, as well as the experiences of neighboring countries that are also acceded to resolve this issue. In order to facilitate the provision of universal services in the whole territory, there was a conscious discrimination of customers in highly profitable areas, in respect to those in low profit areas. Unique service price on entire territory for some meant punishment, and for others meant prize. In addition, reserved universal postal service area that is accepted as a form of financing of universal service, prevents the entry of other postal operators into this segment which may be more effective, and public operator is not motivated to increase efficiency not having any competition.

Having that in mind, it is obvious that some essential questions about the strategy of providing universal postal services haven't been answered. Some of these issues should be reviewed and implemented a new approach to solving the problem of providing universal postal services and defining the strategy of providing.

During the evaluation of problems related to the provision of universal service experts are faced with imprecision, which may in some cases be too high compared to the value of the error that can be tolerated.

The decisions that needs to be adopted in solving real problem, inevitably includes consideration of material based on several criteria rather than considering only one dominant criteria. In order to overcome these difficulties methods of MCDM (multi-criteria decision making) can be applied. They were developed with the aim to set global preferences between the options, that is, to make the final decision based on the output ranking of alternatives (Mehmet Kabak, 2012). In this regard, the work relies on MCDM theory to facilitate the decision making process when choosing the model of financing the universal postal service. Taking into account that estimates of the parameters can be associated with uncertainty, subjectivity, imprecision and ambiguity the process of their evaluation is suitable for fuzzy analyzes (Teodorović, 1999).

Next part of the paper is structured as follows: the description of different models of funding universal service, the framework for their evaluation and proposition of the methodology.

2. MODELS OF FINANCING

Levels and methods of financing the universal postal service, is mainly determined by political factors, but cost estimates and defining the method for calculating is the job of regulatory bodies. There are different models in the approach to financing the universal postal service. This paper will discuss: Restricted area, compensation fund, pay or play, and financing through additional activities.

Reserved area of service is a specific segment of the national postal market over which the universal service operator holds the exclusive franchise as a base of effective, sustainable system of financing of this public service whose provision is guaranteed by the government. This reserved area must be accurately described in terms of three basic elements: type of service, mass of the shipment and protective prices. In establishing the reserved service area, the state decide what kind of postal services will be performed solely and exclusively by the public postal operator. The scope of services to be reserved depends on the needs of countries for providing postal service in accordance with the requirements of the Universal Postal Union. According to the directives of the European Commission, which are binding on all member states, as well as candidates for entry into the European Union, only letterpost services can be reserved for one operator (Directive 97/67/EC, Directive 2002/39/EC, Directive 2008/6/EC). The scope of the area in terms of weight of items varies depending on the maturity of the postal market and the level of development of the universal service operator. Without exception, the range of these variations is inversely proportional to the level of development of the postal operator and the maturity of the postal market. Terms of performing services in the postal market demand protection of services prices reserved for the universal service operator to ensure effective exercise of the right to that part of the market and minimize its vulnerability to unfair competition and predatory price setting by other postal operators. Regulations describing the reserved area, must establish certain minimum price of postal services to private operators or any other operators except the universal service operator.

Compensation funds in the postal sector are often discussed, but the possibility of their practical applications are limited. Questions that always arise when establishing any compensation fund, and which have the greatest impact on analysis through the established evaluation criteria are:

- Who should fill the fund and how to determine the amount of contributions,
- How to define the tax base (the amount of contribution) in order to collect enough funds to cover all costs incurred by the provision of universal service, while at the same time cause minimal distortion to the postal and the global market.

Way to fill the compensation fund can be made through: income tax, profit tax,"Lump-sum" taxation, the unit tax on each service (shipment) and so on.

Pay or Play is one of the more sophisticated models of financing universal service, which combines the question of how to finance the service and who should provide universal service. This approach has the same starting position as well as models of compensation funds in accordance with the requirements of financing and provision of universal services in sectors with high fixed costs and average price levels. Operators that operate exclusively in highly profitable sectors (low cost / high volume services) are required to pay additional benefits in the compensation fund. However, unlike traditional funds, where there is determined only one operator that provides universal service, and thus acquire the right to dispose of the entire fund, this model gives the right to every operator in the market to decide whether to provide universal service (" Play") or fill the fund (" Pay").

Financing through additional activities in development programs is related to the financing of universal service, with the revenue from the additional activities of the public operator, through participation in regional development and the information society. This model would involve a public operator and several private operators in the area where the monopoly, as a reserved area, is abolished. Universal service would be financed from additional activities, that is, with the increase of efficiency and profitability of the public operator.

3. EVALUATION FRAMEWORK AND METHOD

A method of selection of the optimal model consists of several steps (Figure 1). First of all it is necessary to define the characteristics that form prism through which each of the proposed models will be seen. Application of the AHP method will determine the weight coefficients which are conditioned by the characteristics of the observed area. Assessment of achievement of each criterion in the application of a particular model is realized by fuzzy sets theory, where is obtained a universal matrix of contribution of each criteria with respect to the discussed model which is applied to each area. The final step is the application of TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) by which the selection of the most appropriate method of financing the universal service is made.

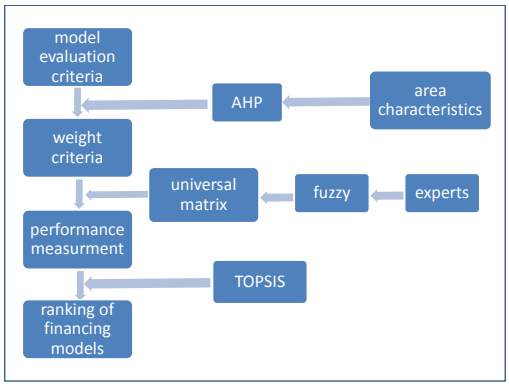

Figure 1: The process of selecting models of financing

3.1 Criteria for model evaluation

Models of financing the universal service may jeopardize the survival and development of operators in a given market. Models should provide contributions for public operators to compensate for the provision of universal service, allowing market entrance for the efficient, competitive operators and preventing the entry of inefficient operators. Operators should evenly divide the obligations arising from the necessity of providing universal service. Funding model should be" well-balanced" that is, to meet the criteria of **fair competition**.

The criterion of social equality, in practice, is a normative concept which determines criteria and assesses which sectors of society need to be more privileged compared to others in terms of the postal service. This assessment is performed mainly in relation to universal service. Criteria should answer the question of whether financing model ensures that strata of society similar economic power get universal service at approximately same prices.

Any of the financing models, may it be the least reliant on financial support from the state, **must comply with national and other positive regulations of the financial sector.** This primarily relates to the compensation fund, which is filled with general or special taxation, and whose resources the state uses to subsidize universal service. Any transfer of state resources, direct or indirect, which provides certain competitive advantages to the recipient or lead to disorder in the liberalized market, is considered to be unlawful government act. This does not mean that any financial help from the state to the provider of universal service will be construed as an illegal intervention.

Calculation must be **transparent** in order to avoid favoring the recipient in relation to its competitors. The compensation should cover only the most basic expenses incurred by the provision of universal service, in special cases can be considered a minimum profit of the operator. When the selection of public operator is not made through public procurement procedure, the level of compensation must be determined by analyzing the costs that would theoretically occur in the case of efficient service delivery. From the perspective of this criterion, the principle of operation of the model of financing should be available and clear

to all market participants. All participants should be able to understand the way in which amount of compensation is determined, who pays contributions for financing the universal service and the way in which those contributions are set. Also, information on the establishment of the fund and entities who have established it must be available, and then how to access the resources of the fund and the availability of specific operators in a given time to have access to the fund. All participants, if they wish, must be provided with the opportunity to meet the requirements for funding from the fund. All this information must be verified and published.

Collection of contributions to small operators reduces the possibility of new entrants to the market, and in the long run leads to its polarization and negative consequences for users. Accordingly, European Commission has put forward a proposal that in case of covering all the costs of providing universal service with funds collected from contributions of other operators, perform the allocation of contributions. Collecting contributions should be non-discriminatory and based on the **principle of proportionality**, and if there is no higher level of market presence, small operators should be freed of this obligation. Proportionality means that the given model of funding achieved a reasonable balance between the projected goals and objectives of the global market. It needs to be ensured that the model minimally affects other market mechanisms and introduces minimal distortion in the global economic plan.

Feasibility is determined by the complexity of financial schemes and information necessary for their establishment and management. Complex mechanisms with complicated procedures of implementation and exploitation require greater funding at practical use and there is increased uncertainty about achieving the projected goals. This criterion has a direct impact on the transparency, in terms of easier or more difficult access to information relating to the current situation and progress in terms of achieving the objectives of the designed model of financing.

Sustainability is key criterion for achieving the minimum cost of establishing a specific financing model. The main aspect of this criterion is that the model, first of all need to act on clearly defined objectives to be achieved. Every action in the framework of the model is to provide a sustainable universal service.

Reliable financing model is one that ensures the long term sustainability of the universal service. The mechanism that provides long-term security financing is much more convenient than those with short and unpredictable financial arrangements. It is important that the model is based on economic principles.

Implementation of a financing model should provide minimal distortion of economic efficiency and increase profit of the operator. In practice, there are three main aspects that can support the concept of efficiency: **allocative, productive and dynamic** efficiency. Financing models that promote redistribution allows operators to raise prices to the level of service that will reflect the cost of providing service, including a reasonable profit based on invested funds. Despite the fact that allocative efficiency is directly contrary to the recognized principles of universal service operators, particularly those large, are increasingly trying to prove its necessity. Production efficiency is based on the obligation of the operator to provide services at the lowest possible cost, with the optimum use of all available technological resources. In this context, financing mechanisms should provide incentives in procurement and implementation of optimal technologies, which will enable full utilization of potential at an acceptable cost. The model should also facilitate the selection of optimal operator which will be entrusted with the provision of the universal service and thus avoid the increase of fixed costs of service. Dynamic efficiency refers to facilitate innovative process, which leads to the development of completely new and enhanced services. The advantage of the dynamic efficiency is in the possibilities of development of universal service based on the applied mechanism, through new ways of providing services or the introduction of entirely new services.

3.2 Analytic Hierarchy Process (AHP)

Analytical Hierarchy Process is a systemic procedure for determining the relative importance of a set of activities or of criteria (Kujačić, 2002). The approach is based on three main components. The first is defined in the request of necessity to decompose the problem into a hierarchical structure. The second component relates to the measurement scale expressing the priorities in the elements (Saaty, 1986).
Dependence of criteria and sub-criteria on the alternatives and mutual dependence of criteria is formed by a matrix whose values are defined by a numerical (1 through 9) or semantic scale. The third component is to define the measurement mechanism for setting priorities in the hierarchy and consistency of assessments provided by experts. Calculating the priority is reduced to the determination of the appropriate vector of weight coefficients.

3.3 The theory of fuzzy sets

A small piece of information about a particular problem can be seen as certain, or deterministic. Problem of uncertainty that arises in information can lead to deceiving if the blur of human decision-making is not taken into account. Fuzzy set theory provides a mathematical basis for the representation of ambiguity and vagueness in human systems (Ross, 2004). Starting from the development of the theory of fuzzy sets (Zadeh 1965), a large number of papers deal with the problem of uncertainty in decision-making based on the theory of fuzzy sets. In this direction, this paper endeavors to encompass fuzzy subjective assessment of experts in terms of the financing model for the universal service.

Fuzzy numbers can be regarded as a generalization of the concept of trust (Teodorović and Šelimć, 2012). That is every fuzzy number can be specified with confidence interval and affiliations functions. Under the term fuzzy numbers is considered to be limited, convex and normalized fuzzy set (Dubois and Prade, 1978). The statement of the extent to which it met certain criteria as linguistic variables (eg, part ") can be represented by triangular fuzzy numbers in the range of 0-5. Triangular fuzzy number can be defined as a triple (a, b, c) (Fig. 2), where the affiliations function is defined as follows (Zimmermann, 1991):

(1)

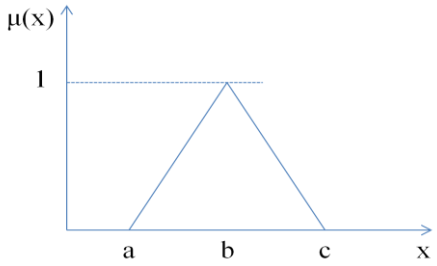

Figure 2: Triangular fuzzy number

Algebraic operations on triangular fuzzy numbers can be defined by means of arranged triplets:

$$(a1,b1,c1) \oplus (a2,b2,c2)=(a1+a2,b1+b2,c1+c2) \quad (2)$$

$$(a1,b1,c1) \quad (a2,b2,c2)=(a1-a2,b1-b2,c1-c2) \quad (3)$$

$$K \quad (a,b,c)=(Ka,Kb,Kc) \quad (4)$$

The concept of linguistic variable is very useful for dealing with situations that are too complex or ill-defined to describe understandably conventional quantitative expressions (Deng Yong and Chan, 2011). Each of these variables can be associated with affiliate function. In this paper, we used expressions in terms of the degree of achievement of the observed criteria: “unrealized”, “poorly realized”, “medium realized”, “very realized”, “and fully realized”. Experts were asked to give their opinion and each linguistic variable is demonstrate triangular fuzzy numbers in the range of 0 to 5 In order to provide a more objective evaluation of the fuzzy assessment, there was a aggregation of linguistic variables LV_{ij} alternative A_i for criterion C_j based on the expression:

$$LV_{ij} = (a,b,c) = \left(\frac{1}{n}\right) \otimes (LV_{ij}^1 \oplus LV_{ij}^2 \oplus ... LV_{ij}^n) = \left(\frac{\sum_{i=1}^{n} a_i + \sum_{i}^{n} b_i + \sum_{i}^{n} c_i}{n} \right). \quad (5)$$

Equation (5) shows that the average performance can be expressed in the form of a new triangular fuzzy numbers (Buckely 1985). As the result of the synthesis is a new fuzzy number, it is necessary to realize defuzzification (a technique of converting fuzzy numbers into solid real numbers). Defuzzification procedure is positioning the BNP (Best Nonfuzzy Performance) value. Many defuzzification techniques are available (Zimmermann, 1991), but the common defuzzification methods include the center of area, first of maximums, last of maximums, and middle of maximums (MoM). This paper used Center of Area method taking into account ease of use, where defuzzification value can be obtained:

$$BNP_{ij} = (c_{ij} - a_{ij}) + (c_{ij} - a_{ij}) / 3 + a_{ij} \qquad \forall i, j. \quad (6)$$

3.4 TOPSIS

Technique for order performance by similarity to ideal solution (TOPSIS), was first developed by Hwang and Yoon (1981) for solving a MCDM problem. It is based on the selection of the optimal alternative that is closest to the positive ideal solution and farthest from the negative ideal solution. An ideal solution is composed of all best values attainable of criteria, whereas a negative ideal solution is made up of all worst values attainable of criteria. Take the objective space of the two criteria as example which is indicated in (Figure 3.), A^+ and A^- are, respectively, the ideal solution and negative ideal solution, and observation A_1 is shorter in distance in regard to the ideal solution (A^+) and negative ideal solution (A^-) than A_2. As a matter of fact, the ups and downs of these two observations regarding to ideal solutions cannot be compared because there exists some tradeoff between the ups and downs. However, TOPSIS can help resolving this problem because it has defined such „relative closeness" so as to consider and correlate, as a whole, the distance to the ideal solution and the negative ideal solution.

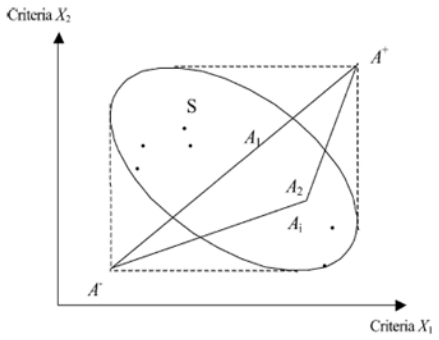

Figure 3: Position A1 and A2 with respect to the ideal and the negative ideal solution

The process of calculation is carried out through the following stages:

- forming normalized performance matrix,
- forming weighted normalized matrix by multiplying weight coefficients and criteria:

$$V_{ij} = w_{ij} \times r_{ij} \qquad \forall i, j. \tag{7}$$

where w_{ij} is the weight of criterion j, and r_{ij} normalized value of the j-th performance criteria for the i-th alternative;

- determining the ideal solution:

$$A^+ = \left\{ \max V_{ij} \middle| j \in J \right), \left(\min V_{ij} \middle| j \in J' \right), i = 1,2,\ldots,m \right\} \tag{8}$$

- determining the ideal negative solution:

$$A^- = \left\{ \min V_{ij} \middle| j \in J \right), \left(\max V_{ij} \middle| j \in J' \right), i = 1,2,\ldots,m \right\} \tag{9}$$

where J is associated with the benefits of the criteria, and J 'from the cost criterion,

- calculating the distance between the ideal and the negative ideal solution of each alternative.

$$S_i^+ = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - V_j^+ \right)^2} \qquad i = 1,2,\ldots,n, \tag{10}$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - V_j^- \right)^2} \qquad i = 1,2,\ldots,n, \tag{11}$$

- calculating the relative proximity of each alternative to the ideal solution:

$$R_i = \frac{S_i^-}{S_i^+ + S_i^-} \qquad i = 1,2,\ldots,n, \tag{12}$$

- ranking of alternatives in descending order R_i.

4. METHOD OF SELECTION OF PROPOSED MODELS ON A PARTICULAR AREA

Taking into account the diversity of various regions within one country, there is a need for special consideration of each of them in terms of defining the method of financing the universal service. Therefore it is necessary to observe the territorial units established by NUTS 2 standard. In each of these units observed, depending on the characteristics of the postal market and the aim sought to be achieved by the regulatory body, weights of the criteria are set for the evaluation of certain alternatives of financing the Universal Service. The determination of these weights is carried out by AHP method. The core of the system is a performance matrix for specific criteria by proposed alternative models of financing. Values of matrices are obtained on the basis of questionnaires filled by experts for financing models. The survey was conducted over 10 experts. The experts were asked to assess the realization of each criterion, via linguistic variables which are expressed by triangular fuzzy numbers in the range of 0-5. The possible values of these variables are: “unrealized”, “poorly realized”, “medium realized”, “very realized”, “and fully realized”. From the obtained fuzzy numbers, by applying BNP, we get defuzzicated values. Ranking of values is made by implementing TOPSIS, and then the selection of the financing model most similar to the ideal solution is made.

We will observe the territory of the Republic of Serbia. In accordance with the NUTS 2 standardization and looking at the highest concentration of competition we decided to consider the statistical region of Belgrade. Looking at the characteristics of the observed area weight coefficients of the criteria defined on the basis of AHP are: fair competition – 0.15, social equality - 0.1, compliance with state aid rules - 0.1, transparency - 0.1, proportionality - 0.1, feasibility - 0.05, reliability - 0.05, allocative efficiency - 0.1, productive efficiency - 0.1, dynamic efficiency - 0.1. Results of testing experts analyzed on the basis of equation (5) are given in Table 1. After measuring performance in the form of fuzzy numbers, made their defuzzification using the Center of Area (equation (6), so that it could be applied TOPSIS the procedure of ranking (Table 3).

Table 1: Fuzzy performance of financing model

criteria / alternatives	Reserved area	Compensation fund	“pay or play”	Additional funding
Fair competition	(1.81, 2.21, 2.47)	(3.90, 4.23, 4.58)	(3.52, 4.29, 4.7)	(3.91, 4.18, 4.24)
Social equality	(3.63, 3.93, 4.24)	(3.09, 4.06, 4.75)	(4.72, 4.84, 4.95)	(4.54, 4.63, 4.69)
Compliance with state aid rules	(4.75, 4.91, 4.94)	(4.49, 4.87, 4.96)	(4.15, 4.53, 4.76)	(3.97, 4.01, 4.06)
Transparency	(2.95, 3.12, 3.72)	(1.48, 2.39, 2.54)	(2.8, 2.94, 3.03)	(2.04, 2.9, 3.19)
Proportionality	(2.42, 2.87, 3.18)	(1.91, 2.40, 2.57)	(2.79, 3.16, 3.22)	(2.95, 3.37, 3.5)
Feasibility	(4.57, 4.68, 4.73)	(2.03, 3.39, 3.57)	(2.84, 3.22, 3.91)	(3.93, 4.27, 4.40)
Reliability	(4.67, 4.72, 4.87)	(2.75, 3.24, 3.77)	(2.74, 3.08, 3.31)	(3.39, 3.92, 4.12)
Allocative efficiency	(2.62, 3.31, 3.55)	(2.17, 2.89, 3.12)	(3.7, 4.34, 4.6)	(3.03, 3.48, 4.18)
Productive efficiency	(2.27, 3.20, 3.69)	(2.04, 2.48, 2.62)	(4.09, 4.38, 4.71)	(4.35, 4.43, 4.82)
Dynamic efficiency	(1.69, 2.12, 2.48)	(1.31, 2.40, 2.71)	(4.42, 4.68, 4.95)	(4.05, 4.21, 4.44)

Table 2: Overall performance measures of financing models

criteria / alternatives	Reserved area	Compensation fund	“pay or play”	Additional funding
Fair competition	2.13	4.24	4.17	4.11
Social equality	3.94	3.97	4.84	4.62
Compliance with state aid rules	4.87	4.77	4.48	4.01
Transparency	3.26	2.14	2.92	2.71
Proportionality	2.82	2.29	3.06	3.27
Feasibility	4.66	3.00	3.32	4.20
Reliability	4.75	3.25	3.04	3.81
Allocative efficiency	3.17	2.73	4.21	3.56
Productive efficiency	3.05	2.38	4.39	4.53
Dynamic efficiency	2.10	2.14	4.68	4.23

Table 3: Ranking of financing models

Rang	Model	The similarity to the ideal solution
1	“pay or play”	0.8047
2	Additional funding	0.7655
3	Compensation fund	0.4144
4	Reserved area	0.3299

5. CONCLUSION

The problem of financing the universal postal service captures the attention of the postal sector for many years. One of the basic principles underlying the role of postal services is facing the issue of sustainability, as profitability of postal system is becoming more and more basic benchmark in successful functioning. Past experience has shown that this business segment is unattractive for operators that have emerged from the market liberalization, so public postal operators have taken this responsibility. The reason for this may be sought in the financing model that is administered on the whole territory of the state.

Different characteristics of each region within the state should be considered in order to establish appropriate mechanisms to encourage other operators to take an active role in the provision of universal service. On the model that we presented, we came to the conclusion that the most appropriate model for the observed region is “pay or play”, while a reserved area that is currently in force took the last place in relation to the considered models of financing.

REFERENCES

Buckley, J. J. (1985). Ranking alternatives. Using fuzzy numbers. FuzzySets and Systems, 15(1), 21–31.

Deng, Y., & Chan, F. T. (2011). A new fuzzy dempster MCDM method and its application in supplier selection. Expert Systems with Applications, 38(8), 9854-9861.

Dieke, A. K., Bender, C., Campbell Jr, J. I., Cohen, R. H., Müller, C., Niederprüm, A., de Streel, A., Thiele, S., & Zanker, C. (2013). Main Developments in the Postal Sector (2010-2013). Bad Honnef: WIK Consulting.

Directive 97/67/EC of the European Parliament and of the Council of 15 December 1997.

Directive 2002/39/EC of the European Parliament and of the Council of 10 June 2002.

Directive 2008/6/EC of the European Parliament and of the Council of 20 February 2008.

Dubois, D., & Prade, H. (1978). Operations on fuzzy number,International Journal of System Science, 9(6), 613–626.

Gautier, A., & Paolini, D. (2010). Universal service financing in competitive postal markets: One size does not fit all. In Sixth conference on regulation, competition and universal service in the postal sector, Toulouse.

Gautier, A., & Wauthy, X. (2010). Price competition under universal service obligations. International Journal of Economic Theory, 6(3), 311-326.

Hwang, C. L., Yoon, K. (1981). Multiple Attributes Decision Making Methods and Applications, Springer, Berlin Heidelberg.

Jaag, C., & Trinkner, U. (2011). The interaction between universal service costing and financing in the postal sector: a calibrated approach. Journal of regulatory economics, 39(1), 89-110.

Jaag, C., Trinkner, U., Lisle, J., Waghe, N., & Van Der Merwe, E. (2011). Practical approaches to USO costing and financing. Competition and Regulation in Network Industries, 12(2), 108-129.

Kabak, M., Burmaoğlu, S., & Kazançoğlu, Y. (2012). A fuzzy hybrid MCDM approach for professional selection. Expert Systems with Applications, 39(3), 3516-3525.

Kujačić, M. (2002), Primena analitičkog mrežnog procesa u projektovanju organizacije poštanskog saobraćaja, Saobraćajni fakultet, Beograd

Oxera Consulting Ltd (2007) Funding universal service obligations in the postal sector- Prepared for La Poste, De Post-La Poste, Hellenic Post, Poste Italiane, P&T Luxembourg, Correos, Magyar Posta, Cyprus Post, Poczta Polska.

Price Waterhouse Coopers (2006) The Impact on Universal Service of the Full Market Accomplishment of the Postal Internal Market in 2009, report to the European Commission.

Ross, T. J. (2009). Fuzzy logic with engineering applications. John Wiley & Sons.

Saaty, T. L. (1986). Axiomatic Foundation of the Analytic Hierarchy Process. Management Science, 32, 841-855.

Teodorović, D. (1999). Fuzzy logic systems for transportation engineering: the state of the art. Transportation Research Part A: Policy and Practice, 33(5), 337-364.

Teodorović D., Šelmić M. (2012) Računarska inteligencija u saobraćaju. Saobraćajni fakultet, Beograd.

Tsaur, S. H., Chang, T. Y., & Yen, C. H. (2002). The evaluation of airline service quality by fuzzy MCDM. Tourism management, 23(2), 107-115.

Zadeh, L. A. (1965). Fuzzy sets. Information and control, 8(3), 338-353.

Zimmermann, H. J. (1991). Fuzzy set theory and its applications. Boston: Kluwer Academic Publishers

COMPARISON OF MOVING AVERAGES FOR TRADING TRENDS: THE CASE OF THE BELGRADE STOCK EXCHANGE

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Abstract: *This study examines the comparative performance of Simple Moving Average (SMA), Linear Weighted Moving Average (LWMA), Exponential Moving Average (EMA) and Kaufman Adaptive Moving Average (KAMA). These moving averages are incorporated into the basic trend following trading system and tested on the BELEX15 stock components. Testing different values of the lag parameter showed that increase in its value leads to the increase in the profitability of trading strategy. Unexpectedly, LWMA performed the best, while KAMA performed the worst.*

Keywords*: Technical analysis; moving average; trading system.*

1. INTRODUCTION

With the development of technology, computer aided and technical trading systems become widely used by professional traders worldwide. Nowadays, there are numerous automatic trading systems in financial markets and many of them are using some kind of technical trading. The basics of technical trading are set by academicians in the sixties when Alexander (1964) and Fama & Blume (1966) dispute the ability of technical trading systems to produce excess returns. This opened wide academic discussions with the participation of many authors. Later studies, including Brock et al. (1992), LeBaron (1999), Ellis & Parbery (2005) and Metghalchi et al. (2012) and many others demonstrate various trading systems capable of outperforming the market.

This study examines the comparative performance of Simple Moving Average (SMA), Linear Weighted Moving Average (LWMA), Exponential Moving Average (EMA) and Kaufman Adaptive Moving Average (KAMA) on BELEX15 market index components. The observed moving averages are used as the models of trend within a basic trend following system. Different values of the lag parameter are tested for all four types of moving averages. Return on investment (ROI) is used to measure profitability of the trading system. The proposed trading system is run on all BELEX15 stock components and resulting ROI values are averaged to get overall results for each of the observed moving averages. These results are benchmarked to the “Buy and hold” strategy.

The remainder of the paper is structured as follows. Section 2 reviews moving average models used in this paper. In Section 3 the basic trend following trading system is presented. It is used for the purpose of testing moving average models from Section 2. Section 4 gives a detailed description of data and experimental settings. Further, the results are presented along with the corresponding discussion. Finally, Section 5 concludes the paper.

2. MOVING AVERAGES

There are several purposes in regard to trading that Moving Averages (MA) serve. A Moving Average is a good way to gauge momentum as well as to confirm trends, and define areas of support and resistance. Also, Moving Averages form the basis of several other well-known technical analysis tools such as Bollinger Bands and the MACD. One of the most important roles that the Moving Averages play in trading is a form of lagging (or reactive) indicator, which plots average asset prices over time. The main idea is to smooth the curve of points given by the close prices.

There are lots of types of Moving Averages which all take the same basic premise and add a variation. Most notable are the Simple Moving Average (SMA), which is the simple average of a security over a defined number of time periods, and the exponential moving average (EMA), which gives bigger weight to more recent prices exponentially. Also, widely used moving averages are the Linear Weighted Moving Average (LWMA), which gives bigger weight to more recent prices linearly, and Kaufman Adaptive Moving Average

(KAMA), which was created by Perry J. Kaufman (1995) and takes into consideration not only the direction, but also the market volatility.

2.1 The Simple Moving Average (SMA)

The Simple Moving Average (SMA) is arguably one of the oldest and the most popular of all technical indicators. Its rule is one of the most widely used technical trading rules by investors to analyze the stock and eventually strive to outperform the stock market. Technically, SMA is represented by the equation:

$$SMA_n = \frac{1}{n} \sum_{t=k-n+1}^{k} P_t \tag{1}$$

In equation 1 the number of periods included in the average is marked as argument n, the relative position of the period currently being considered within the total number of periods is marked as argument k, and P_t is the price at time t. SMA is also known as just “moving average”, “weighted moving average (WMA)” or as an “arithmetic average” because each price in the data series is equally weighted. In other words, Simple Moving Average (SMA) is calculated when you divide the sum of the prices for the past n days by the number of days (n days). There are no weighting factors applied to any of the data points, but one of the possibilities for improving SMA is weighting more heavily the market’s most recent behavior and so incurred other moving averages.

2.2 The Linear Weighted Moving Average (LWMA)

Linear Weighted Moving Average (LWMA) is used to smooth out price and volume fluctuations ("noise") that can confuse interpretation to emphasize the direction of a trend in a very specific way. Similarly to the EMA, the main idea of the Linear Weighted Moving Average (LWMA) is to apply more weight to the most recent price data, but there is a difference in weighting prices. In LWMA there is a less contrast between the weighting of earlier and more recent prices than in the EMA. The popularity of this moving average has been diminished by the exponential moving average, but none the less it still proves to be very useful. LWMA is given by the formula:

$$LWMA_k = \frac{\sum_{j=1}^{n} P_{k-n+j} \cdot j}{\sum_{j=1}^{n} j} \tag{4}$$

where k is the relative position of the period currently being considered within the total number of periods, n is the number of periods included in the average, $LWMA_k$ is the value of Linear Weighted Moving Average (LWMA) at time k, P_{k-n+j} is the price at time k-n+j. From this formula we can see that the oldest price included in the calculation receives a weighting of 1, the next oldest price receives a weighting of 2, and the next oldest price receives a weighting of 3, all the way up to the most recent price which receives a weighting of n (n is a number of periods).

The downside to using a weighted moving average is that the specific resulting average line could make it more difficult to discern a market trend from a fluctuation. For this reason, some traders prefer to place both a SMA and a LWMA on the same price chart. Though the linear WMA is more sensitive to trend changes than the simple moving average, it is less sensitive than the exponential moving average. Some traders find this method more relevant for trend determination, especially in a fast-moving market. LWMA is also called just “Weighted Moving Average (WMA)”.

2.3 The Exponential Moving Average (EMA)

As well as for all moving averages, the basis for Exponential Moving Average (EMA) is Simple Moving Average (SMA). There are two main differences between EMA and SMA:

- calculation method,
- the way that prices are weighted.

Calculation of the EMA is a little more complex than the calculation of the SMA, but in the age of computers it is facilitated considerably. EMA is represented by the equation:

$$EMA_k = P_k \cdot p + EMA_{k-1} \cdot (1 - p) \tag{2}$$

where k is the relative position of the period currently being considered within the total number of periods, $EMA_k$and EMA_{k-1} are the values of Exponential Moving Average at time k and k-1, respectively, P_k is the price at time k, and p is weighting multiplier.

For the construction of the EMA we have to calculate weighted multiplier p given by the formula:

$$p = \frac{2}{n+1} \tag{3}$$

where n is the number of periods included in the average. Weighting multiplier p is also known as “smoothing factor”, and limiting values of weighting multiplier are $0 < p < 1$.

Obviously, EMA has to start somewhere and for calculation of the first EMA (EMA_{n-1}, where n is the number of periods) we can use price value at that time, simple moving average, some other type of moving average, etc. According to Boylan and Johnston (2003), the best solution is to use an adequate SMA (SMA_{n-1}). That's because EMA needs a previous value and thus we need to start somewhere.

Essentially, EMA is a weighted moving average. The theory is that more recent prices are considered to be more important than older prices. So, the weighting is such that the recent days' prices are given more weight than older prices and that’s the reason why EMA reacts faster to recent price changes than a SMA. The Exponential Moving Average (EMA) is also known as "Exponentially Weighted Moving Average (EWMA)".

2.4 Kaufman Adaptive Moving Average (KAMA)

One of the most used types of all adaptive moving averages is Kaufman Adaptive Moving Average (KAMA), which was created by Perry Kaufman (1995) and first presented in his book Smarter Trading. He wanted to overcome two key shortcomings of different smoothing algorithms for financial time series:

- accidental price leaps can result in the appearance of false trend signals,
- smoothing leads to the unavoidable lag in predicting the trends.

Adaptive Moving Average (KAMA) is represented by the equation:

$$KAMA_t = P_t \cdot C_t + KAMA_{t-1}(1 - C_t). \tag{5}$$

The formula for KAMA is similar to the formula for the EMA, but the difference is that instead of weighting multiplier p Kaufman proposed smoothing constant C_t . In equation 5 the current (at time t) value of the KAMA is marked as argument $KAMA_t$, value of the KAMA in the previous period (at time t-1) is marked as argument $KAMA_{t-1}$, P_t is the price at time t, and C_t is smoothing constant.

Smoothing constant C_t is calculated every day as:

$$C_t = sc \cdot sc = (sc)^2 \tag{6}$$

where sc is scaled smoothing constant, calculated as:

$$sc = ER_t \cdot fast\ sc + (1 - ER_t) \cdot slow\ sc. \tag{7}$$

In equation 7 fast sc and slow sc are represented by the same equation as weighting multiplier p in equation 3. Kaufman (1995) realized that weighting multiplier p should be adjusted both for fast and slow trend speed, and because of that he introduced fast and slow smoothing constants. He suggested that the number of days in the fastest and slowest applicable Simple Moving Average should be 2 and 30 days, respectively. For that matter, fast and slow smoothing constants will be 0.6667 and 0.0645, respectively. Of course, these parameters are usually optimized and adapted to the market under study.

ER_t given in equation 7 is Efficiency Ratio at time t. Kaufman (1995) wanted to make a mechanism that senses market speed and “chopines” and gives feedback to the moving average. Based on this moving average adjust the speed of its smoothing. Efficiency Ratio is represented by the equation:

$$ER_t = \frac{D_t}{V_t} \tag{8}$$

where ER_t is Efficiency Ratio at time t, D_t is momentum or the n-day change in price, and V_t is volatility or the sum of the absolute value of daily price changes. D_t is calculated as:

$$D_t = P_t - P_{t-n} \tag{9}$$

where P_t and P_{t-n} are prices at time t, and t-n, respectively. V_t is calculated as:

$$V_t = \sum_{i=1}^{n} |P_t - P_{t-i}| \tag{10}$$

where P_t and P_{t-i} Are prices at time t, and t-i, respectively.

In other words, Efficiency Ratio measures the strength of the trend. ER divides the net price movement by the total price movement. The first and one of the most important steps in the construction of the KAMA is an estimation of the Efficiency Ratio. The limiting values of the efficiency ratio are $0 \leq ER \leq 1$. When markets are very noisy for the current amount of direction and movements of the market are in a larger range $ER \to 0$. The opposite of that, when prices are highly directional and changing of price contain relatively little noise $ER \to 1$.

Essence of trend-following methods adapt to different market conditions, and that is the starting idea of all adaptive moving averages. KAMA seeks to adapt its behavior, according to the combination of market direction and speed by use of the Efficiency Ratio (ER). Kaufman (1995) noticed four characteristic types of market for research and the development of KAMA: runaway markets (with very fast speeds), fast markets (with fast speeds), congested markets (with very slow speeds) and middle-trends with some volatility (slightly faster sometimes). He based his adaptive moving average on a theory that slow (i.e. Long-length) moving average will be preferred when markets are ranging and fast (i.e. Short-length) will be preferred when market prices are trending.

3. TRADING SYSTEM

In all presented moving averages common parameter is price P, but it is not specified which price. For parameter price can be used any of open, high, low and close price or some kind of combination of them. In this research, we decided to use close price because, in this context, close price is the best solution for including most of the distributions and corporate actions that occurred at any time prior to the next day's open.

The length of the moving average is very important parameter suitable for discussion. It depends on the analytical objectives. For short-term trends and trading short moving averages (5-20 periods) are the best, for medium-term trends better are longer moving averages that might extend 20-60 periods, and long-term investors would opt moving averages with 100 or more periods. It is widely known that some moving average lengths are more popular than others. One of the most popular short-term moving averages is a 10-day moving average. The 50-day moving average is quite popular for the medium-term trend. Perchance one of the most popular moving averages is the 200-day moving average which is long-term moving average, because of its length. It is not new to combine shorter and longer moving average and many chartists use the 50-day and 200-day moving averages together. Length of moving average is, usually, optimized for a specific market.

There are a lot of strategies based on the moving average. One of the most popular is connected to the crossover because the crossover is the most basic type of signal and is favored among many traders because it removes all emotion. Regardless of that, we decided to use another moving average strategy because of the type of our research. Since our research is based on comparative analysis of different types of moving averages, we decided to use the same strategy for all presented moving averages:

- Open long position if moving average is rising
- Close long position if the moving average is dropping

The main idea of this research is to compare different moving averages using the same strategy and we consciously decided to use this, tentatively, simple strategy. Also, we decided to use a control strategy “Buy and hold” where an investor buys stocks and holds them until the end of the time series.

4. RESULTS AND DISCUSSION

In this section we will describe data used for research and experimental conditions and settings. After that, we will present the results that we obtained and discussion of the results.

4.1 Data

Our target market is the Belgrade Stock Exchange (BSE). BSE was established in 1894. and by many criteria is behind larger stock markets. Regardless of that, according to the latest ongoings Belgrade Stock Exchange might have a promising future. We consider a set of 14 major stocks of the Belgrade Stock Exchange, which make the most important index of the Belgrade Stock Exchange called BELEX15 (AERO, AIKB, ALFA, ENHL, FITO, GMON, IMLK, JESV, KMBN, MTLC, NIIS, SJPT, TGAS, VZAS). Index basket constituents on the last revision day 31.12.2013. Data used for research purposes includes volume, open, high, low and close price of mentioned stocks.

Table 1: Data used for research

Symbol	Company	Period start	Period end	Number of observations
AERO	Aerodrom Nikola Tesla a.d., Beograd	7.2.2011	31.12.2013	733
AIKB	AIK banka a.d., Niš	9.1.2006	31.12.2013	2014
ALFA	Alfa plam a.d., Vranje	9.1.2006	31.12.2013	2014
ENHL	Energoprojekt holding a.d., Beograd	9.1.2006	31.12.2013	2014
FITO	Galenika Fitofarmacija a.d., Zemun	9.1.2006	31.12.2013	2009
GMON	Goša montaža a.d., Velika Plana	7.5.2012	31.12.2013	422
IMLK	Imlek a.d., Beograd	9.1.2006	31.12.2013	2014
JESV	Jedinstvo a.d., Sevojno	10.8.2009	31.12.2013	1111
KMBN	Komercijalna banka a.d., Beograd	18.6.2006	31.12.2013	1836
MTLC	Metalac a.d., Gornji Milanovac	9.1.2006	31.12.2013	2014
NIIS	NIS a.d., Novi Sad	30.8.2010	31.12.2013	846
SJPT	Soja protein a.d., Bečej	9.1.2006	31.12.2013	2009
TGAS	Messer Tehnogas a.d., Beograd	9.1.2006	31.12.2013	2014
VZAS	Veterinarski zavod Subotica a.d., Subotica	28.2.2007	31.12.2013	1730

In Table 1, we present all stocks used for research with their basic information including company name, period start, period end and the number of observations.

4.2 Experimental Settings

Developed system has some experimental settings and conditions. The value of the of commission is set at 0,0065 , which is the actual commission on the Belgrade Stock Exchange (BSE), and the value of starting account is 1 000 000 RSD. Purchase transactions can be done once a day at the opening of trading at a price that was achieved in the opening. It is assumed that any volume that our system is able to trade is realizable at specified prices. If volume is zero, i.e. if there is no trade, our trading system does not do anything. Also, one of the restrictions is that shorting stocks is not possible.

4.3 Results and Discussion

For all mentioned moving averages number of periods included in the averages is optimized. Limiting values of the number of periods included in averages are 2 and 100 with intermediate steps of 1. Herewith we would like to include all three main types of moving averages (short-term, medium-term and long-term).

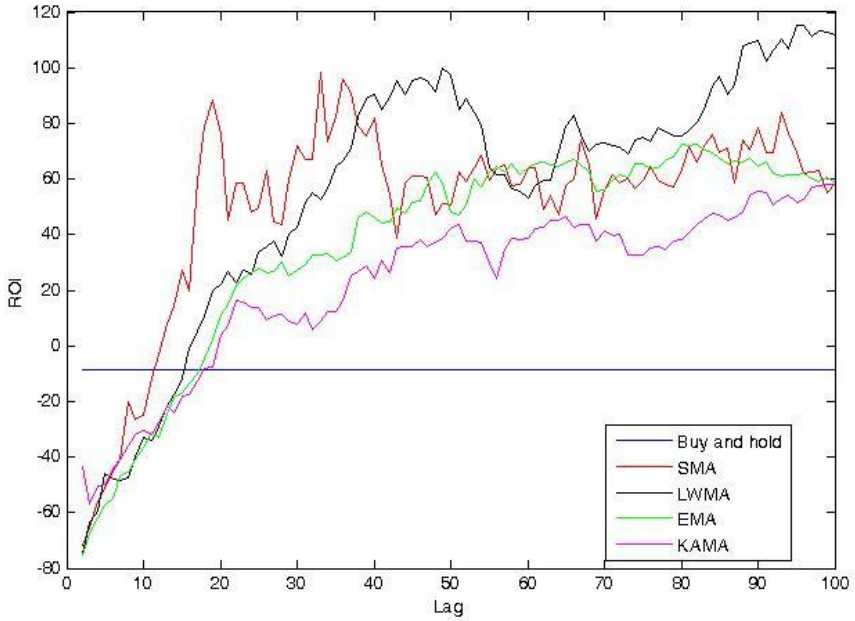

Figure 1: Comparison of moving averages with respect to average profitability (BELEX15)

In Figure 1 we present changing ROI depending on the lag, where ROI is return on investments and lag is optimized number of periods included in averages. ROI is, also, used to evaluate the efficiency of an investment and is given by the formula:

$$ROI = \frac{net\ profit}{investment} \cdot 100\% \tag{11}$$

We show ROI of all the moving averages compared with the ROI of control strategy “Buy and hold”. Generally, in this research Return on investment (ROI) is used as a ranking criterion.

It shows that the standard set of MA rules (SMA, LWMA, EMA, KAMA) performs poorly on short-term trends (length up to approximately 10) and it was expected. The main reason for this is commission, which is an advantage for “Buy and hold” strategy, because in that strategy, there is no trading until the end of the time series. Also, the average ROI of “Buy and hold” strategy is -8,398 and in short-term trends, average ROI for our moving averages is negative. For longer short-term trends with length in the range of approximately 10 and 20 average ROI of all four moving averages exceeds ROI of “Buy and hold” strategy and, soon, become positive. That happens to SMA, LWMA, EMA and KAMA, respectively. On medium-term trends, with length in the range of approximately 20 and 40, the biggest average ROI is for SMA and after that average ROI for SMA decreases rapidly to the middle, in the range of approximately 40 and 70, where it stays to the end of the time series. As regards of LWMA, its average ROI is in the middle, in the range of 20 and 40, and after that is mainly the best except when the range of lag is approximately 55 and 65. For LWMA profit has tendency to increase with increasing the lag. For lag higher than 20, profit for EMA is mainly in the middle between the profit for SMA and LWMA. Surprisingly, the average ROI for KAMA is the worst of all four moving averages, even it shows an upward tendency with increasing the lag. An interesting fact is that SMA, EMA and KAMA are converging together for lag higher than 95.

Two most attractive stocks on BSE are NIIS and ENHL. Ad hoc predictions were that we will get interesting results for these two actions and it turned out to be true. NIS (stock symbol: NIIS; English: Petroleum Industry of Serbia) is a Serbian multinational oil and gas company headquartered in Novi Sad, Serbia. NIS held a monopoly on all oil imports in Serbia until 2011.In Figure 2 we present close price for stock NIIS, as well as average ROI for all four types of moving averages depending on the lag, for the same stock.

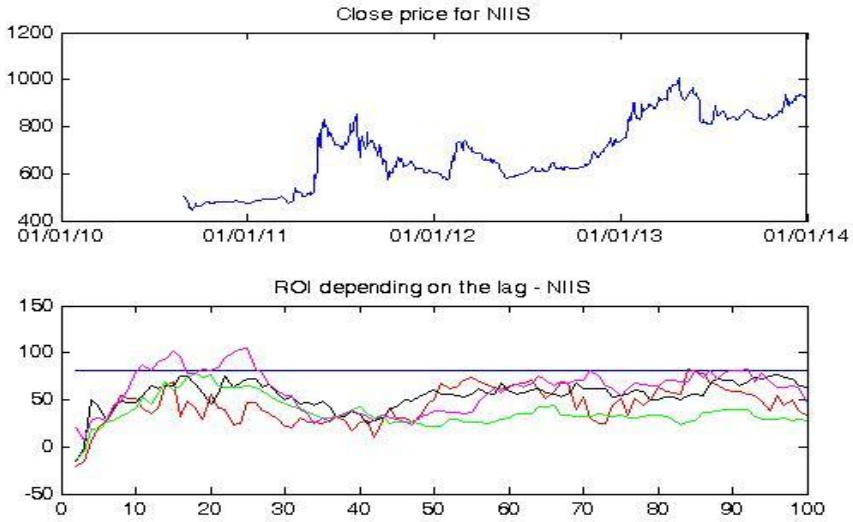

Figure 2: Comparison of moving averages with respect to average profitability (NIIS)

What is characteristic for this stock is the very high average ROI of "Buy and hold" strategy. One of the main reasons for this is, generally, upward trend of this stock. NIIS is the most liquid stock on the Belgrade Stock Exchange and has a strongly trended bull market. Also, very interesting are the results for KAMA for trends with length in the range of approximately 10 and 25. In that range KAMA has the best average ROI, excluding the two falls. Kaufman (1995) suggested KAMA with a length of 21, which results are good in this case, but not so good as KAMA with a length of 15 and KAMA with a length of 25. Except KAMA with mentioned lengths, all other moving averages with different lengths, mostly, has a lesser average ROI. KAMA as, conditionally speaking, "smarter" moving average gives better results on stocks such as NIIS.

Energoprojekt holding (full legal name: Energoprojekt holding a.d. Beograd) is a Serbian construction company founded in 1951 in Belgrade, Serbia. It enters into the composition of BELEX15 and BELEXline, the two main indices of the Belgrade Stock Exchange. This stock is very interesting for the investors and one of the highly liquid stocks. In Figure 3 we present close price for stock ENHL, as well as average ROI for all four types of moving averages depending on the lag, for the same stock.

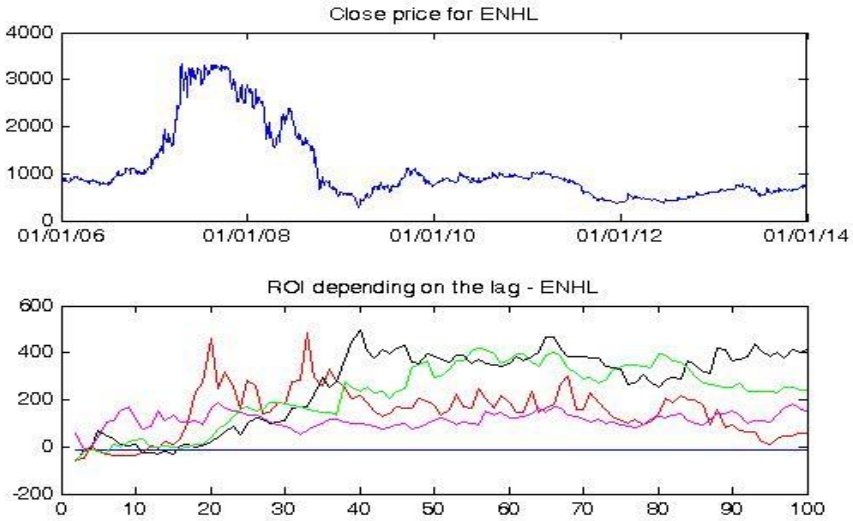

Figure 3: Comparison of moving averages with respect to average profitability (ENHL)

As we can see from the graphs, there is a very low average ROI of "Buy and hold" strategy, which is negative. This is, mostly, because of the influence of the financial crisis. Except for smaller lengths, results of "Buy and hold" strategy are the worst from all four moving averages. The best results are for SMA with a length of 20, SMA, with a length of 33, and for LWMA with a length of 40. In the middle-term trends, principally, SMA dominates. In trends with length longer than 40, there is "battle" between LWMA and EMA in which LWMA dominates. KAMA for trends with length longer than 10, has small oscillations.

5. CONCLUSION

In this study, we have compared four types of moving averages – Simple Moving Average (SMA), Linear Weighted Moving Average (LWMA), Exponential Moving Average (EMA) and Kaufman Adaptive Moving Average (KAMA). To compare the averages, we use them as models of trends within the basic trend following trading strategy. Trading strategy is tested on most liquid equities from Belgrade Stock Exchange (BSE). The selected equities represent the components of the BELEX15 market index.

Our study has shown that, on overall, basic trend following strategies can be profitable and can give better results than “Buy and hold” strategy. We found that increase in the MA lag parameter is followed by the increase in the profitability of trading strategy. The overall results show that LWMA outperforms other moving averages. Unexpectedly, KAMA performed the worst. Further, the resulting ROI for SMA, EMA and KAMA are converging for large values of lag parameter.

REFERENCES

Alexander, S. S. (1964). Price movements in speculative markets: trends or random walks. In: Cootner, P.H. (Ed.), Random Character of Stock Market Prices, vol. 2., M.I.T. Press, Cambridge, 338–372.

Boylan, J. E., & Johnston, F. R. (2003). Optimality and Robustness of Combinations of Moving Averages. The Journal of the Operational Research Society, 54(1), 109-115. doi: 10.1057/palgrave.jors.2601472

Brock, W., Lakonishok, J., & LeBaron, B. (1992). Simple technical trading rules and the stochastic properties of stock returns. The Journal of Finance, 47(5), 1731-1764. doi: 10.1111/j.1540-6261.1992.tb04681.x

Ellis, C. A., Parbery, S. A. (2005). Is smarter better? A comparison of adaptive, and simple moving average trading strategies. Research in International Business and Finance, 19 (3), 399-411. doi: doi:10.1016/j.ribaf.2004.12.009

Fama, E. F., & Blume, M. (1966). Filter rules and stock market trading. J. Bus., 39, 226–241.

Kaufman, P. J. (1995). Smarter trading: Improving performance in changing markets. New York, USA: McGraw-Hill Inc.

LeBaron, B. (1999). Technical trading rule profitability and foreign exchange intervention. Journal of International Economics, 49 (1), 125-143.

Metghalchi, M., Marcucci, J., & Chang, Y.-H. (2012). Are moving average trading rules profitable? Evidence from the European stock markets. Applied Ecconomics, 44(12), 1539-1559. doi:10.1080/00036846.2010.543084

RESULTS OF APPLIENCE OF BENFORD'S LAW ON SERBIAN COMPANIES[1]

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Abstract: *Benford`s Law is one of the most common technique for detecting anomalies and irregularities in accounting data. Its purpose is to analyses patterns of digits in numbers sets. Benford`s Law explain frequency for each digits of numbers in log-normally distributed data. The subject of this research is to determine does some of accounting positions (fixed assets and net result in absolute numbers available on the site of the Agency of legal entities) in official financial reports of 847 big Serbian companies which perform business in 2012, have behaviour in accordance with Benford's Law. By applience of Audit Command Language (ACL) it is confirmed main hypothesis of the research that Benford's Law can be applied on financial reports of Serbian companies, i.e. can discover fraud in financial results. The results suggest that data of fixed assets reported in Serbian company's financial statements do not deviate from Benford`s Law and it is proof that data are presented fairly. In contrast, data of profits/losses showed a deviation, which indicated the potential existence of fraud in the income statement.*

Keywords: *Benford`s Law, ACL, accounting, fraud, fixed asset, net result, management*

1. INTRODUCTION

In order to increase profitability and market share many companies expanded their activities on other industries by establishing or acquiring other companies in the country or abroad. Globalization has had impact on increase of international trade, but they have introduced a lot of problems connected to the book keeping and accounting. Different taxes on profit and other important items of financial reports resulted in favour of headquarter (profit is booked there) while expenses were booked in financial reports of daughter companies (majority costs belong to the mother company). Profit has been moved from country to country in accordance with headquarters' need.

At the same time, internationalism raised question of financial report validity. Different accounting regulation had made problems in monitoring and comparing daughters' businesses. In practice it was possible that there were different book keeping in two countries where one internationally active company was present.

Introduction of International standards of financial reporting (IFRS) was good step in solving the described problem. It uniformed and standardized regulation for creating and booking financial reports. Serbia implemented IFRS in 2004.

However, IFRS didn't solve all problems, because standards allow accounting judgement (Milojevic and Terzic, 2013). The fact is that IFRS requires intensively implementation of judgment which can have impact on bigger differences due comparison of financial reports of group of connected companies in different countries. Rules can be explained on different ways which can resulted in different results in appliance of the same rule. However, appliance of IFRS allows companies to prepare and analysed financial reports by applying the same basis all over the world.

The subject of this research is to determine does some of accounting positions in official financial reports of Serbian companies have behaviour in accordance with Benford's Law. The aim of the research is to check

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quality and validity of chosen accounting positions in order to make proper conclusion. The main hypothesis of paper research is: Benford's Law can be applied on financial reports of Serbian companies.

2. LITERATURY REVIEW

Phenomena known as Benford's Law was discovered by NewCobe in 1881, when he noticed that smaller digits at the beginning have higher frequent of appearance than bigger. Fifty years later, in 1938, Benford confirmed this regularity (Hill, 1998). Moreover, Benford expended analysis with determine frequency of appearance of the first digit in different data: length of the river, article numbers, demographical statistics etc. Digits results of those data were near to logarithms distribution.

Nigrini, used to analyse Benford's Law, and he stressed the importance of it in controlling data i.e. discovering fraud or mistake (Nigrini, 1996). Benford's Law is used to determine normal frequency of repeating some number in the data pool (Nigrini, 1999). This is silent confirmation that some pool of accounting data or number of voices on election or data in any experiment which isn't enough in accordance with Benford's Law, can be result of manipulation or mistake in data.

Benford's distribution is the only distribution of the first important digits which remains the same with the scale's change i.e. it is the same when the data is converted from one currency into another currency (Diekman and Ben, 2010). Pool of data has the higher probability to be under Benford's Law if the data comes from more various distributions. Engel confirmed that Greek's debt crisis could be predicted by digit analyses of euro stat data (provided by the Greek Government). He thinks that Benford's Law has full appliance in practice in this case (Engel, 2010).

There is a wide range of literature connected to the appliance of Benford's Law in accounting and auditing. For example in accounting, Carlslaw (1988), Kinnuen and Koskela (2003) and Van Caneghem (2002) did researches on "cosmetic profit management" and frauds. They confirmed that there are bases for suspicions on manipulation on chosen sample of companies, which were subject of analysis. Moller applied Benford's Law in auditing and tax auditing (Moller, 2009(.

Carlslaw did research in accounting filed on financial reports of New Zeeland companies in 1988, and he confirmed and documented their practice of profit management in line with Benford's Law. Accordingly, profitable companies expressed higher (lower) frequency of appliance of 0 (9) as second digit in profit. This shows that those companies manipulated with their profit where the second digit was higher than the first in order to increase the first digit (Carlslaw, 1988).

Benford's Law allows auditors to get information about probable frequency of appearance of determined digit in data. It helps them to discover the data which can't be visible by applying traditional methods of auditing financial reports. The templates of appearance of digits can lead to imaginary digits, systematic fraud, and mistake in data or subjective way of expressing data (Nigrini, 1996).

In the first row of the first page of the paper, below the space reserved for header, you should type the paper title. Names of the authors, names of the institutions and the addresses should be typed below the paper title, as shown at this page of the instruction. In the first empty row below the address of the first author, apply style "Line" or copy/keep the line from this template. Below the paper title and names of the authors, you should write a short abstract. Below the abstract, you should write key words.

3. METHODOLOGY

The sample subjects of analyses are:

- 847 big companies which perform business in Serbia, and they are part of internationally active companies and have connected companies locally in 2012 (in accordance with Law on Accounting and Auditing).
- Following items from balance sheet and income statement: fixed assets and net result.

As it is known, appliances of fair value, moment of accepting income, cost of capitalization, write off stocks or receivables, are items with whose correction it can be influenced on company's business. In this research we implemented tool for checking the data quality in terms of their surety and originality. In the case when original data is behaviour in accordance with Benford's Law, replacement of correct with imaginary data leads to discrepancy with the Law (Benford, 1938).

Authors decided to analyse:

- Fixed assets because companies were obliged to correct value of own assets with market value in accordance with IFRS. So, we authors were interested did companies do it on right way or not i.e. was there suspicion that Serbian companies expressed on false way value of own fixed assets.
- Net result (profit or loss) because this item is subject of manipulation and hot topic for domestic and international researches. Furthermore, higher net profit increases credit potential of the company, appetite of owners and strategy for the decrease for paid tax on profit to the state.

The basis of analysis was financial reports available on site of the Agency for legal entities. In order to process easier chosen balances' items we converted them into MS Excel, and then transferred to module ACL (Audit Command Language) to check Benford's Law in Practice. Authors decided to use ACL because of following reasons: Firstly, there is significant beneficiaries' forum with higher number of visitors comparing to other auditing software. There is huge number of experts which are capable to answer on any technical or methodology problem which can be appeared. Secondly, there is huge number of beneficiaries' groups organized on regions, which are determined by technological equipment level, geographical position and way of expressing data in financial reports. Thirdly, there is enormous number of publications which cover ACL module in electronic form and published books. Finally, there are more ACL than IDEA users. So, large companies rather will employ ACL than IDEA users (Coderre, 2009).

The following formulas were applied:

A. Frequency of appearance of the first digit in accordance with following logarithmic equation:

$$F_a = \log(1+\frac{1}{10}) \qquad (1)$$

Where is n leading decimal digit which is not 0 i.e. 1, 2, 3, 4, 5, 6, 7, 8, 9.

B. Other digits

In the case of number which starts with decimal digits nz

$$F_b = \frac{log_{10}\left(1+\frac{nz+1}{nz}\right)}{log_{10}\left(\frac{n+1}{n}\right)} \qquad (2)$$

Where z can have following values 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

C. Appliance of Benford's Law on any numbers

Number which starts with decimal numbers abc … opq,

$$\log\ 1+x\ \approx\left(x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+\ldots\right) \text{ Taylor's seria (3)}$$

$$\log_{10}\ 1+x\ \approx\left(x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+\ldots\right)/\log(10) \text{ (4)}$$

$$F_q=\frac{\log_{10}\left(\frac{abc\ldots opq+1}{abc\ldots opq}\right)}{\log_{10}\left(\frac{abc\ldots op+1}{abc\ldots op}\right)}=\frac{\log_{10}\left(1+\frac{1}{abc\ldots opq}\right)}{\log_{10}\left(1+\frac{1}{abc\ldots op}\right)}\approx\frac{abc\ldots op}{abc\ldots opq}\to 1/10 \text{ for increasing q (5)}$$

Table 1 showed that the first digits in real time of measurement, are generally speaking, logarithmically distributed, with the highest frequency of appearance of digit 1 (30.1%) and with the lowest frequency of appearance of digit 9 (4.6%).

Table 1: Probability of appearance of digits in collected pool of numerical data in accordance with Benford's Law

Digit	**Expected Frequencies Based on Benford's Law**		
	1st place	1st place	1st place
0		0.1197	0.1018
1	0.3010	0.1139	0.1014
2	0.1761	0.1088	0.1010
3	0.1249	0.1043	0.1006
4	0.0969	0.1003	0.1002
5	0.0792	0.0967	0.9980
6	0.0670	0.0934	0.9940
7	0.0580	0.0904	0.9900
8	0.0512	0.0876	0.9860
9	0.0458	0.0850	0.983

(Source: Nigrini, 1999)

It means that probability of the first digit is decreasing with the increased of its height. Distribution of the second digit has the same trend; decreasing trend is shortening with movement of the digit position on the right in collected pool of numerical data. In the case when numbers of some pool are ranked from the smallest to the biggest, they roughly follow geometrical distribution (roughly, because Benford's pool of data of two numbers can be identical). Pool of numbers is in accordance with Benford's pool of data if fulfills minimum following three conditions:

- Pool of data has to be homoginious: population of the town, surface of the lake, value of shares, etc.
- Data doesn't have low (especially zero) and up bound.
- Data can't be in passwords, such as telephone numbers, post codes, numbers of social insurance.

A reason why those data isn't in accordance with Benford's Law is clear [5].

It is important to emphasize that this distribution is not applicable on any scope of numbers. Firstly, scope of numbers should be big enough to allow distribution of digits. Some of authors discovered that scope which consists with less than 100 items won't be in accordance with Benford's Law. Secondly, numbers shouldn't contain artificial limitations or origin [15].

Limitations of the research are connected to the fact that all: analysed companies didn't have fixed assets and net result of company's performance is expressed in absolute number.

4. RESULTS OF RESEARCH

Results of applied Benford's Law on the leading digits of value of fixed assets of 847 big companies which perform business in Serbia are presented in table 2. Leading digits are expressed from 1 to 9, their number of appearance in the sample, expected number (count) in accordance with Benford's Law, value of Z statistics, as well as lower and upper bound of tolerance.

Table 2: Frequencies of appearance of the first digits expressed in fixed assets of Serbian big companies in 2012

Leading Digits	Actual Count	Expected Count	Z stat Ratio	Lower Bound	Upper Bound
1	243	246	0.209	221	272
2	141	144	0.233	123	165
3	88	102	1.449	84	121
4	88	79	0.972	63	96
5	66	65	0.094	50	80
6	44	55	1.436	41	69
7	57	47	1.356	34	61
8	51	42	1.374	29	54
9	40	37	0.346	26	49

(Source: Authors calculations)

We can conclude that frequency of appearance of all digits on the first place of accounting item fixed assets of big Serbian companies is in accordance with Benford's Law. By appliance of 0.10 level of surety, table 2 discovers that frequency of real appearance of all digits from 1 to 9 is statistically unimportant different from expected frequency of appearance (expected count). In Serbian case, 814 companies have 1 as the first digit of value of fixed assets, which represents 29.85% of total number of analysed data. In accordance with Benferd's Law expected count is 246, which means that this discrepancy is not statistically important, which we confirmed by calculating Z statistics, i.e. lower and upper bound of discrepancy. The similar situation is with other digits and their frequency of appearance on the first place, which is the best visible in Figure 1.

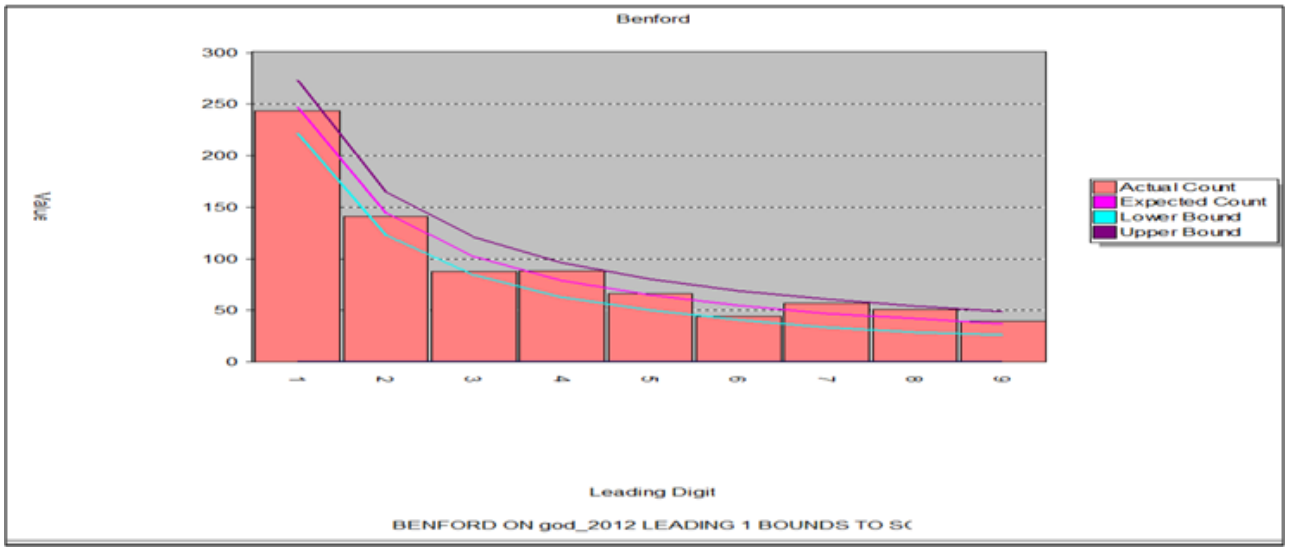

Figure 1: Frequency of appearance of the first digits in item fixed assets of big Serbian companies in 2012

On the basis of Figure1, where it is shown real and expected number of appearance of the first digit expressed in the item of fixed assets, and lower and upper bound, we can conclude that big Serbian companies expressed on the truth way value of own fixed assets. It is interesting that probability of appearance of all digits is in accordance with Benford's Law i.e. in prescribed borders. This finding is very important for auditors and state's bodies engaged on control of any company's business in Serbia.

Results of applied Benford's Law on the leading digits of value of net results of Serbian big companies, which are subject of analysis, are presented in table 3. Leading digits are expressed from 1 to 9, their number of appearance in the sample, expected number (count) in accordance with Benford's Law, value of Z statistics, as well as lower and upper bound of tolerance. In accordance with it, distribution of digits in profit of Serbian big companies is not in accordance with Benford's distribution.

Table 3: Frequency of appearance of the leading digits expressed in net result of Serbian big companies in 2012

Leading Digits	Actual Count	Expected Count	Z stat Ratio	Lower Bound	Upper Bound
1	**284**	255	1.687	229	281
2	148	149	0.392	127	171
3	83	106	2.320	87	125
4	71	82	1.229	65	99
5	70	67	0.310	52	82
6	60	57	0.384	42	71
7	45	49	0.826	36	62
8	**29**	43	1.844	31	56
9	**57**	39	2.918	27	51

(Source: Authors calculations)

Digits which aren't in accordance with Benford's distribution are 1, 8 and 9. Number 1 has the highest appearance on the first place, and it can be explained with nature of the position, which is difference between income and costs. For numbers 9 and 8 we can't find proper logical explanation. This finding is important for auditors, investors and small shareholders. For auditors, this result is important and useful in the moment of preparing and giving auditing opinion. For investors and small shareholders, it means that they should not accept financial reports without further analysis. Manipulation with achieved financial result can bring investors and small shareholders in bad position in terms of considering profitability i.e. earning situation of the company. However, we can conclude that this research should be expanded on longer period of analysis, which will cover period before and during the crisis, in order to confirm validity of prepared financial reports of Serbian companies.

Finally, we can conclude that the main hypothesis of the paper research is approved i.e. Benford's Law can be applied on financial reports of Serbian companies.

5. CONCLUSION

The main hypothesis of the paper research is approved i.e. Benford's Law can be applied on financial reports of Serbian companies. The sample consists of 847 companies which perform business in Serbia in 2012, where items subject of Benford's Law appliance are fixes assets and net result (profit or loss) expressed in absolute numbers. Authors used ACL model to determine applicability of Benford's Law on financial items of Serbian big companies.

Conclusions are following:

- Frequency of appearance of all digits on the first place of accounting item fixed assets of big Serbian companies is in accordance with Benford's Law. By appliance of 0.10 level of surety, table 2 discovers that frequency of real appearance of all digits from 1 to 9 is statistically unimportant different from expected frequency of appearance (expected count). In Serbian case, 814 companies have 1 as the first digit of value of fixed assets, which represents 29.85% of total number of analysed data. In accordance with Benferd's Law expected count is 246, which means that this discrepancy is not statistically important, which we confirmed by calculating Z statistics, i.e. lower and upper bound of discrepancy. Furthermore, we can conclude that big Serbian companies expressed on the truth way value of own fixed assets. It is interesting that probability of appearances of all digits is in accordance with Benford's Law i.e. in prescribed borders. This finding is very important for auditors and state's bodies engaged on control of any company's business in Serbia.

- Distribution of digits in profit of Serbian big companies is not in accordance with Benford's distribution. Digits which aren't in accordance with Benford's distribution are 1, 8 and 9. Numbers 1 and 9 have the highest and number 8 has the lowest appearances on the first place as result of executed research. The higher appearance of digit 1 can be explained by the character of the position, because group of companies intend to decrease payment of tax on profit. More frequent appearance of digit 9 and lower frequent appearance of digit 8 can be explained with intention of group of companies to expressed better result than it is, in order to create better picture in eyes of stakeholders of the companies. This manipulation is in accordance with human psychology, which says that it is more impressive when achieved result is 901,500,000 dinars (RSD) than 897,500,000. On the basis of calculated frequency of appearance of the first digit we can conclude that there are three group of companies in sample subject of analysis: the first one expressed truly correct results, the second group intends to express lower result in order to pay less taxes on profit, and the third group of companies intend to increase achieved net result with usage digits 8 or 9 on the second and third place in order to increase importance of the first digit. It can be said that the second and third group of companies are subject of management manipulation i.e. their plans to achieve their private aims.

  This finding is important for auditors, investors and small shareholders. For auditors, this result is important and useful in the moment of preparing and giving auditing opinion. For investors and small shareholders, it means that they should not accept financial reports without further analysis. Manipulation with achieved financial result can bring investors and small shareholders in bad position in terms of considering profitability i.e. earning situation of the company.

Limitations of the research are connected to the fact that all: analysed companies didn't have fixed assets and net result of company's performance is expressed in absolute number. Further researches will be

expanded on longer period of analysis, which will cover period before and during the crisis, in order to confirm validity of prepared financial reports of Serbian companies.

REFERENCES

Benford, S. (1938, March). The law of anomalous numbers. Proceedings of American Philosophical Society, Vol. 78, 551-572

Brenner, G.A., & Brenner, R. (1982). Memory and Markets, or Why Are You Paying $ 2.99 for A Widget. The Journal of Business, Vol. 55, 147/158

Carlslaw, C. (1988). Anomalies in income numbers: Evidence of goal oriented behaviour. The Accounting Reviwe, Vol. 63, 321-327

Coderre, D. (2009). Primena kompjutera u sprečavanju i otkrivanju kriminalnih radnji. John Wiley&Sons, Hoboken, New Yersey, 197-203.

Diekmann, A., & Ben, J. (2010). Benford's Law and Fraud Detection: Facts and Legends. German Economic Review 11(3), 397–401

Engel, S. (2010). Fact and Fiction in EU-Governmental Economic Data. German Economic Review 12(3), 243–255

Hill, T.P. (1998). The First Digit Phenomenon. American Scientist, Vol. 86, 358-363.

Kinnunen, J., & Koskela, M. (2003). Who is Miss World in Cosmetic Earnings Management? A Cross-National Comparison of Small Upward Rounding of Net Income Numbers among Eigtheen Countries. Journal of International Accounting Research, Vol. 2, 39-68.

Law on Accounting and Auditing, The Official Gazette of Republic of Serbia No 46/2006 and 111/2009

Milojević, M., & Terzić, I. (2013, December). Uticaj međunarodne regulative na finansijsko izveštavanje kompanija posmatrano sa aspekta stalne imovine. 14. Međunarodni naučni skup Sinergija 2013, 176-183

Moller, M. (2009). Measuring the Quality of Auditing Services with the Help of Benford's Law– An Empirical Analysis and Discussion of this Methodical Approach. Retrived from http://ssrn.com/abstract=1529307

Nigrini, M.J. (1996). A Taxpayer Compliance Application of Benford's Law. Journal of the American Taxation Association, Vol. 18, 1: 72-91.

Nigrini, M.J. (1999). I've got your number. Journal of Accountacy. Vol.37, 79-83

Todter, K.H. (2009). Benford's Law as an Indicator of Fraud in Economics. German Economic Review, Vol. 10, 339–351.

Site of the Agency for legal entities. Retived from http//www.apr.rs

Watrin, C., Struffert, R., & Ullmann, R. (2008). Benford's Law: An Instrument for Selecting Tax Audit Targets ? Review of Managerial Science 2, 219–237.

TESTING MOVING AVERAGE TRADING RULE IN CASE OF SERBIAN AND CROATIAN STOCK MARKET INDICES

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Abstract: *This paper examines the Belgrade Stock Exchange Index (BELEX15) and the Zagreb Stock Exchange Index (CROBEX) with respect to simple moving average rules. Using standard statistical tests, our results indicate significant difference between trading rule profit mean and unconditional profit mean in both observed stock markets. Also, the implementation of various moving average trading strategies drives to significant difference between average buy returns and average sell returns. Although applied moving average trading rule strategies mainly generate more losing trades than winning trades, most of them comes with extra profit compared to passive buy-and-hold strategy. In addition, it seems that presented moving average rules have forecasting power for the recent sample, which could be due to the fact that these rules have not been employed by market participants.*

Keywords*: Moving average trading rule, stock markets, indices, profitability, weak-form efficiency*

1. INTRODUCTION

If stock prices demonstrate various regularities in observed sample of time, they will allow the market participants to run a profitable trading strategy and to reject the weak-form market efficiency hypothesis. Anyway, the absence of weak-form efficiency, in which information consider only historical price data, does not unquestionably convert into profitable information. To prove this statement, Park and Irwin (2007) review evidence on the profitability of technical analysis and reveal that previous studies are not able to bring reliable arguments supporting the benefits of technical trading strategies.

Brock et al. (1992) provided strong encouragement for further development of trading strategies. Also, the focus of this paper is on the methodology similar to that of Brock et al. (1992). Bessembinder and Chan (1995) conclude that two simple technical trading rules are successful in predicting stock price movements in Japan, Hong Kong, South Korea, Malaysia, Thailand and Taiwan. Mills (1997) showed that even though the used technical trading rules outperform profits of defined benchmark in the time interval, their predictive ability significantly decline after the observed period.

However, most lately, the attention of technical trading analysis has shifted to emerging stock markets which collectively deliver a significant alternative source of opportunities to potential investors. Parisi and Vasquez (2000) and Gunasakarage and Power (2001) found support for the profitability of technical trading rules in several South American and emerging South Asian markets, respectively. Chang et al. (2004) also found that technical trading rules are profitable on some emerging stock markets. Similarly, McKenzie (2007) tested three technical trading rules for seventeen emerging markets and indicated that some of the trading rules appear to earn significant returns but the forecast accuracy decreases for more recent sample periods. Same author claims that market inefficiency could be a constant feature of emerging financial markets. Than as well, Marshall et al. (2009) consider technical trading rules more profitable for smaller, less liquid stocks. Moreover, Mitra (2011) investigated moving average trading rules for the Indian stock market and observed that profitable opportunities from technical analysis holds as a puzzle in the stock market.

On the other hand, investment attractiveness and predictive power seem to disappear in the course of time. Hence, it is of significant interest to investigate whether the inducement of technical trading strategies keeps on hold for the most recent sample periods. Consequently, the basic goal of this paper is to investigate the profitability and predictive ability of technical trading rules in Serbian and Croatian stock market during the last couple of years.

2. MOVING AVERAGE TRADING RULES

Trading rules or their alternatives, trading strategies, are measuring algorithms that generate an output investment decision containing the information about buy or sell a stock for a given period of time. If there is more volatility in the stock price data, there are more potential opportunities to buy and sell stocks. Though

the stock market may have indicated a stabile long term price movement pattern, in the short term the price behavior is very noisy. Thus, active trading strategies should be more profitable in the short term with more variation than the long term.

There are many different trading rules according to possible application and predictive ability. This paper focuses on one widespread used method, called the moving average trading rule. It is based on moving averages which are series of simple partial averages of prices P over the previous n trading days, including the current day. They represent a measure of stock price momentum. Therefore, the moving average at time t for n trading days is computed as follows:

$$MA_t^n = \frac{1}{n}\sum_{t=1}^{n} P_t \tag{1}$$

Thus, the original time series of stock prices conducts two new series of partial moving averages, one for short term (s) and another for long term (l), as we present by relations in table 1.

Table 1: Application of moving average trading rule

Condition	Decision
$MA_t^s > MA_t^l$	Buy/hold position
$MA_t^s < MA_t^l$	Sell/stay out position

Considering the moving average rule, when the short moving average of stock prices is above the long moving average, the traders initiate buy or hold decision relying on believe that the short term price growth surpass the long term price growth in expected time period. Oppositely, when the short moving average is below the long moving average or when they are equal, the traders make a sell or stay out decision.

A typical number of trading days in short and long term moving averages depends on research assumptions. Hence, Brock et al. (1992) are used 1 and 5 days interval for the short moving average, and from 50 to 200 trading days for the long moving averages, while Charoenwong (2012) considered that the short moving averages can range from 5 to 15 days and the long moving average from 50 to 90 days. This paper implements 1 and 5 days interval for the short, and 100, 150 and 200 trading days for the long moving average.

3. TESTING METHODOLOGY

Moving average trading rule represents unquestioned evidence of the stock price predictive ability if expected stock prices depend on available buy/sell information. To measure such a relationship it is crucial to test the difference between expected returns of buy and sell signals or returns of buy/sell signals generated from the technical trading rules and returns of buy-and-hold strategy. Evident choice for this purpose is the t–test of differences between the arithmetic means of two subsamples, presented by the following expressions in two variants:

$$t^* = \frac{\overline{R}_b - \overline{R}_s}{\sqrt{\frac{\sigma_b^2}{N_b} + \frac{\sigma_s^2}{N_s}}} \tag{2}$$

$$t^* = \frac{\overline{R}_{b/s} - \overline{R}}{\sqrt{\frac{\sigma_{b/s}^2}{N_{b/s}} + \frac{\sigma^2}{N}}} \tag{3}$$

Where the $\overline{R}_b$ and $\overline{R}_s$ are mean returns following the buy and sell signals, $\overline{R}$ is the unconditional mean, σ_b^2 and σ_s^2 are the variances of returns generated from buy and sell signals, σ^2 is the unconditional variance, N_b and N_s are the numbers of buy and sell signals, N is the overall number of observed data. The index b/s identifies combined buy and sell signals. The results of the t–test will help either accept the null

hypothesis (there is no actual difference between mean returns) or reject it (there is an actual difference between mean returns). However, these results assume independent and stationary time series with asymptotically normal distribution.

4. DATA AND SUMMERY STATISTICS

As noted previously, implementing a well-known trading rule provides an initial test of the weak-form market efficiency hypothesis. If stock markets are efficient, one cannot achieve superior results by using technical trading rules. However, if market inefficiencies are present, profitability opportunities may arise.
Due to the research of moving average trading rule in the course of time, this paper work uses the period of time from January 2009 to March 2014 presented by 1301 daily stock market indices values. In analysis we use two stock market indices: the Belgrade Stock Exchange index (BELEX15) and the Zagreb Stock Exchange index (CROBEX). Both indices are recognized as indicators of average stock price movements in emerging financial markets.

Table 2: Descriptive statistics

Index	BELEX15	CROBEX
Mean	0.00002	0.00002
Max	0.08250	0.08563
Min	-0.07471	-0.07020
Std	0.01292	0.01173
Skewness	0.41144	0.25183
Kurtosis	8.97576	11.20887
ρ(1)	0.26031	0.11024
ρ(2)	0.10592	-0.01563
ρ(3)	0.04200	0.07012
ρ(4)	0.10409	0.02522
ρ(5)	0.04610	-0.00333

Developing stock market indices, such as BELEX15 and CROBEX, significantly alter in statistical features from developed markets. Table 2 encompasses descriptive statistics of daily returns for time series of two stock market index values. The results indicate decidedly leptokurtic characteristics of data series with some potential signs of skewness. Furthermore, the volatility, presented by standard deviation (Std), is approximately the same for both indices. Also, serial correlations ρ(i), estimated at lag i for each data series, are roughly small, except at the first lag of BELEX15. Such data provides large enough samples to generate robust trading strategies that accomplish long term excess profits.

5. EMPIRICAL ANALYSIS

The remainder of this paper considers the implementation of moving average trading strategies to the series of historical index return data. In this sense, we incorporate six different trading strategies derived from moving average trading rule. These trading strategies differ among one another in the length of short and long moving averages denoted in the parenthesis. Table 3 and 4 shows the results of applying different moving average trading rules and approve further comparison of buy and sell trade signals generated by those rules.

Table 3: Test results for moving average trading rule using BELEX15

Strategy	N(buy)	N(sell)	R_t(buy)	R_t(sell)	$R_t>0$(buy)	$R_t<0$(sell)	t-test buy-sell.	p-value	t-test uncond	p-value
ma(1,100)	476	662	0.00102	-0.00002	0.51185	0.49118	2.00164	0.04553	1.55948	0.11913
ma(1,150)	449	592	0.00159	-0.00142	0.54681	0.44026	6.34211	0.00000	4.56152	0.00001
ma(1,200)	420	571	0.00048	-0.00106	0.52643	0.47311	3.42192	0.00064	2.33675	0.01960
ma(5,100)	564	526	0.00121	-0.00116	0.53162	0.44332	5.10662	0.00000	3.74980	0.00018
ma(5,150)	441	597	0.00091	-0.00073	0.52216	0.46718	3.31362	0.00095	2.44021	0.01481
ma(5,200)	420	569	0.00000	-0.00071	0.47917	0.47655	1.49474	0.13522	1.00910	0.31311

First column of table 3 presents short description of applied trading strategy. Therefore, the moving average trading rule is expressed in parentheses with short and long moving averages respectively. Following two

columns N(buy) and N(sell) contain the number of buy and sell signals recorded during the sample interval of time. After those columns, the next two $R_t>0$(buy) and $R_t>0$(sell) are the fraction of buy and sell returns greater than zero in whole sample. The t-test (buy-sell) indicates the test statistics of differences between the arithmetic means of buy and sell signals. The following column, p-value, represents the probability of obtaining test statistics. The rejection of the null hypothesis is indicated by the probability column if p-value turns out to be less than a certain significance level, for example 5%. Finally, t-test (uncond.) presents standard statistics results of testing the difference between buy and sell one-day returns and unconditional one-day mean return.

Applied moving average rule presented in table 3 for BELEX15 demonstrates the existence of a significant difference in the number of generated buy and sell signals among all six trading strategies. However, the appearance of a trading signal does not necessarily represent immediate buy or sell action. A sell signal should be a precaution for investors to avoid potential stock investment activity until another convincing trading signal emerges. Otherwise, a buy signal without making any investment action could be an unquestionable evidence of maintaining the position of given stocks in the investment portfolio. Generally, the first trading signal in potential sequence of buy or sell signals is assumed to be of most interest due to the existing stock price autocorrelation. Such a mechanism of frequent generating trading signals gathers less credibility of the investors, but at the same time inspires the growth of activity at the stock market. Moving average strategies present different average return results considering a whole sample of time interval. Meanwhile, every applied strategy obtains a positive one-day average return on generated buy signals and a negative one-day average return on sell signals. Mentioned averages on buy and sell signals are significantly different than unconditional averages presented in table 1. Because of that, t-test of difference between conditional and unconditional average returns in case of BELEX15 shows significant difference with p-value less than 5% in four of six trading strategies.

Table 4: Test results for moving average trading rule using CROBEX

Strategy	N(buy)	N(sell)	R_t(buy)	R_t(sell)	$R_t>0$(buy)	$R_t<0$(sell)	t-test buy-sell.	p-value	t-test uncond	p-value
ma(1,100)	627	624	0.00023	0.00007	0.49945	0.48603	0.06954	0.94457	0.03316	0.97355
ma(1,150)	537	612	0.00089	-0.00083	0.51441	0.46827	4.73631	0.00000	2.54779	0.01096
ma(1,200)	470	627	0.00054	-0.00074	0.49703	0.48620	3.85213	0.00012	1.96337	0.04982
ma(5,100)	579	620	0.00038	-0.00046	0.48264	0.49169	2.22486	0.02626	1.34446	0.17903
ma(5,150)	545	604	0.00046	-0.00054	0.48545	0.48114	2.66328	0.00783	1.49647	0.13477
ma(5,200)	471	626	0.00013	-0.00029	0.46814	0.48392	0.35697	0.72117	0.18447	0.85368

On the other hand, testing results in case of CROBEX are presented in Teble 4. First impression about results is the increasing number of trading signals compared with the case of BELEX15, although we used the same size of sample in both cases. Furthermore, the fractions of buy and sell return greater than zero are just about the same. Anyway, there are significant differences between buy signals average one-day return and sell signals average one-day return in four of six implemented moving average trading strategies. Such results provide a confirmation that trading strategies produce useful trading signals. Thus the returns made from the trading rule in case of BELEX15 and CROBEX are likely to be predictable. Leaving these inefficient trading strategies, for example ma(1,100) and ma(5,200), this paper proposes a set of moving average trading strategies with significant predictive ability and a high possibility of making profitable investment. Finding the efficient trading rule in both stock market indices supports the rejection of the weak-form efficiency hypothesis. This fact once more reminds on perception improvement of applying technical trading rules in emerging stock markets such as Serbian and Croatian stock market. Both stock market indices indicate similar stock price movement patterns, as well.

Usually, there are more sell signals in observed sample of daily returns. In overall, moving average trading strategies generate sell signals in around 55.9% (BELEX15) and 53.5% (CROBEX) of all trading signals. This epilogue shows the signs of gently to entirely reduced stock market activity and draws attraction to the lack of market capitalization. Altough Pauwels et al. (2012) consider it as a support of the efficient market hypothesis. Despite this, moving average trading rule in case of BELEX15 and CROBEX is capable to generate positive returns over a whole sample period due to the fact that the profit gained by winning trades surpass the losses from losing trades.

4. CONCLUSION

The paper attempted to provide an extensive range of possible moving average trading strategies that are capable to improve forecasting ability of stock price movements in and out of the observed sample. Overall, the results of this study contain strong support for the moving average trading strategies we have investigated and signify that almost all buy and sell differences are positive. According to previous claim, the t statistics mainly reject the null hypothesis of equality between average buy and sell returns or average trading returns and unconditional (passive buy-and-hold) returns. Strictly speaking, adequate implementation of moving average trading rule in case of Serbian and Croatian stock market leads to the rejection of the weak-form market efficiency hypothesis. Furthermore, it is inherent to the emerging stock markets that applied trading strategies generate more losing trades than winning trades.

An implementation of trading rules represents just a fragment of a comprehensive investment portfolio management analysis. As a result, complete perception of the stock price or/and return movement patterns in observed sample of time requires tools of the fundamental investment analysis, which generally rely on experience of financial experts. Nevertheless, applied trading strategies offer insight in the behaviour of the stock markets. Therefore, previously done analysis does not appear appropriate for small investors to implement. Respectively, individual case of stock trades requires analogous procedure of testing performances of moving average trading strategies referred directly to potential investment chances.

REFERENCES

Bessembinder, H., & Chan, K. (1995). The Profitability of the Technical Trading Rules in the Asian Stock Markets. Pasific-Basin Finance Journal, 3(2), 257-284.

Brock, W., Lakonishok, J., & LeBaron, B. (1992). Simple Technical Trading Rules and the Stochastic Properties of Stock Returns. Journal of Finance, 47(5), 1731-1764.

Chang, E., Lima, E., & Tabak, B. (2004). Testing for Predictability in Emerging Equity Markets. Emerging Market Review, 5(3), 295-316.

Charoenwong, B. (2012) ”An Exporation of Simple Optimized Technical Trading Strategies”, Available from: http://deepblue.lib.umich.edu/bitstream/handle/2027.42/91813/chben.pdf?sequence=1 [Accessed on January 15, 2014]

Gunasekarage, A., & Power, D. (2001). The Profitability of Moving Average Trading Rules in South Asian Stock Markets. Emerging Market Review, 2(1), 17-33.

Marshall, B., Qian, S., Young, M., Chuang. S., & Gielen, U. (2009). Is Technical Analysis Profitable on US Stocks with Certain Size, Liquidity or Industry Characteristics? Applied Financial Economics, 19(15), 1213-1221.

McKenzie, M. (2007). Technical Trading Rules in Emerging Markets and the 1997 Asian Currency Crises. Emerging Markets Finance and Trade, 43(4), 46-73.

Mills, T. (1997). Technical Analysis and the London Stock Exchange: Testing Trading Rules Using the FT30. International Journal of Finance and Economics, 2(1), 319-331.

Mitra, S. (2011). Usefulness of Moving Average Based Trading Rules in India. International Journal of Business and Mangement, 6(7), 199-206.

Parisi, F., & Vasquez, A. (2000). Simple Technical Trading Rules of Stock Returns: Evidence from 1987-1998 in Chile. Emerging Market Review, 1(2), 152-164.

Park, C.H., & Irwin, S. (2007). What Do We Know About the Profitability of Technical Analysis. Journal of Economic Surveys, 21(4), 786-826.

Pauwels, S., Inghelbrecht, K., Heyman, D., & Marius, P. (2012). Technical Trading Rules in Emerging Stock Markets. World Academy of Science, Engineering and Technology, 59(1), 2241-2264.

FINANCIAL INTERMEDIATION SERVICES IN THE SYSTEM OF NATIONAL ACCOUNTS

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Abstract: *This document presents the basic methodological concepts of national accounts related to the estimation of the output of credit institutions. The focus of the discussion will be the main source of income of these institutions coming from monetary intermediation – loans and deposits. The interest margin as the difference between the interest receivable on loans and interest payable on deposits in the system of national accounts is decomposed in order to disclose the pure property income and service charge - so called FISIM (Financial Intermediation Services Indirectly measured). This rather complicated statistical procedure often is misunderstood by the users of official statistics and in this paper we will try to explain the basic methodological concepts that are behind it and formulas for derivation of this macroeconomic statistical indicator.*

Keywords*: FISIM, SNA, ESA, Monetary intermediation, Interest margin, National Accounts.*

1. INTRODUCTION

Unlike business accounting that is primarily focused on determining the profit and enterprise value, the national accounts as a tool of macroeconomic analysis represents the statistical system aimed to capture the real economic activity of economic entities of a country. Basic statistical indicators that are used in this system, such as „output“ and „value added“ at the micro level of individual companies do not have their " real " or tangible manifestation in the form of cash flows and financial transactions, as is the case with business income and expenses disclosed in the financial statements of enterprises. This distinction between micro and macro level of the observation of economic activity may be most visible in the statistical treatment of credit institutions (banks and other credit granting companies). The structure of National accounts framework and principles governing national accounts are agreed internationally, and are explained in detail in the "System of National Accounts 2008" (SNA08). The SNA is endorsed by the five major international economic and financial organisations: the United Nations, the International Monetary Fund, the OECD, the World Bank and the European Commission. The European system of national and regional accounts – ESA is based on the SNA and represents the European standard for national accounting and is obligatory for all its member states.

Apart from standardized banking services, banks also generate service income by bringing together borrowers and lenders of money and lending at a higher rate of interest than they borrow. In the system of national accounts, the margin earned by the credit institutions from the difference between interest received on loans and paid on deposits is treated as a part of value of production (output) of these institutions together with other service charges and operating income. In the calculation of output, system of national accounts does not include any kind of property income such as interest, rents on land, dividends, extraordinary and non-operating income.

2. BASIC TYPES OF OPERATING INCOME OF CREDIT INSTITUTIONS

Banks and other credit institutions have two basic types of income:

1) Commissions and fees charged to customers (management of checking accounts, issuance of credit cards and processing of credit card transactions and billing, financial consulting, capital market services, wealth management and tax planning, brokerage services etc.). For this service, the bank explicitly charge for their services and there are clearly established tariffs so customers can immediately identify the costs of these services and banks their income and cash flow.

2) Other operating income such as the trade margins on foreign exchange and securities, income from rentals of its own buildings. As we have said, only the “regular” operating income is included in the output of

enterprises. Property income such as interest, dividends and rents on land are excluded from the national accounts concept of “operating income”. Moreover, income gained on sales of used capital goods, gains and losses from holding the financial assets, other extraordinary gains and losses which are part of net profit and loss of companies, in the national accounts methodology are treated as non-economic transactions which do not generate value added so they are excluded from the calculation of the output.

3) The interest margin as the difference between the lending and deposit rates. The largest part of the income of credit institutions comes from the monetary intermediation – i.e. from borrowing money at lower and lending it out at a higher interest rate to customers. In this difference the value of services of monetary intermediation is “hidden”, and for this part of the income does not exist an explicit fee or price because it is already contained in the said difference. Since there is no explicitly determined fee or price, the actual price of these services can vary from client to client and investment risk etc. For that reason this service of monetary intermediation by banks is called FISIM - or "financial intermediation services indirectly measured" and that is the official term which is used in national accounts statistics.

So, FISIM represents the value of financial intermediation services for which there is no explicit tariff but is included together with other components of operating income in the calculation of output of the banking sector. These three main types of income now face the operating expenses (so called the intermediate consumption) and increase the value added of the financial sector and eventually GDP of an national economy. Without this part of the output of the banks would had negative value added and that is the reason why the SNA1993 introduced FISIM as a concept in the system of national accounts.

3. CREDIT INSTITUTIONS IN THE SYSTEM OF NATIONAL ACCOUNTS

In the national accounts, each transaction must be recorded on the two sides - supply and use. The output of each manufacturer must end somewhere on the expenditure side of the system as either intermediate or final consumption. Commissions and fees as part of the output of banks are relatively easy to allocate and determine their “consumers” since the exact data exist in accounting system of banks so as in the book-keeping records of companies and enterprises (In Serbian official chart of accounts for business enterprises they have a special account for the recording of these transactions). But for the statisticians the biggest challenge and was accurately determine the allocation of FISIM by users for which no explicit accounting records both in banks and enterprises exist because and it is a “invisible” part of interest receivable and interest payable. For that reason SNA1993 and ESA95 (prior to the FISIM Regulation 448/98, which amended ESA95 now fully incorporated in the new ESA2010) established simplified rules for the calculation and allocation of this part of the output of the credit institutions, i.e. its use or consumption is calculated in a special way on the expenditure side of the system of supply and use in national accounts.

The solution for this statistical problem was found in the formation of a special, fictitious or nominal institutional sector that will perform the role of the "consumer" of FISIM for the whole economy. So, on the production side FISIM is included as part of the output increasing the GDP. On the expenditure side, now introduced was a nominal sector with only one item on the uses side and it included consumption of FISIM for all institutional sectors of national economy. He is subtracted from GDP as a kind of intermediate consumption of all the sectors of the national economy including so called “rest of the world – ROW” which designates the exports and imports of these services from abroad.

Detailed formula for the calculation of FISIM used by the Member States and which is still used for structural business statistics was presented in the Annex 6 of Regulation No 295/2008 for SBS. The Output credit institution is calculated by the following formula (Eurostat, 2008):

Table 1. Formula for the calculation of the output of credit institutions defined by SBS regulation No 295/2008

PRODUCTION ACCOUNT	**Sign** (+/-)
1) Interest receivable and similar income showing separately that arising from fixed-income securities These items shall include all income from: . Cash in hand, balances with central banks and post office banks . Treasury bills and other bills eligible for refinancing with central banks . Loans and advances to credit institutions . Loans and advances to customers . Debt securities including fixed income securities	+
2) Income from securities including: . Income from shares and other variable-yield securities [Note: The income from participating interests and the income from shares in affiliated undertakings has been excluded, because the income of productive factors received by a enterprise is not considered as production of that enterprise]	+

PRODUCTION ACCOUNT	**Sign** (+/-)
3) Commissions receivable (shall include income in respect of all services supplied to third parties): in particular: . Commissions for guarantees, loans administration on behalf of other lenders and securities transactions on behalf of third parties . Commissions and other income in respect of payment transactions, account administration charges and commissions for the safe custody and administration of securities . Commissions for foreign currency transactions and for the sale and purchase of coin and precious metals on behalf of third parties . Commissions charged for brokerage services in connection with savings and insurance contracts and loans	**+**
4) Net profit or net loss on financial operations (trading/dealing): including: . The net profit or loss on transactions in securities which are not held as financial fixed assets together with value adjustments and value re-adjustments on such securities . The net profit or loss on exchange activities . The net profits and losses on other buying and selling operations involving financial instruments, including precious metals	**+/-**
5) Other operating income	**+**
6) Sub-Total	

PRODUCTION ACCOUNT	**Sign** (+/-)
7) Interest payable and similar charges These item shall include all charges from: . Amounts owed to credit institutions: . repayable on demand . with agreed maturity dates or periods of notice . Amounts owed to customers: . savings deposits . other debts . Debts evidenced by certificates . Subordinated liabilities	-
= 8) Value of production (excluding value adjustments)	

4. CALCULATION AND ALLOCATION OF FISIM

In order to accurately determine the value of FISIM and its consumption, the new methodology introduced in 1998 required full allocation of FISIM to user sectors. The Part of FISIM consumed by business enterprises, government institutions, Non-profit institutions and other financial institutions, since it is a service related to their business oprations i.e. their economic activity is treated as part of operating costs (intermediate consumption) of these sectors and is distributed according to the deposits and loans of these sectors in banks. The second part of FISIM created in retail banking transactions with citizens i.e households (consumer loans, overdrafts, etc.) is treated as a final consumption of households . In this way, only part of FISIM now appears as intermediate consumption and there is no longer the fictitious institutional sector - the consumer of this service. This leads to an increase in GDP of one side and the final consumption of households on the other.

Distribution of FISIM to institutional sectors is based on the volume of deposits and loans which sectors have in transactions with banks and so-called „internal reference rate“. The reference interest rate is "basic" or minimum price of money that banks have to pay to get it and then deploy as loans to their customers. It's pure interbank interest without the risk premium and costs of monetary intermediation. According to the above mentioned EU regulations, the reference interest rate is calculated as the average interest rate on interbank loans). Upon this „pure“ interest rate, banks are adding the service charge for monetary intermediation i.e. FISIM and so a market interest rate is made.

So, interest that customers of banks receive as a income from their deposits is actually only residual from this pure interest that banks pay for obtainining money on interbank money market after the implicite service charge – FISIM is deducted from it. On the other hand, interest that customers pay for their loans and credits is actually the pure interest on wich a margin of service charge for monetary intermediation has been added.

Figure 1. shows the National Accounts concepts of interest received and payable and the distinction between actual interest and the „pure“ interest of banks on which the service charge margin for the monetary intermediation has been added or deducted.

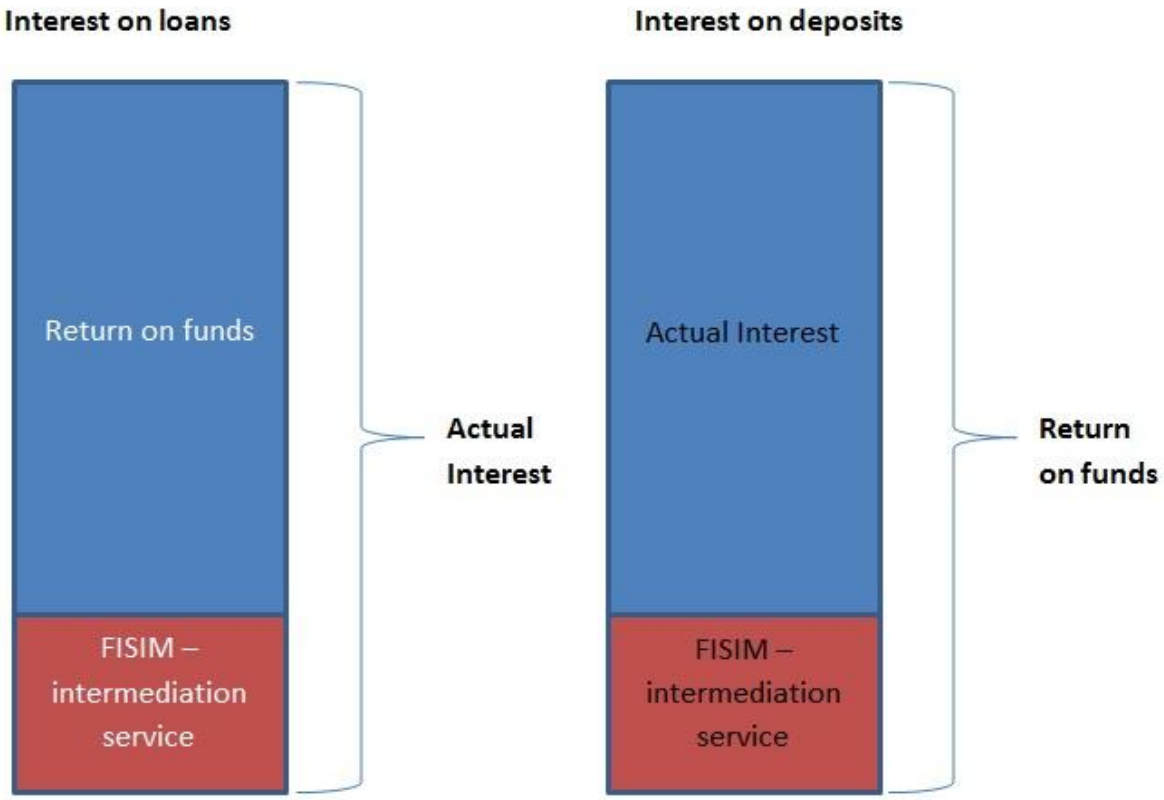

Figure 1: Relationship between different parts of interest in the monetary intermediation

As we have said, the total FISIM by an institutional sector *j* is obtained as the sum of FISIM on loans granted to the institutional sector ($FISIML_j$) and FISIM on deposits of the institutional sector ($FISIMD_j$).

$$FISIM_j = FISIML_j + FISIMD_j = RL - L_j r + D_j r - RD$$

Where RL is interest receivable on loans and RD interest payable on deposits. L is average stocks of loans and D average stocks of deposits. Internal reference rate is represented with *r*.

Rearranging this equation (3), we get:

$$FISIM_j = RL_j - RD_j - (L_j - D_j)r$$

Total FISIM is obtained by summing the FISIM for each institutional sector *j.*

FISIM together with other above mentioned components of operating income represents the value of production of credit institutions i.e. output.

Practically, for the statisticians, the calculation and distribution of FISIM to its user sectors necessiate data on each institutional sector concerning deposits, loans and accrued interest. For the calculation of internal refrence rate i.e. pure interest, data on interbank loans is required.

Now, we will show one simplified example for the calculation of FISIM for the sector of non-financial corporatons:

Reference rate - 5 %
Average stocks of deposit of business enterprise in banks - 100.
Total interest receivable by companies in respect of deposits - 3.
The average interest rate of 3 /100 = 3 %

Average stocks of loans of companies - 200
Total interest expenses of companies - 20
The average interest rate on loans : 20/200 = 10 %

FISIM on deposits will be (5 % - 3 %) * 100 = 2
FISIM on loans will be (10 % - 5 %) * 200 = 10
Total FISIM is 10 +2 = 12

The total interest margin is 20 - 3 = 17. If we subsctract from this interest marigin actual net interest 5 (200-100)*5% we will have the service charge for monetary intermediation.

The same formula applies for the other institutional sectors and the for the estimation imports and exports of FISIM data on deposits and credit transactions with non-resident credit institutions are required together with „external reference rate“ – interbank reference rate in transactions between resident and non-resident banks. The above presented calculation should also include finance leasing companies and other credit granting institutinons.

The ESA methodology for the calculation of the output of credit institutions and its allocation of in all EU countries has led to an increase in GDP because one huge part of it is now not deducted as a intermediate consumption but as a final consumption of households. Depending on the share of loans of households in the total volume of loans, the impact was larger or smaller.

5. CONCLUSION

Measurement of the output of banks and credit institutions in the system of national accounts represents rather complicated statistical procedure that requires reliable data on structure of deposits and loans as well as interest rates by different institutional sectors of national economy. National accounts methodology makes distinciton between actual inerest and „pure“ interest on which costs of intermediation service charge in the form of FISIM is added and charged to customers. In order to calculate the output of credit institutions SNA2008 and ESA2010 determine procedure for derivation of this statistical indicator and its separation from interest as property income.

6. REFERENCES

European Union (1998): Council Regulation (EC) No 448/98 of 16 February 1998 completing and amending Regulation (EC) No 2223/96 with respect to the allocation of financial intermediation services indirectly measured (FISIM) within the European system of national and regional accounts (ESA).

European Union (2002): Commission regulation (EC) No 1889/2002 of 23 October 2002 on the implementation of Council Regulation (EC) No 448/98 completing and amending Regulation (EC) No 2223/96 with respect to the allocation of financial intermediation services indirectly measured (FISIM) within the European System of national and regional accounts (ESA).

European Union (2013): European System of Accounts - ESA 2010. Luxembourg. Publications Office of the European Union.

Eurostat (2008): Methodology for Business Statistics – Methodological manual for statistics on credit institutions, Version 2.0. Luxembourg, Eurostat.

United Nations (2014): Financial Production, Flows and Stocks in the System of National Accounts. New York, United Nations.

POSTAL AND FINANCIAL INCLUSION

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Abstract: *Inability and/or difficult access to financial services consequently forces individuals, especially those most vulnerable, to look for solutions outside of authorized financial institutions. Such solutions are usually less safe and more expensive, and for this social group actually mean a return to the vicious cycle of poverty. Postal financial services are used by more than a billion consumers worldwide. The data suggest that several hundred million people who do not have accounts with banks or other financial institutions, use the Post for basic services, payment services, money transfers, money orders in the domestic and international financial transactions. In this paper, we have analyzed the role of postal financial services in the process of financial inclusion. By applying the survey method we have analyzed the following: the involvement of residents in the financial sector of the Republic of Serbia, the expectations of the financial sector and the opinions and level of satisfaction with the postal financial services. On the basis of obtained results, concrete proposals for further development of postal financial services in the Republic of Serbia are presented.*

Keywords: *post, finance, services, inclusion.*

1. INTRODUCTION

In the postal sector, there are numerous successful examples of postal-financial services, such as: the Postal Savings Bank of China, which has 475 million customers; Brazil's Correios with 10.2 million accounts opened in 10 years through a partnership with a bank; Namibia Post, which banks 20% of the total population in the country; India Post, which covers risks for 20 million people through its postal life insurance policy and holds 250 million of savings accounts; Papua New Guinea Post which is one of the three main competitors for mobile financial services in the country; Serbian Post which makes 150 million financial transactions per year in a country of 7 million inhabitants and so on (Berthaud&Davico, 2013).
Postal operators, in all their activities, have always relied on a business model based on large volumes and low cost. Financial services combined with the universal postal service and public postal network give the mandate to the Post to become a part of global fight against financial exclusion of the population.
Three major historical patterns explain the reasons why the postal organizations have begun to provide financial services:

- *First*, in most countries, the government has mandated the postal administrations or post savings banks to become an active participant in government development policy through the provision of public services to population that has no access to banks in the country. A good example of this is the formation of Postbank Lao and Vietnam Postal Savings Company (World Bank, 2006). The government's goal was to use the postal network to deliver the funds to enterprises and local government in rural and remote areas, such as Sri Lanka and India. Most countries in Western and Central Asia used a similar model. Not long after, the option of saving as another public service was offered.
- *Second*, offered financial products - mainly the service of savings via the post can be a source of government financing. The Post invests collected savings into government bonds or other financial instruments, as it is the practice in most African countries. The practice in India and Pakistan serves as another alternative, where post offices serve as the Government representatives in the sale of securities.
- *Third,* the government had in mind the income arising from financial services as resource for covering the cost of the universal postal service.

Post office's range of services depends on the legal and regulatory provisions under which financial services are offered. Post uses several models and methods of providing financial services, such as:

- *The Post as a part of the Ministry of Telecommunication and Postal Services* do not represent a separate entity, they do not have separate structure and are managed by the Minister (India, Yemen). Provision of financial services is performed within the same legal framework.
- *The Post is a separate legal entity whose ownership belongs to the state.* Within the post there is a sector which conducts financial services without a certain balance or statement of profit and losses.
- Many different legal entities (such as postal savings banks and postal services) conduct/provide financial services (the Philippines, Serbia, Montenegro). There may be a cooperative agreement (agreement on the type/level of services) which regulates the quality of services, payment of commission, cost-sharing,

training of personnel, accountability. This agreement defines the conditions under which these organizations work together and use the term "postal".

- *Post and postal savings bank wholly or partially belong to private investors* , which is not in accordance with protection of the principles of the public interest (Kavanagh, 2013).
- Post Offices focus on their core business, while financial services are handed over to specialized institutions such as commercial banks (Brazil, Malaysia, and United Kingdom). Financial products are sold under the brand name of postal organizations (Estonia) or the operator providing that service. The contract binds the post and financial institution. Posts can choose their partners by means of tenders, which has been done in the case of Brazil's Correios in Brazil, when the firm *Bradesco* was selected. However, in some countries (India, Pakistan) post offices on the basis of agent agreement, sell state bonds and other financial services (World Bank, 2006).

2. IMPORTANCE OF FINANCIAL INCLUSION AND THE ROLE OF POST IN THE PROCESS OF FINANCIAL INCLUSION

The concept of financial inclusion appeared for the first time in the UK in 1995. At that time, financial exclusion was primarily observed in the context of geographic accessibility. Nowadays, it is more than clear that financial exclusion is far more complex and that it does not only include access to variety of financial products and services, but also the possibility of their use.

The European Commission stresses that the "financial exclusion refers to a process whereby people encounter difficulties accessing and/or using financial products and services in the mainstream markets, and these products and services meet their needs and enable them to lead a normal social life in the society to which they belong" (Petrovic & Kaplanovic, 2012).

According to a survey by MasterCard "The Road to Inclusion", millions of people in Europe are fully or partially excluded from the financial flows. The average age of people who are completely excluded from the financial flows is 40 years old. The largest part of this financially excluded group (40%) in the last three months did not receive any form of payment, salary, welfare or anything similar. 35% received some type of salary in that time frame. 81% of them have lived in the same country all their life. Rather than benefiting from the characteristics of bank accounts such as transferring funds from one account to another, electronic banking or even the subsequent ability to buy merchandise at a discount over the internet, most people in these groups use cash to pay the rent (98%) and bills for utilities (95%), and stash their money in a secret hiding place in the house. Only in Western Europe, there are 93 million people who do not have a bank account or partially use services of banks.

United Nations – UN defined goals of financial inclusion as follows:

- Access at a reasonable price for all households to a full range of financial services, including savings or deposit services, payment and transfer services, insurance and credit services (Leonelli, 2002)..
- Sound and safe institutions, governed by clear regulations and standards.
- Financial and institutionalized sustainability, continuity and certainty of investment.
- Competition to ensure choice and affordability for customers.

Universal Postal Union - UPU has repeatedly made detailed studies and initiated activities to identify the role of post in the process of financial inclusion. The aim was to provide basic financial services (savings, payments and money transfers) to population without access to such services.

Advantages of post in achieving financial inclusion over other providers of financial services[1], particularly in relation to the banking sector, are reflected in the widespread postal network and confidence that post has especially among the poor.

Postal sector worldwide has more than 660,000 post offices, which makes it one of the largest distribution networks. This is particularly important for developing countries where, according to the World Bank study, the number of postal units and offices (500,000) is almost twice higher than the number of branches of commercial banks (275,000). Moreover, what is particularly important is that widespread postal infrastructure allows the postal system to provide services to the whole population. This is what differentiates the postal financial system and the private banking sector which seeks to allocate their institutional resources to the wealthier segments of the population, in order to obtain maximum profitability.

In addition to the extensive network of postal branches, advantage of post is also computer network for electronic data exchange. It facilitates the provision of payment system (Abdallah&Shakurova, 2012)..

[1] Financial services providers, can be divided into groups:

- Major commercial profit-oriented providers (banks and insurance companies);
- Commercial social-oriented providers (savings banks, postal banks and joint organizations):
- Alternative commercial (savings-credit cooperative and other micro financing institutions); i
- Alternative commercial profit-oriented financial services providers.

A typology of business models for postal financial inclusion (Berthaud&Davico, 2013) can be represented as follows:

- Post as a real estate provider – post can rent the space within postal units to financial service providers. Process of financial inclusion will depend on the financial partner which rents space from the post.
- Post is CM (CM - cash-merchant) – Post offers a single private partner or multiple partners the use of its units and staff for transactional financial services.
- Postal transactional financial services - Postal money orders generally form part of the traditional financial postal services and are a part of its core business.
- Post and partnership with a financial service provider - In this business model the Post usually offers the whole range of products of its partner.
- Post and unlicensed postal and financial services - This model involves provision of savings and credit services directly by post. In some countries, depositors of savings accounts benefit from a preferential tax exemption up to a certain amount. Northern, Western and Southern Africa, Western Europe, South Asia, East Asia and the Pacific are the regions with the highest postal savings. In Algeria, for example, the post has 15.1 million, i.e. 63% of savings accounts of the total 24.1 million accounts in the country. The Post in Algeria performs this service on the basis of the Postal Act, which allows the Post to offer these services without a banking license.
- Post and licensed postal financial services - More and more countries are exploring the possibility of creating a postal bank. The Post of Japan generates 90% of its income by its financial services, France with 23%, and Morocco with 62%. However, creating a postal bank is followed by some challenges. First, there is a regulatory challenge in securing a banking license. Second, capital requirements are a major obstacle (government and private sector). In Belgium, postal bank is a joint venture with the private sector, i.e. the Post owns 50% of the capital while a large banking group owns the rest.

The World Bank defines 6 basic types of financial products and services (World Bank, 2006):

1. insurance,
2. bank accounts,
3. savings,
4. credits,
5. transfer
6. financial consulting.

In developing countries, 2.7 billion people or 70% of the adult population does not use financial services of authorized financial institution (Mylenko, 2010).

Inability and/or difficult access to financial services consequently forces individuals, especially those most vulnerable, to look for solutions outside of authorized financial institutions. Such solutions are usually less safe and more expensive, and for this social group actually mean a return to the vicious cycle of poverty. More than 100 million people, i.e. 27% of the population in Central and Eastern Europe and Central Asia are located outside the banking sector or poorly covered by it. Proportion of the population that is not involved in banking relations varies from 25% in Central Europe to over 80% in Central Asia. The lowest offer of financial services is in rural areas (Petrovic & Kaplanović, 2012).

The current crisis solicits the need for the state to conduct an active policy of financial inclusion. In many countries and in different ways, such a policy is already implemented. The fact is that the postal sector, known for its values (user trust, quality, reasonable prices) receives a significant role in the implementation of this policy (Petrovic & Kaplanović, 2012).

The purpose of financial inclusion, and therefore the role of the post office is to bring excluded populations to regulated financial flows in order to provide financial support and improve the quality of their life.

The concept of financial services provision through the post office is not new, but in the practice it had a large number of unsuccessful implementation. The latest challenge is to determine what more can be done in order to offer postal financial services to the population without access to a bank, according to their needs, while on the other hand ensure that the postal network performs these services on a sustainable basis.

Postal network can have an active role in bridging the policy of digital division by connecting postal units through the platform for networking and with adequate technical support and internet (e-government, e-sales) to rural areas.(World Bank, 2006).

Inclusion through the postal network can be viewed at three levels: local, regional and global:

- Inclusion at a local level is provided on the basis of the proximity of access to basic financial services for low and middle income households, access to integrated commerce, communications, delivery/shipment and payment services to micro, small and medium enterprises (MSME) and access to the total population.
- Regional inclusion is provided through integration of MSMEs into regional chains of trade and supply.
- Inclusion at the global level is achieved through special services for migrants in relation to their remittances and postal accounts, as well as through international trade benefits for MSMEs.

The process of financial inclusion, in addition to positively affecting financially excluded population groups, also has significant positive effects for the post. Combined with traditional postal services, postal financial

services, and especially postal savings through more intensive use of the postal infrastructure, in return give the post reduced costs and increased efficiency. The total income generated from financial postal services in the world (excluding Japan) grew in the period from 2001 to 2008 from 14.1 to 29.4 billion dollars.
There are different projects and institutions which support financial inclusion worldwide.
Alliance for Financial Inclusion (AFI) is the largest and most important network of financial inclusion in the world. AFI was founded in 2008, as the project funded by Bill & Melinda Gates Foundation and supported by AusAID to promote the development of a reasonable policy of financial inclusion in developing countries. AFI network counts more than 105 institutions from 88 member countries from 2008 to 2013. In 2011 AFI has adopted Maya Declaration, a set of common principles and objectives of the development policy of financial inclusion.
Center for Financial Inclusion (CFI) is a movement that was formed in 2008. To help establish financial inclusion around the world, CFI defined full financial inclusion as sustainable if users have access to complete package of financial services, at affordable prices in a unique way, equally, without discrimination. The vision of CFI is to fully implement the inclusion through a stable and competitive service provision. Access to financial services is accelerated as a result of the following: micro insurances are booming and reaching half a billion of insured people; the potential market is between 1.5 and 3 billion people; a large number of financial policy makers throughout the global community promotes financial inclusion The *Basel Committee on Banking Supervision* (*BCBS)* and The *Financial Action Task Force* ((*FATF*)). Central banks and ministers of finance from over 80 countries participate in the Alliance for Financial Inclusion (AFI); focus is on the importance of the customer. Generally, financial inclusion involves various directions and steps, such as:

- Opening a bank account without unnecessary details and conditions, available to almost the entire population. Banks are advised to enable an overdraft on this account.
- Simplification of procedures and norms for opening an account.
- The involvement of intermediaries in providing financial and banking services.
- Using technology: Banks are advised to make effective use of legal, informational and communication technologies and to provide easy performance of all banking services through intermediaries.
- In order to assist the poor and vulnerable, cheap an easily accessible credits are available for this layer of population.
- Establishment of permanent bank branches in rural areas.

Financial inclusion has its shortcomings and risks. Above all, risk of excessive debt of population. This problem is solved by defining an optimal set of basic financial services. However, the benefits of financial inclusion are numerous, from the lower prices of financial services to greater access to the financial sector, and the development of competition in the banking market and the development and improvement of existing financial services.

3. FINANCIAL SECTOR IN THE REPUBLIC OF SERBIA, POSITION AND PERSPECTIVE OF THE POST OF SERBIA

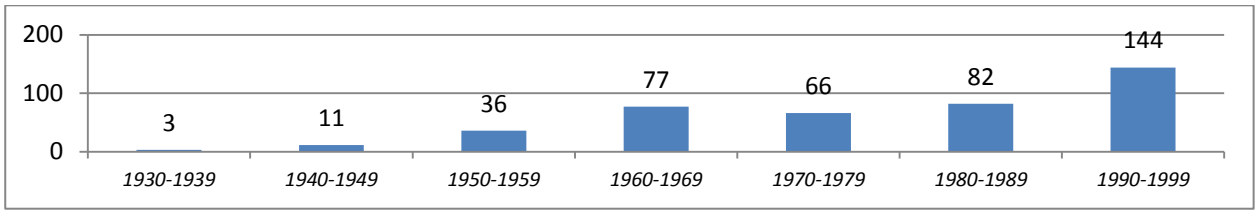
At the end of the first quarter in 2013, 32 banks were doing business in Serbia. Banks owned by foreign entities continue to have a dominant share in the banking sector by approximately 75% of the assets and profit of the banking sector. Banks which originate from the European Union have the share of 70.7% (69,2% from countries where euro is used) and the banks originated from Russia and USA have the share of 3,6% and 0,3% respectively. While the relation of asset to capital according to the origin of ownership in banking sector is almost the same, banks owned by domestic entities (primarily state-owned banks) still have more developed branch network, as well as a larger number of employees, i.e. 36% of the organizational network and 28, 4% workforce in contrast to 25,4% share in balance sheet and capital. Of the total number of banks, 22 of them operated with a positive result that is a total of 12.63 billion dinars, while 10 banks operated with losses of total 1.78 billion.
Financial services that are performed in the units of postal network in the Republic of Serbia can be divided into:

- services performed in the name of post and for their own account,
- services performed on behalf of the bank and for the account of bank.

Post performs various financial services as a part of their own business to private and legal entities, in accordance with the regulations governing this area (laws, regulations, manuals, price list etc.) and contracts signed with clients. Services performed by post but on behalf and account of bank are also regulated by general laws, special agreements with banks, as well as internal regulations, which were adopted by both the bank and post office for the performance of these services.

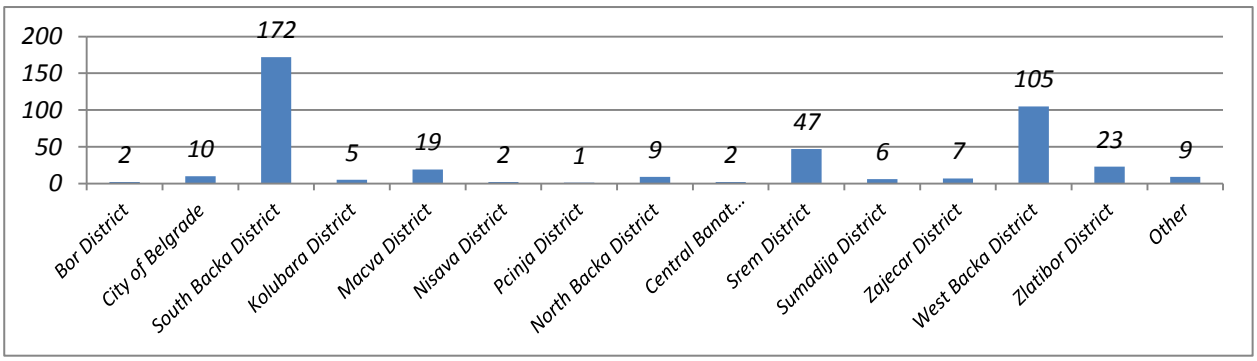
3.1. Analysis of the involvement of people in the financial sector

For the purposes of this study, 419 inhabitants of the Republic of Serbia were surveyed of whom 191 (46%) were males and 228 (54%) were female. The average age was 36 years. The oldest respondent was 72 years old and the youngest 19 years old. The graph 1 shows the number of respondents by age.



Graph 1. number of respondents by age

Graph 2 shows the number of respondents per the administrative districts of the Republic of Serbia. The largest number of respondents came from the South and West Backa District (277). Although the survey included the respondents from other districts (133), as well as residents of the Republic of Serbia whose permanent place of residence is outside the Republic of Serbia (9).



Graph 2. respondents by place of residence

Of total 419 respondents, 162 (38.66%) are employed in the public sector, 63 (15.03%) are employed in the private sector, 7 (1.67%) are entrepreneurs, 168 (40.09%) are unemployed and 19 (4.53%) are retired. Confidence in the banking sector has presented 222 (53%) respondents. 102 respondents are satisfied with their financial situation, while a higher number is not satisfied (319 respondents). Another interesting fact is that 40 out of 168 unemployed persons are satisfied with their financial situation. This fact indicates that these people make significant income while unemployed in the form of gifts, income from property, and income from deposits, insurance fees, scholarships and other.

220 respondents regularly receives income from employment (of which 28 respondents have other sources of income), 42 respondents have income outside regular employment occasionally working on contractual basis (of which 16 respondents have other sources of income). 36 respondents receive pension, of which 19 receive old-age pension and disability pension, while others receive survivor pension, and belong to the group of unemployed persons (those are usually students and persons who earn income outside of employment). Public aid (welfare, material benefit, alimony, child support, scholarships) receives 44 respondents and they also have other forms of income such as gifts and awards. Solely from gifts and gains, 46 respondents generate income. 373 respondents have bank accounts, while 46 respondents do not have a bank account. It is also indicative that the of 46 respondents who do not have accounts, 22 of them receive earnings from casual employment in cash, while 14 respondents receive money from pensions and public through money order.

Of the total number of respondents, 268 are partially satisfied with the services of banks in Serbia, while 58 respondents are not satisfied with the service. Even though 9 respondents have not used banking services, but the number of those who used several different banking services (current accounts, loans, electronic banking, etc.) is bigger than this. 17 respondents use cards to pay over the Internet, 89 own credit cards, while 190 respondents use debit cards. Credits that are most commonly used are: cash loans (50 respondents), residential (27 respondents), consumer (19 respondents). Electronic banking is used by 59 respondents.

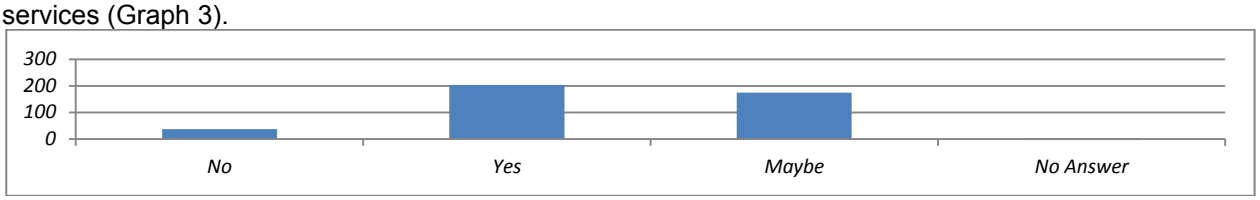
At the same time, respondents were asked about the services they are unable to use and there is a demand for these services. Therefore, 74 respondents are in need of e-banking services, but need more information about those services, and 115 respondents are in need for some form of credit, but their personal financial situation or the conditions under which these are granted, does not allow their use.

Respondents have listed reasons for not using banking services and those can be broken down as follows:

- no need for additional services (45)
- inadequate working hours of banks (29)
- The Bank has no branch in their neighborhood (5)
- lack of information about the services of banks (125)
- poor personal financial situation (172)
- bad portfolio of banking services with high commission and bank interest (14)

3.2. User expectations of the financial sector

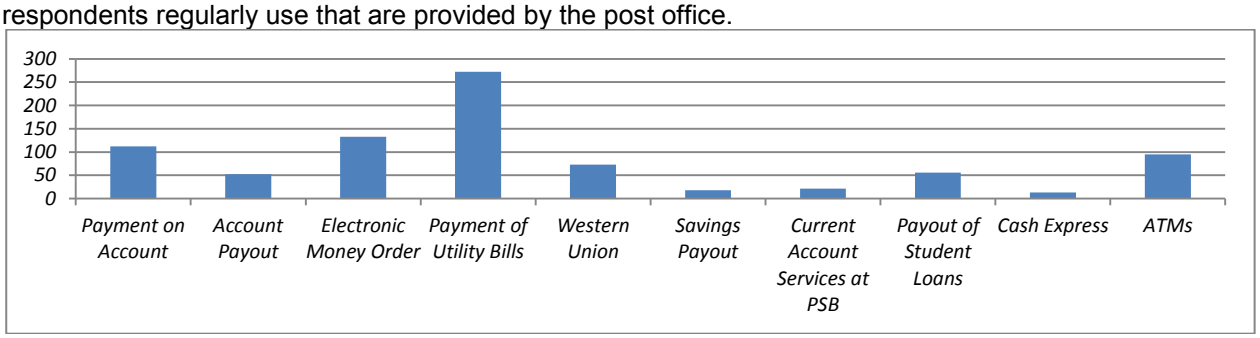
Respondents expect the banks to decrease bank interest and commission (154). Mainly, people expect lower interest rates on cash loans and overdrafts. Then, credits without interest and loans to pay for food for the winter, fuel, utility costs (heating and electricity), taxes and other costs incurred in order to satisfy the existential and basic needs. Greater availability of insurance (health and pension) is expected on behalf of 10 respondents.
A larger number of respondents (203) believe that the post office can provide greater availability of financial services (Graph 3).



Graph 3. Do you think that post can provide greater access to financial services?

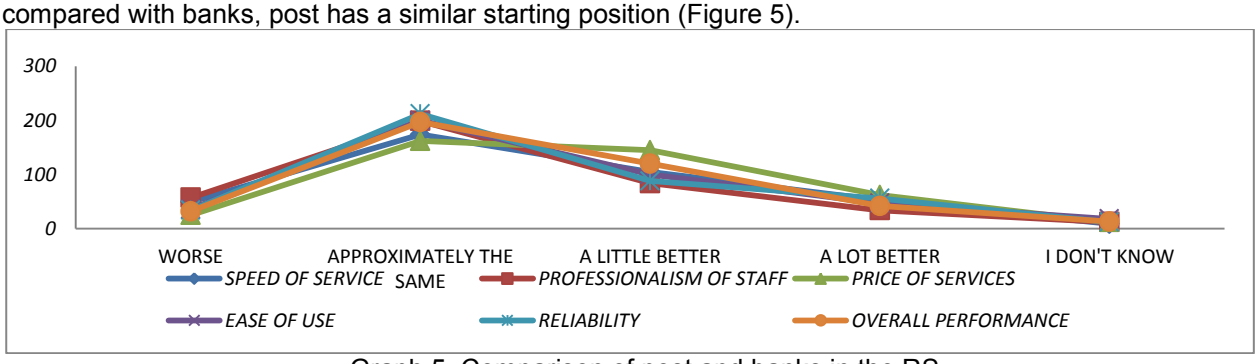
3.3. Assessing the role of post in the development of financial sector

Respondents use certain payment services regularly and give priority to the use of these services at the post office in relation to the bank (for example, payment of utility bills). Graph 4 represents services that respondents regularly use that are provided by the post office.



Graph 4. Services that customers regularly use in the post

Certain aspects of postal financial services (cash operations) such as speed of service, professionalism of staff, ease of execution, range of products and service quality, respondents have assessed as satisfactory, and the price of services as moderate in relation to quality. Availability of service information is satisfactory, as well as availability of forms and the speed and efficiency of handling documents.
Respondents believe that the post has yet to act in order to improve each of these aspects. However, compared with banks, post has a similar starting position (Figure 5).



Graph 5. Comparison of post and banks in the RS

3.4. Perspective of post and redesign of postal financial services

Based on different evaluation of respondents and valuing resources of post, such as:

- Developed ICT solutions (computer network PostNet, technological application solution PosTis, the certification body of the Post, participation in e-government project, etc);
- Postal network with approximately 1,500 locations throughout the RS;
- Contractual relationships with banks, utilities and other organizations and institutions, we have concluded that the process of financial via Post of Serbia can be implemented.

The following arising question relates to the choice of model which will be used. So far, posts in the RS have not performed full set of contractual business/obligations/agent services for banks (credits, savings, issuing credit cards etc.).

Its operations have primarily been based on cooperation with the Postal Savings Bank, which is an independent business entity. Apart from the expansion of the network and services of the Postal Savings Bank, the issue of providing banking services to vulnerable population and that in rural areas the RS, which are geographically and economically excluded from the financial services sector, still remains unsolved.

Post in RS, in the process of financial inclusion should improve the quality of existing financial services, customer relationship and ensure provision of new services such as:

- service of user profiling of favorable financial services based on e-government, with the aim of reducing the cost of obtaining the necessary documentation from different parts of the administration (land certificates, proof of unemployment, confirmation of the amount of social benefits, the number of household members, etc.).
- services for vulnerable and poor population - loans with no interest or loans with a lower interest rate for food, clothing and footwear, housing costs and treatment, based on the earned income (public aid, welfare, scholarships, etc.);
- insurance services, primarily health care and retirement, with the possibility of savings and access to funds prior to the expiration of the insured period (bearing in mind the social profile of the user).

This approach requires a broader initiative with the support of the government and the financial sector. Current provision of this type of services by post is only possible through a contract with banks on the performance of agent activities, and participation of state funds for subsidizing these types of crediting and e-government services.

Another possibility is that post performs these services without a license or to be provided with a banking license to a limited set of services.

4. CONCLUSION

Development of the financial sector in the Republic of Serbia in the future will depend on availability of certain financial services and opportunities that a large part of the population becomes involved in regular financial flows. If the current trend still continues, there will be a reduction in the number of branches of banks, and greater geographic exclusion of the population. Post as a provider of financial services and a public postal network as a resource, this can quickly stop this trend and assist in the implementation of services for socially deprived part of population.

In further research, it is necessary to define the criteria for profiling users of financial services and to determine the set of services that will optimally meet their needs.

REFERENCES

Abdallah, F., Shakurova, Y. (2012). Measuring postal e-services development, Universal Postal Union., Bern.

Berthaud, A., Davico, G., (2013). Global Panorama on Postal Financial Inclusion: Key Issues and Business Models, Universal Postal Union, Bern.

Kavanagh, J. (2013). Financing Services of General Economic Interest: The European Commission's Economic Tests, Financing Services of General Economic Interest Legal Issues of Services of General Interest, 149-159.

Leonelli, L. (2002). The Posts: a Full Range of Payment Services, Modernisation and Privatisation of Postal Systems in Europe, 175-211.

Mylenko N. (2010). Measuring Access to Financial Services, Access Finance Newsletter No. 30, The World Bank.

Petrović-Vujačić, J., Kaplanović, S. (2012). Uloga poštanskog sektora u procesu finansijske inkluzije, XXX Simpozijum o novim tehnologijama u poštanskom i telekomunikacionom saobraćaju – PosTel 2012, 51-58, Saobraćajni Fakultet, Beograd.

CREDITING AND INSURING EXPORT BUSINESS

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Abstract: *Export credit agencies are financial institutions that promote exports and facilitate investment in foreign markets that are considered risky. These agencies can be organized as banks, insurance companies or financial corporations and are mostly owned by the state, and do business in order to support national exports and investment. Special emphasis is placed on the work of the Berne Union, as an important link in the chain of world trade. By establishing special agencies for export financing and providing capital for their activation, state creates capital by which export credit is continuously funded, and thus the main branches, pillars of the industrial development of the country and the state, are maintained and developed.*

Keywords*: export business, export credits, export financing, credit insurance, export credit agencies, the Berne Union*

1. INTRODUCTION

The development of international economic relations, increasing intensity of foreign trade and growing competition in the global market require that the method of payment of exports of goods and services represent an increasingly important element of competitiveness in the global market. In today's business environment, international trade financing is one of the most common forms of business financing. International trade of goods and services is done in very difficult conditions which are linked to a number of risks that are far greater than those that occur in domestic (internal) trade. Due to the possible adverse consequences, it is of great importance for exporters to neutralize the negative effect of export risk or at least to minimize it to a certain extent.

Many countries highlight export growth as the primary goal of their economic policy. In this way, a certain foreign income is ensured, thereby strengthening macroeconomic stability, increase in production and employment and providing regular servicing of external debt. Considering this, the whole set of measures is developed by economic policy-makers with the principal aim: export growth. As a part of this system an important place is occupied by export credit agencies. Established as agencies they are provided to support local businesses in entering foreign markets, primarily through financing and insuring export activities and investment. Almost all countries have this type of agencies, and they have a particularly significant role in the initial stages of development and in terms of market penetration and development of activities on high-risk foreign markets. These institutions may be part of the state apparatus (NEXI, Japan and the ECGD, UK), a special state agencies (the Ex-Im Bank, U.S. and AOFI from Serbia), institutions of private capital under the state influence (Hermes AG, Germany) or mixed-ownership institutions (SACE, Italy). The development of the globalization process and the establishment of regulations on the multilateral level have led to the introduction of rules on the work of export credit agencies. This partly limited their work, but their importance is still relevant, so that they still occupy a special place even in developed countries.

The Berne Union (International Union of Credit and Investment Insurers) has led to the cooperation at the international level and embracement of sound principles in export credit insurance and investment abroad, as well as to equalize the conditions under which the coverage of export credits and investment is approved abroad. The globalization of the world economy imposes the need for our country to be included in the global flows and the exchange of goods and services, labor and capital and thus to define the modern models of support for exports.

2. CREDITING AND INSURING EXPORT BUSINESS

With growing competition in a global market the ability to sell goods and services increasingly depends on the terms of payment. Manufacturers sell their products on credit in order to be more competitive in the global market and provide a greater product placement. In addition to crediting exports of capital goods, other activities are credited that enhance the placement on foreign markets, such as: market research, project development, preparation of production for exports, import of the necessary raw materials and components needed for manufacturing, etc. An international trade crediting is one of the most prevalent forms of international business financing of business entities in international economic relations. Crediting international commercial transactions is realized through export credits. Export credits can be repaid under commercial market conditions or with the official state support through export credit agencies. Depending on

to whom is export credit granted, and who is the user of credit,we can make difference between: supplier's credit and buyer's credit.

Stimulating exports, due to their positive effects on the growth of national income, is a continual task in almost all countries. An important place in this field occupies facilitating export financing under more favourable conditions.(Mladenović, 2010, p.126) The term ***export financing*** involves two interrelated transactions:

- Export credit insurance against commercial and non-commercial risks and
- Providing financial support for exports by issuing guarantees and credit approval toexporters or buyers abroad by commercial banks or specialized institutions for export financing and insuring. (Vapa – Tankosić,2010,p.119)

Supplier's credit / exporter's credit is the financial arrangement of export credit agencies in which supplier / exporter of goods and / or services is credited and may be in the form of direct financing of exporters, refinancing or co-financing through commercial banks' supplier, that is, exporter. Export credit agencies approve this type of credit to domestic suppliers / exporters based on the concluded foreign trade transaction, and in accordance with the general and specific rules for crediting export transactions. Credit approval is conditioned by acceptable collateral, as well as by ensuring payment of export business (insurance policy assigned for the benefit of creditors) and the transfer of receivables based on export contract to the agency. In addition to direct financing of exporter / supplier, agencies may exercise refinancing of export transactions through commercial banks of exporter, wherein the agency places its funds through commercial banks with a more favourable interest rate than the market rate. In case of co-financing exporters, the agency places a part of the funds to the exporter under the agreed conditions (conditions depend on the category of exporters and export business), while the other part of the credit is financed by a commercial bank under the terms of the agency agreement. One form of export credits with the official state support, that are approved by agencies for crediting export transactions is ***a credit to foreign buyer or buyer's commercial bank***. It is a financial arrangement in which a bank or financial institution approves the credit directly to the foreign buyer or the bank of the importing country for financing the purchase of goods and / or services. They are usually in the form of interbank credit lines aimed at establishing long-term relationships with financial institutions in countries that are of strategic importance for exports.For exporters this business of exports on credit is virtually cash credit, because it is charged by the real creditors (a bank), and a foreign buyer repays the credit to the bank creditor based on the contracted repayment schedule, so that this bank bears the risk of debt collection. An agreement to credit buyer or buyer's bank is a financial arrangement that is very favourable for exporters, since the exporter is charged immediately after the delivery, while the credit is repaid by the buyer / bank from abroad. Thus the exporter avoids the risk of export charges and ensures liquidity in the banking business. This type of credit agreement is conditioned by acceptable credit insurance. Consumer credit program or a commercial bank abroad may also be in the form of:

- independent credit to customer or a bank abroad or
- in the form of co-financing export transactions together with commercial banks.

The amount of credit that can be approved by agencies can even be 100% (usually for credits with repayment period of up to two years) to the maximum 85% for export transactions with repayment period[1] up to 10 years. In accordance with the rules of the OECD (The Organisation for Economic Co-operation and Development), the repayment period for financing the construction of hydroelectric, thermal power stations and renewable energy sources can be up to 15 years. Interests for credit users are determined based on the creditworthiness of the bank, the State of export, the types of foreign trade transaction and the like, although one must comply with the minimum interest rates established by international rules (the rules of the OECD). This type of crediting is conditioned by, in addition to the usual collateral (mortgages, pledges, deposits, etc.), credit insurance with export credit agencies, and the insurance premium is usually paid in advance.

3. THE METHODS FOR APPROVING AND EXPORT CREDIT INSURANCE

Crediting as an important factor that affects the competitiveness of exports is closely related to the emergence and development of export credit insurance, because a significant part of the foreign trade transactions is concluded on credit. Hence receivable arises from the foreign debtor that carries a number of

[1]The repayment period is the time from the moment of the obligation to pay for goods or services to the moment of the final payment and depends on the type of goods and services that are exported. For the export of raw materials, intermediate goods and consumer goods, short-term credits are mainly granted with repayment period of up to one year. For the export of equipment and capital goods credits are approved with repayment period of 1-5 years, while long-term credits are approved for implementation of investment projects abroad, delivery and installation of plant investment and their repayment period is over 5 years.

risks and the inability to collect debt. There are basically three types of approval and export credit insurance, and these are:

- export financing or refinancing,
- subsidizing interest rates,
- guarantee and export credit insurance

Governments of countries usually analyze the effects of interest rates on the price of export products and the competitiveness of exporters. Interest rates are subsidized most frequently, so that the bank that approved the credit charges fewer funds than exporters. This is done by a mechanism of refinancing credits granted by commercial banks.

The purpose of the insurancemechanism is that the state should provide sufficient security (reduce the debt collection risk) for the banks which finance exports and stimulate them to grant export credits. The insurance contract is defined as the contract by which the insurer with the premium charge undertakes to indemnify the insured in case of insolvency of the insured person, who is credited by the insurer within the provided coverage limits. (Radović,1989,p.39)

Credit insurance for exports is often performed by specialized agencies for credit insurance for exports through export insurance and financing. This is a case-in-point for all countries. However, these agencies may differ from country to country in terms of status and organization, as well as other characteristics. They may be state-owned, privately owned, or they may be private, but work on behalf of the state.

Export Credit Agencies (ECAs) may (in whole or in part):

- directly finance exporters for export of goods and / or services on credit;
- co-finance exporter with exporter's commercial banks;
- refinance commercial banks for credits that they granted to exporters and foreign buyers for export of goods or services on credit;
- subsidize the difference in interest rates on the funds mobilized in the capital markets at commercial interest rates and lower interest rates by which export credits are approved to foreign buyers.

Some of these agencies provide cover for short-term business and some just for medium-and long-term business. Regardless of the differences in terms of ownership, state-owned agencies are more prominent. Exceptions are: Austria (*OeKB*), France (*COFACE*), Germany (*Euler Hermes*), Portugal (*COSEC*) and the Netherlands (*Atradius*), which have agencies for credit insurance against political and commercial risks in private ownership. Export credits with the official state support are largely conditioned by the participation of the goods of domestic origin in exports (usually a minimum of 50%) and insurance claims while respecting international credit conditions (minimum interest rates) and insurance (minimum premium amount) in order to avoid unfair competition, or subsidizing exports. Export credits with the official state support aim to facilitate and promote national exports, and therefore the national economy as a whole.

According to the operations carried out, that is, the types of instruments that are used to achieve the goals, agencies are divided into:

- Agencies that perform export credit insurance exclusively, while financing activities are left to the banking sector. Such agencies include: Office National du Ducroire (Belgium) , Serviziassicurativo del Commercio Estero - SACE (Italy) , ECGD (The UK), Guarantee Institute for Export Credit - GIEK (Norway);
- Agencies that provide export business, whose activities are supported by a special agency that finances exports. Thus in France, COFACE is a leader in credit insurance, while Natexis finances exports. In Germany, HERMES provides export business, and KfW finances exports, while in Sweden the Exportkreditnamnden - EKN is in charge of insurance, and AB SvenskExportkredit - SEK is in charge of export credits;
- Agencies that provide services of insurance and crediting of exports and issuance of guarantees in export business. These agencies are: Ex-Im Bank (The USA), Export Development Canada - EDC (Canada), Slovenian Export Corporation - SEC (Slovenia) and ATRADIUS NV (The Netherlands).(Berneunion, http://www.berneunion.org/about-the-berne-union/berne-union-members/)

Another important activity of the agencies in addition to credit and export insurance is ***to provide information and consultancy services***. This activity involves the supply of information to exporters, which in terms of breaking into a new market can be of great importance. (Kjell& Kirsten, 2005, p.676-695) In this context, agencies provide their clients with a wide range of information on the creditworthiness of customers,

banks, institutional framework and legislative regulations in the country of (potential) importer, etc. These pieces of information provide a clear picture of a particular country (foreign partner) by whichrisks are reduced to a certain extent, and therefore the hidden costs of doing business.In this sense, a positive example is the Canadian EDC (Export Development Canada), which supplies its customers with a set of databases including research of regulatory environment and economic conditions in certain countries. In addition, the EDC has the function of mediator in the sense of establishing contact between Canadian exporters and potential partners from other countries, which greatly facilitates the undertakingof initial steps of Canadian exporters on the road to conquer new markets.

4. INTERNATIONAL UNION OF EXPORT CREDIT INSURANCE - THE BERNE UNION

International union of credit and investment insurers - the Berne Union has led to an international cooperation and embracement of sound principles with export credit insurance and investment abroad, as well as to equalize the conditions under which coverage of export credit and investment abroad are approved. The Berne Union was founded in 1934, by a group of private and state-owned export credit insurers from France, Italy, Spain and the United Kingdom. (Berneunion, http://www.berneunion.org/about-the-berne-union/) Registered headquarter is in Bern, which means that the law of Switzerland is applied, but headquarter of a very active secretariat is in London. During time, this extremely important and influential international non-profit association, widened its membership and broadened the range of activities.

The main condition for membership in this association was that an institution ensured*receivables*to significant extent from*non-commercial*–political risks. Insurance claims from commercial risks is also present in these institutions, with the difference that the insurance of *non-commercial* risksis the main characteristic and purpose of association due to its multiple features, non-compactness of these risks, opportunities for simultaneous occurrence of a large number of risks, difficult or almost impossible actuary in a way that it exists in all other types of insurance, insurance institute combinations and measures of foreign policy, geopolitics, national export strategy and development, diplomacy and other public law elements.

Since the mid-nineties until now, the national export credit agencies has joined this association and / or other organizations from countries that have completed the process of transition as well as some countries that have succeeded in an attempt to move from the status of developing countries to the status of developed countries. (Stamenković&Rujević – Džodžo,2008, p.25)***The main aim of the Berne Union*** is the promotion of international practices of export credit insurance and foreign investment, and the acceptance of common principles of insurance, mutual exchange of information about customers, banks and countries. It cooperates closely with international financial organizations. The changes in the market of credit insurance in the early nineties had a major impact on the organization of the Berne Union.Namely, along with the globalization of the world economy came a major expansion of network of branches and subsidiaries of insurers, members of the Berne Union, privatization and acquisitions.

Special activities of the Berne Union include the acceptance of harmonized basic rules and standards in the implementation of insurance, that is,export credit guarantee and investment, and the development and implementation of insurance-related innovative financial products for export and debt collection. The Berne Union, within determining insurance policies, forms the key guidelines for export credit insurance for certain types of products and services, relies on the categorization by the OECD, regarding a list of risks of countries, brings the basic principles and recommends requirements in export credit insurance, guarantee of payment, investment insurance in some investment countries.Members of the Berne Union, in relation to the official export credits (export credits with state support mostly through ECAs and for the corresponding products and the duration over two years), are obliged to adhere to the OECD Agreement on guidelines for officially approved export credits (height of a minimum advance payment, the credit duration depending on the type of export, development of a country, credit risk and country risk, the minimum interest rate, provided that these conditions are reviewed every six months, and the interest rate on a monthly basis, appropriate protective clause, etc.). The present arrangement does not cover the export of military equipment and export of agricultural products.With regard to the premium insurance, since 1998, the OECD members have reached an Agreement on minimum premium rates that must be charged with export credit insurance, in order to avoid the possibility of subsidized transactions, in case of applying lower premium than the prescribed minimum. This agreement is known as "The Knaeppen" packageand within it all the countries are divided in eight categories (the OECD countries with high amount of annual income tax, very low political risk etc. belong to the category "O"), so that the premium is determined depending on the category to which a ranked country belongs in terms of risk, the percentage of credited part of a business and life insurance coverage. Categorization of the OECD countries according to the level of risk is reviewed every six months.

Table 1: Rules of the Berne Union in terms of the credit duration

Types of goods and services	Credit duration
Raw materials, primary products and semi-finished products	Maximum 6 months
Consumer goods and consumer services	Maximum 6 months
Durable goods	Maximum 2years
Parts and components including related services	Maximum 6 months, , exceptionally up to 5 years if it is justified
Quasi capital equipment, including related services	Depending on the contract value, maximum 5 years
Capital goods and project services	Maximum 5 years, or more if it is in accordance with the agreement with the OECD
Complete factories	Maximum 5 years, or more if it is in accordance with the agreement with the OECD

Source: Bern Union General Understanding, January 2001

Depending on the type of goods that are exported, members of the Berne Union agreed on the maximum duration of the credit, as shown in Table 1.

The Berne Union and its members are an important link in the chain of world trade and its member states record a steady growth in business, or in the extent of coverage of export business and investment with state support. The Union concludes agreements, issues recommendations and encourages the exchange of information through three committees - for short-term business, for the medium / long-term business and through the committee for investment insurance. According to estimates, about 90% of world trade is carried out with the support of one or more instruments of trade finance. (Kovačević, 2013, p.12) The importance of export credits mostly includes the following information on the insured amount of export credits.

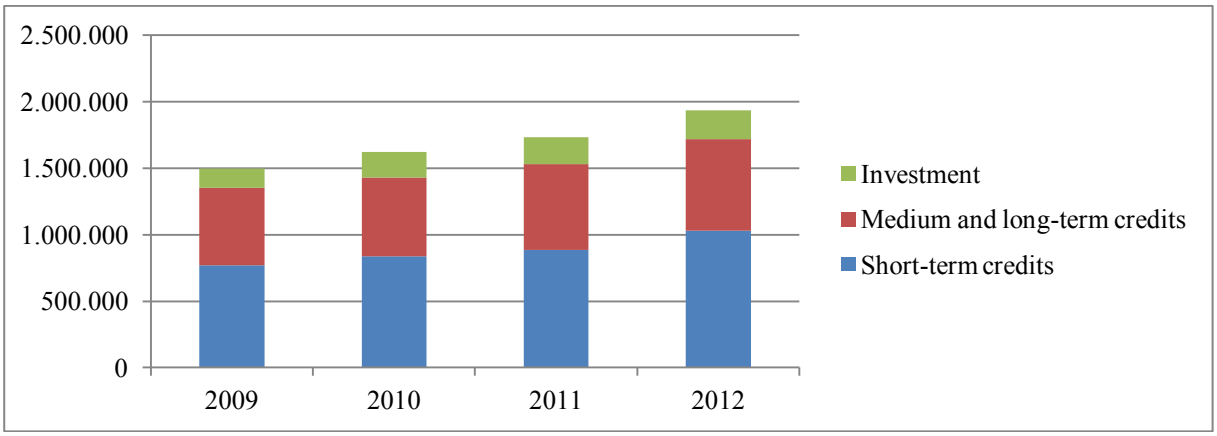

Figure 1: Investment, medium and long-term credits, short-term credits

Source: Berne Union Statistics 2008-2012, http://www.berneunion.org/wp-content/uploads/2013/10/Berne-Union-2013-Charts-and-numbers-for-website.pdf

From the chart we can observe a dominant share of short-term credits (up to 12 months), with a tendency of growth in the period 2009-2012. The same tendency can be seen in the movement along the demand for medium-and long-term credits. The increase in demand for insurance of medium-and long-term credits is characterized by the appearance of environments in which systemic risks occur, and in this segment of the market credit agencies play a crucial role. During the current crisis they mitigated the basics of credit insurance and increased the offer in order to reduce market tensions.

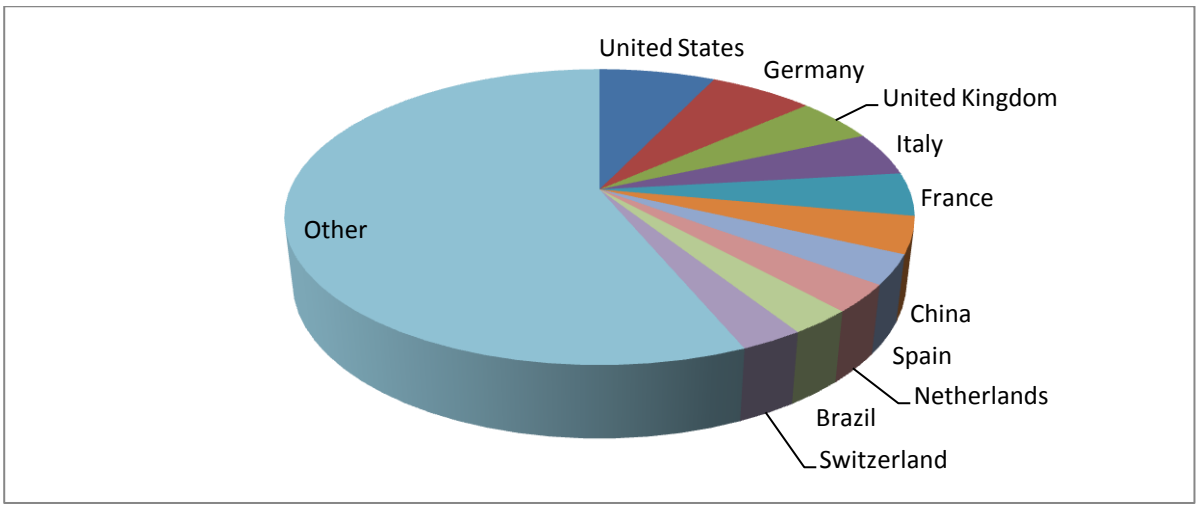

Figure 2: Short-term credit insurance by countries

Source: Berne Union Statistics 2008-2012http://www.berneunion.org/wp-content/uploads/2013/10/Berne-Union-2013-Charts-and-numbers-for-website.pdf

The previous chart illustrates the participation of short-term credit insurance by the countries with the highest credit amount. The United States has the largest amount of insured short-term credits amounting to USD 73,538,000, and immediately after the approximate amounts of short-term export credits belong to Germany and the United Kingdom.

When it comes to the insured medium- and long-term credits by countries, Russia has the highest amount of these credits amounting to USD 9.386 million, and immediately after, the United States amounting to USD 9.224 million. The share of the ten countries that have the highest achieved volume of insured medium-term and long-term export credits can be seen in the following chart:

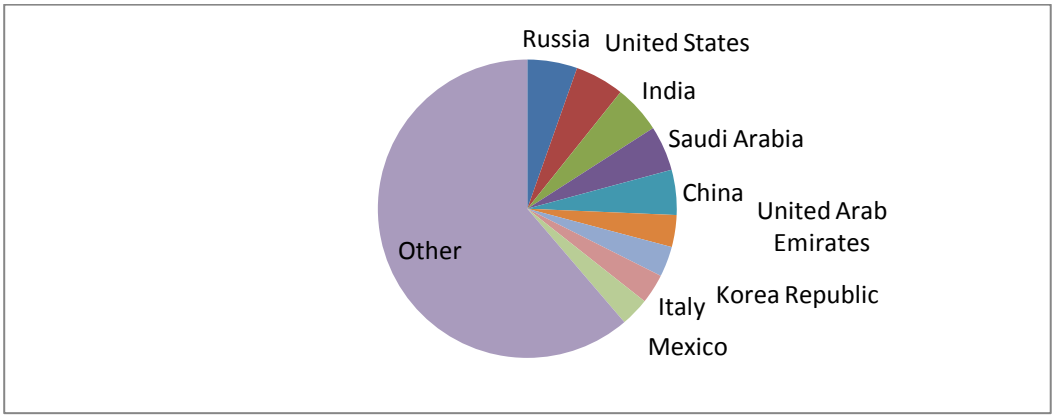

Figure 3: Medium and long-term export credit insurance by countries

Source:http://www.berneunion.org/wp-content/uploads/2013/10/Berne-Union-2013-Charts-and-numbers-for-website.pdf

In addition to the Berne Union, there are other associations of export credit insurers worldwide with state support. One of them is the International Credit Insurance & Surety Association (ICISA), which has 40 member states, and some of them are members of many such associations (e.g. Euler Hermes, Atradius and Coface, as well as the leading reinsurance companies Munich Re, Swiss Re, Hannover Re, Partner Re and Converium). Similar to the Berne Union, ICISA sets as its main aim the mutual exchange of information, promotion of international practices of export credit insurance and representing the interests of insurers at the international level (in the EU, the World Bank, the UN, etc.). The total number of registered agencies (public and private) that deal with financing and export credit insurance is 163 in 79 countries, provided that in this area there are a number of multilateral agencies (Corporation Andina de Fomiento, Banco Latino Americano de Exportaciones, MIGA, Afrieximbank, Inter Arab Investment Guarantee Corporation).

5. SERBIAN EXPORT CREDIT AND INSURANCE

In the mid-fifties, Yugoslavia began to export capital goods and carried out investment projects abroad, along with the demand for export business financing. Our country was among the first developing countries that started the implementation of the crediting system and export credit insurance and investment abroad. From 1957, which is taken as the starting year, a number of phases in the development of export support were allocated, in particular, medium-and long-term exports:

- period from 1957 to 1965 when this was the responsibility of the *Yugoslav Bank for Foreign Trade (later Jugobanka)*;
- period from 1968 to 1979 when the *Export business credit and insurance fund* operated;
- period from 1979 to 1997when the export business support through the export insurance and financing instruments was performed by *the Yugoslav Bank for International Economic Cooperation* in accordance with the specific Law;
- period from 2002 until today: in 2002 with the establishment of the *Insurance and Financing of Foreign Affairs Fund* (at the federal level) and in 2005, with the *Agency for Export Credit and Insurance of the Republic of Serbia*.

Financing exports of capital goods and implementation of investment projects abroad started in 1957, and it was the responsibility of the *Yugoslav Bank for Foreign Trade* - later Jugobanka. (Trifunović, 1988, p.59-67) Until 1965 funds for crediting exports were provided by the General Investment Fund of the Federation and by the Yugoslav Bank for Foreign Trade. The beginnings of export credit insurance are linked to the *National Insurance Institute* and the decision making about the management of the National Insurance Institute that assigned, among other things, the performance of the insurance of export credits.(Gazivoda, 2004, p.34)However, due to the lack of a legal instrument that would determine more precisely how this activity would be performed and due to the lack of experience in the field of export business insurance, the country resorted to adopting the business concepts of foreign insurance companies. Thus we adopted *The Regulation for insurance claims from foreign and public utility services and other companies for exported goods on credit*, by following the model of the internal rules of German insurance company *Hermes*. The commercial risks were the subject of insurance exclusively, while the *Yugoslav Bank for Foreign Trade*dealt with the non-commercial risks insurance. Non-commercial risks insurance could not be provided without the adequate state guarantees, and funding from the budget.

The Agency for Export Credit and Insurance of the Republic of Serbia Inc. (*further referred to as* ***the Agency***) was founded by the Law on the Agency for Export Credit and Insurance of the Republic of Serbia in 2005, as well as other state institutions with the aim to "encourage and promote exports and development of economic relations between the Republic of Serbia and other foreign countries." (*Official Gazette of the Republic of Serbia,2005*)
The task of the Agency, in order to improve the strategic requirements of the export economy and to change the structure of exports of the Republic of Serbia, is to act jointly with all the development, financial and other institutions, and private companies and institutions when there is a mutual interest. An initial funding for the work of the Agency for Export Credit and Insurance of the Republic of Serbia in the amount of 25 million euros has been earmarked from the budget of the Republic of Serbia.
The Agency in its business policy defines the following services:

- crediting export business (including direct crediting, co-financing and refinancing credits through commercial banks of exporter);
- insurance claims of exporters on the basis of export business;
- international and intrinsic factoring;
- issuance of state guarantees (this service is not yet approved, but, according to information from the official website, it is under review); and
- consulting. (The Agency for Export Credit and Insurance of the Republic of Serbia,www.aofi.rs)

First of all, it is evident that the Agency for Export Credit and Insurance of the Republic of Serbia in its operations, such as the Fund, supports mainly short-term business. The Agency, according to its business policy requires certain conditions when it comes to foreign affairs and exporters who apply for certain services.
Conditions are divided into general and specific, that is binding and non-binding.

- General Binding: export in value of at least 1.0 million euros in the previous year; a net operating result in the previous year; share of domestic origin goods at least 51% of the value of goods subject to exports and financing;
- Specific binding conditions: positive creditworthiness of the borrower; positive profitability of export project; positive quality assessment - the collateral safety;

- Additional non-binding conditions (the fulfilment of these conditions implies the favourable conditions in obtaining services, such as the achievement of positive net export effect and a major exporter status. (Unković&Stakić, 2011, p.132)

Based on these conditions it can be concluded that the conditions are primarily formulated in order to achieve basic principles for agency formation - liquidity, safety and profitability. Only hints of support for a certain goals of economic policy (net financial effect) are found at additional, non-binding conditions. Agency is allowed in the discretion to determine by its acts the conditions and the way to maintain the real value of assets, as well as other measures to protect against the risk of its operations. Business policy of the Agency is largely based on the previous principle, which can best be seen from the fact that the credits are granted to a foreign currency, while the exchange rate at which the repayment of credit is done cannot be lower than that at the time of closing a business. Thus in case of strengthening the domestic currency, revenues of the Agency increase based on exchange rate differences.

The Agency pays a special attention to establishing and maintaining successful relationships with international financial institutions, development banks, export credit agencies and commercial banks. It actively cooperates with chambers of commerce and other state institutions in order to find the best solutions for their clients. From 2011 it has been affiliated to the European Association of Public Banks and they have signed a cooperation agreement with a Greek state export credit agency-ECIO.

In 2011, the Agency concluded 58 contracts of insurance claims based on the export activities of domestic customers in relation to 1124 foreign buyers.(The Agency for Export Credit and Insurance of the Republic of Serbia, www.aofi.rs) From May 2006, when the first insurance policy of export receivables against commercial risk has been issued, the number of insurance contracts has significantly increased. In the main part of the insurance portfolio the most frequent is the metal industry with a share of 20.38%, followed by paper manufacturing with a share of 17%, wood processing with 7% and chemical products with 6%.

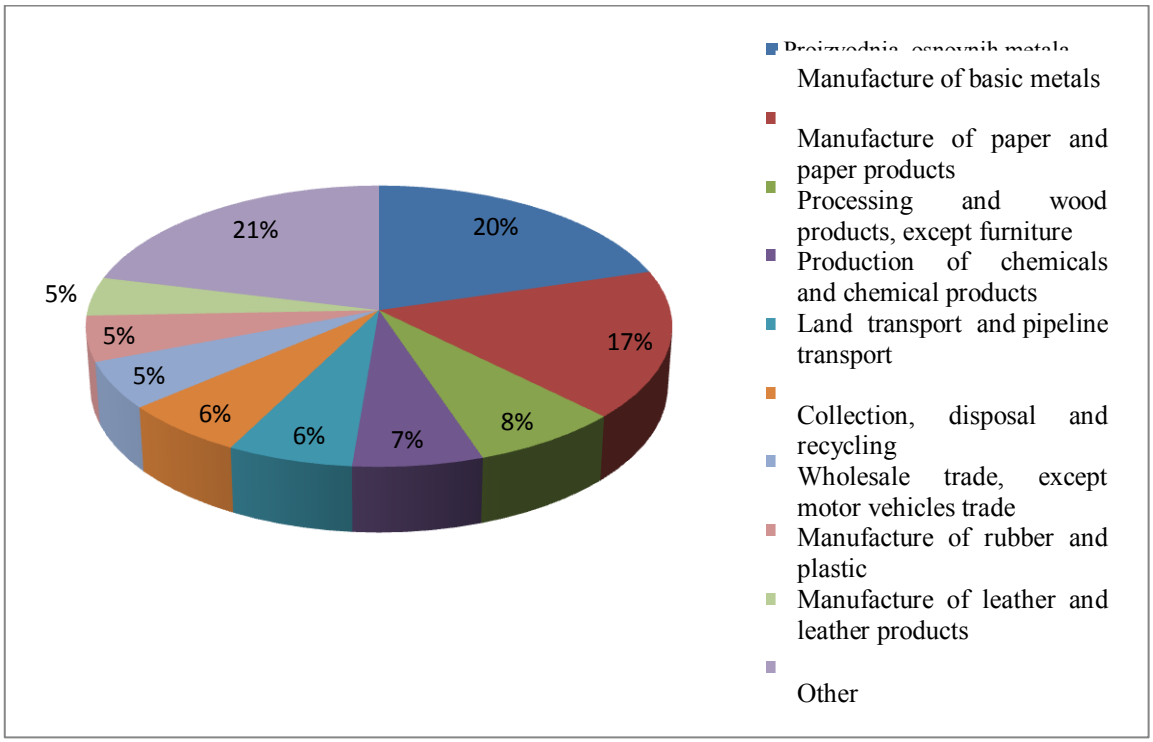

Figure 4: Diversification of the main portfolio in relation to industry branches
Source: The Agency for Export Credit and Insurance of the Republic of Serbia http://www.aofi.rs/wp-content/uploads/2011/12/AOFI-GI-2011-srp-web1.pdf

The EU countries are leading in the total amount of exposure in the structure of export business. Among them Italy has the predominant participation.Countries in the region are significant destination of Serbian export products. Diversification is the branch of activity and represents the measures implemented by the Agency in response to the still current world crisisin order to achieve the effect of reducing the harmful effects of the crisis. The effects of the economic crisis are particularly reflected in the area of buyers' liquidity. In 2011 the Agency received a total of 36 damage claims. During the reporting period 8 damages per insured events were paid (settled), and according to the amount of damages Germany had the largest

share.Through the possibility of paying compensation, Serbian exporters recognize the importance of risk sharing arrangements and insurance debt collection, as well as its impact on preserving the liquidity of companies.

During 2011, the Agency granted 57% of realized credits with a maturity of 6 months, while the remaining 43% of the credit had a maturity of up to one year. Given the evaluation of professionals and acceptance of a controlled risk in its portfolio, the Agency, despite the effects of global economic crisis on Serbian exporters, achieved the collection of overdue credits of about 95% with the use and activation of a variety of collateral, while the remaining 5% of delayed credits were covered by high-quality collateral.

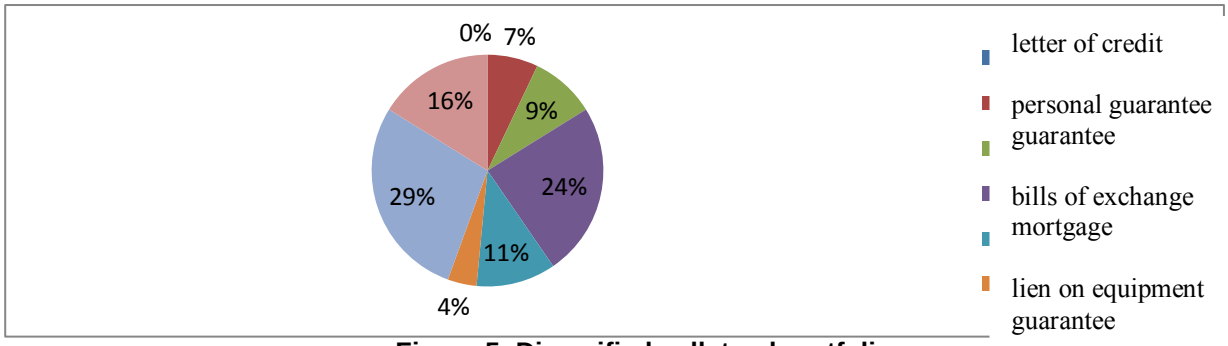

Figure 5: Diversified collateral portfolio

Source: The Agency for Export Credit and Insurance of the Republic of Serb -content/uploads/2011/12/AOFI-GI-2011-srp-web1.pdf

During 2011, the Agency has realized 64 credits amounting to EUR 10.575 million to exporters who belong to small businesses, 70 credits amounting to EUR 21.74 million to exporters belonging to medium-sized enterprises and 56 credits amounting to 43.97 million to exporters-large enterprises, as can be seen in the chart below.

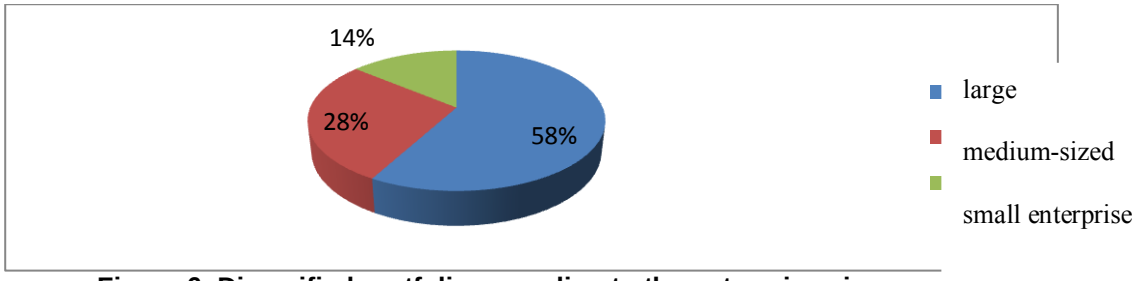

Figure 6: Diversified portfolio according to the enterprise size

Source: The Agency for Export Credit and Insurance of the Republic of Serbia, http://www.aofi.rs/wp-content/uploads/2011/12/AOFI-GI-2011-srp-web1.pdf

Businesses operating in the food industry had the highest share in the use of short-term credits, amounting to EUR 30.415 million, representing 40% of all placements. Companies of manufacturing (40% of all placements) and metal (10% of all placements) industry also had a significant share in the credit portfolio of the Agency. The share of other industries can be seen in the following chart:

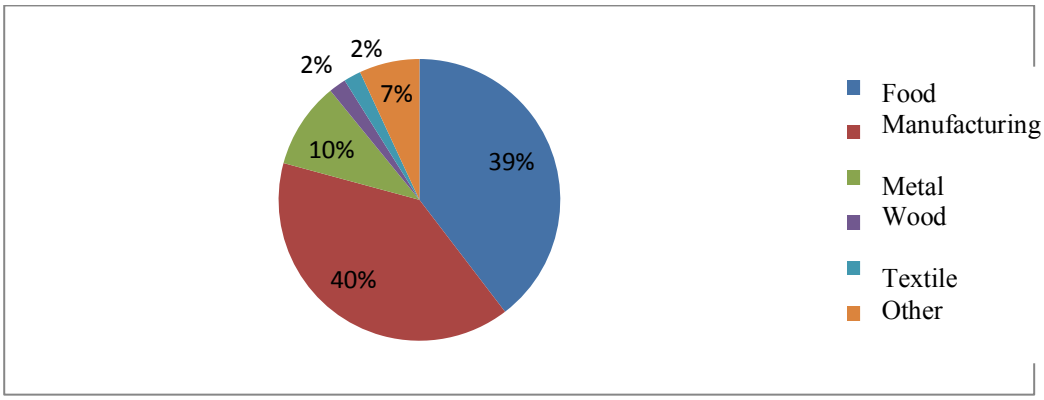

Figure 7: Diversified portfolio according to the industry

Source: The Agency for Export Credit and Insurance of the Republic of Serbia, http://www.aofi.rs/wp-content/uploads/2011/12/AOFI-GI-2011-srp-web1.pdf

The EU affairs have the largest share in the structure of credited export business amounting to about 59%, because precisely there are the biggest trade partners of Serbia. Then, there are:export business with the former Yugoslav republics, which participate with 29% of the Agency's portfolio and operations with Russia with an amount of 12%. By crediting concrete export contracts, the Agency supported the export of goods to the Russian market with EUR 9.12 million, EUR 8.07 million to the Dutch market, EUR 6.77 million to the Italian market, EUR 6.58 million to the market in Bosnia and Herzegovina and EUR 5,540 000 to the German market. The presented data are shown on the following chart:

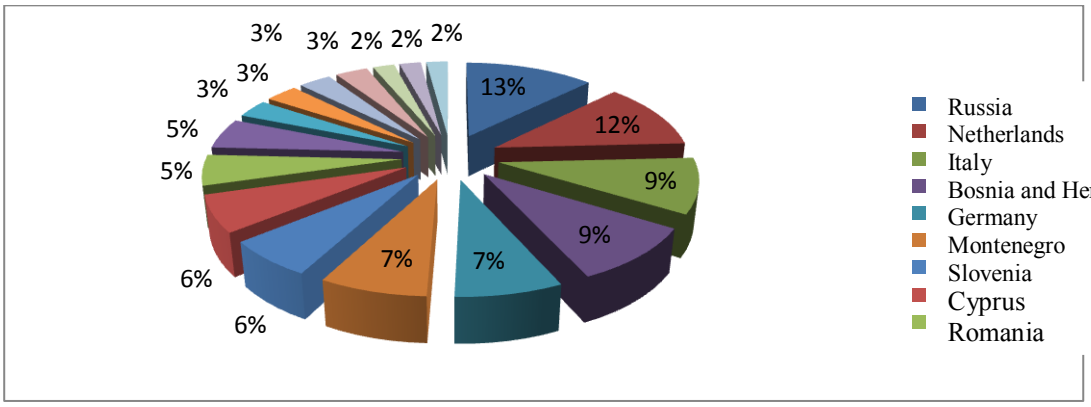

Figure 8: Diversified portfolio according to the country of export

Source: The Agency for Export Credit and Insurance of the Republic of Serbia, http://www.aofi.rs/wp-content/uploads/2011/12/AOFI-GI-2011-srp-web1.pdf

After the commencement of the transition process, that is, from 2001, Serbia has faced with the problem of high foreign trade deficit, and the current account deficit. As an imperative, there is a need for increasing exports in the future. Despite the existence of export credit agencies, Serbia still does not have the sufficient capacity to support stronger exports. In order to provide more efficient support to their exporters, the Agency provided its clients with information on the creditworthiness of existing and potential customersin addition to crediting under favourable conditions in cooperation with the similar agencies in the region and credit-rating agencies abroad.

6. CONCLUSION

Organized institutional support for exports is of great importance, because in this way the competitiveness is strengthened in the market. A demand for agencies for crediting and insuring exports grows by intensifying foreign trade. This should enable the secure exchange of goods and services. In developed countries, insurance agencies are specialist institutions that employ the export crediting programs in the name and on behalf of the Government and by their support for crediting exports, the risks and costs of conquering new markets are significantly reduced. Agencies for Export Credit and Insurance differ from country to country, and we cannot say that there is a typical agency.
It is important to highlight that the state is of great importance and plays an important role in supporting export credit agencies.State aid to the exports is a part of a general economic policy of the state because it has the task of contributing to the achievement of positive effects of national enterprises in foreign markets within the support of exports. State support of exports is usually in the form of insurance, which means that the state issues guarantees, on its behalf and for its own account, on the basis of insurance business and export financing, so it may be the insurer or reinsurer of risk and thus can provide favourable financing conditions for its exporters or commercial banks. The work of government agencies for insurance and financing export business is subject to international regulations that coordinate the work of these agencies at the multilateral level.

In the area of regulation, the Berne Union, the OECD, the World Trade Organization and the European Union achieved the long-term results. The Berne Union and its members are an important link in the chain of world trade and its member states record a steady growth in business, that is, in the extent of coverage of export business and investment with official state support. The Union concludes agreements, issues recommendations and encourages the exchange of information through the three committees - for short-term business,for the medium / long-termbusiness and through the committee for investment insurance. There is a dominant share of short-term credits (up to 12 months), with a tendency of growth in the period from 2009 to 2012. The same tendency can be seen in the movement of demand for medium-and long-term credits.The increase in demand for insurance of medium-and long-term credits is characterized by the appearance of environments in which systemic risks occur, and in this segment of the market, credit agencies play a crucial

role. Countries that were analysed, through its economic policies indirectly affect the performance of foreign trade activities, since export growth is one of the key factors that affect the economic prosperity of the country, andthe USA, Russia and Germany have a dominant share of insured credits.

The awareness of Serbian economic characteristics and current export performance of the domestic economy imposes the need for designing appropriate economic development strategy with special emphasis on the strengthening of the export sector. Policy of strengthening the export sector should be supported by a strong economic sector with a large number of competing companies that operate in a competitive environment. Only under such conditions, the existence of adequate export credit agencies may be additional support to strengthening the export sector. For this purpose it is necessary to redefine the current role of export credit agency that would facilitate the fulfilment of its basic function, in the optimal way and under the given conditions.When designing the policies for encouraging exports through strengthening export credit agencies, special attention should be paid to regulation in this area. Due to the fact that Serbia is still not a member of the European Union there is a possibility for more flexible operation of existing agencies. That possibility, along with the necessary condition for enhancing the competitiveness of the domestic economy and the existence of clearly conceptualized system of export incentives, provides a reasonable basis for the growth of the export sector and the creation of realistic assumptions for long-term economic development.

REFERENCES

Agency for Export Credit and Insurance of the Republic of Serbia.Retrieved from www.aofi.rs

Berne Union.Retrieved from http://www.berneunion.org/

Fund for Foreign Trade Business Insurance and Financing.Retrieved from www.smeca.rs

Gazivoda J. (2004). Osiguranjeizvoznihkredita u domaćojpraksi.Insurance Law Review. Vol. 1/2 ,pp. 34-41.

Kjell T., Kirsten R. (2005). Attributes on information quality of export market assistance: an exploratory study, European Journal of Marketing, Vol.39, No. 5/6, pp. 676-695.

Kovačević R. (2013). Uticajtrgovinskihibankarskihkreditanasvetski
izvoz, Bankarstvo, Vol. 3, pp. 12-33.

Law on Fund for foreign exchange operations insurance and financing, Retrieved from http://www.izvoznookno.si/Dokumenti/srbija1.pdf

Mladenović O. (2010). Forfetiranjekao jedan odoblikafinansiranjaizvoza, Bankarstvo, vol. 3-4, pp. 124-147.

Radović Z. (1989). Osiguranjeizvoznihkredita, Ugovor oosiguranjuizvoznihkredita, TheInstituteforComparativeLaw, Belgrade.

Stamenković L., Rujević - Džodžo K. (2008). UticajiznačajPraškogklubaBernskeunijenaosiguravačekreditaiinvesticija u evropskimzemljama u tranziciji, Bankarstvo, Vol. 5-6, pp. 24-35.

Trifunović M. (1988). Međunarodniplatnipromet, bankarstvoimonetarnisistem, Naučnaknjiga, Belgrade, pp. 59-67.

Unković M., Stakić B. (2011). “Spoljnotrgovinskoideviznoposlovanje”.Singidunum University, Belgrade..

Vapa-Tankosić J. (2010). Promene u načinuposlovanjaagencijazaosiguranje i finansiranjeizvoza, Proceedingsfor social sciences / Matica srpska. Vol. 133, pp. 119-130.

ACHIEVING SET DEVELOPMENT GOALS WITH ECONOMICAL EXECUTION OF PUBLIC EXPENDITURES

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Abstract: In this paper we presented a model of program budgeting as a contribution to modern trends of an economical handling of public expenditures. It will also be the topic of this paper to prove that certain development goals of public institutions and authorities can be achieved by economical execution of planned expenditures. Links between the realization of the goals and execution of expenditures will be displayed using the developed model of program budgeting, which otherwise is not possible with line budgeting of expenses.

Keywords: execution of expenditures, program budgeting, carriers of execution, development goals, capabilities.

1. INTRODUCTION

In the first decade of the twenty-first century in the Republic of Serbia a preparation for the introduction of multi-year budgeting according to the model of most countries in the region was started. The result is the fact that since 1st January of 2014 all public expenditures within the budget of the Republic of Serbia must be expressed through program budgeting. While in the world multi-year ("mid-term") budgeting began in the 60's and early 70's, today this approach has become more or less universally accepted in most countries.

Modern strategic form of budgeting which soon became represented in more than 72% of countries around the world is the model of program budgeting. Because the program budgeting focuses on planning, that is the expected results, as well as monitoring which was achieved in the previous period by using of the approved resources. Also, program budgeting clearly introduces the component of liability (for direct users of budget resources) for implementation of the program and thus comes to improving the process of managing performance of the program.

Phases of the model of program budgeting are: planning, programming, budgeting and execution. Planning, as the first phase of the model of program budgeting involves making plans continuously, from long-term to short-term with established goals of development of public authorities and institutions. Programming is the second phase of the model of program budgeting of defense expenditures with which adopted planning documents are translated into programs, projects and activities for a specific time period within available resources, for the purpose of maintaining and developing the capacity of public authorities and institutions. Budgeting involves making a financial plan for the purpose of expressing funds required for the implementation of plans and programs. The focus of this phase model of program budgeting is to convince the Government of Serbia and the members of the National Assembly of the Republic of Serbia with arguments that it is necessary to provide the necessary resources to implement the program and to develop and maintain the established level of capability. Execution is the last stage of the model of program budgeting. The point of this phase is to provide consistent implementation of plans, programs and budgets, and with a goal to build capacity of established public authorities and institutions.

Planning and execution, as the first and last phase of program budgeting are ongoing processes that, unlike programming and budgeting phases are occurring continuously, while the phases programming and budgeting are occurring in cycles in accordance with the budget calendar of activities of the Law on the budgetary system of the Republic of Serbia.

In most scientific and expert papers mainly the phases of planning and budgeting are dealt with, while the programming and especially execution phase have remained least explored. Therefore, the case of this study is to track the execution phase of expenditures and/or financial plan according to the set activities and programs, taking into account the already mentioned limitations, in order to achieve the specific goals of state authorities respecting the principle of economy.

2. PROCESS OF EXECUTION OF PROGRAM BUDGETING

The process of execution of program budgeting takes place with the realization of planned subsistence needs through engagement of arranged budget resources and creation of obligations for payment, as well as payment of obligations created, that is final expenditure of budget funds according to the annual plan.

Execution phase in the process of program budgeting is a dynamic process that permeates all three previous stages of this process, as shown in Figure 1. It is very important to note that as a result of the execution phase, is the answer to the question of whether the set goals are reached.

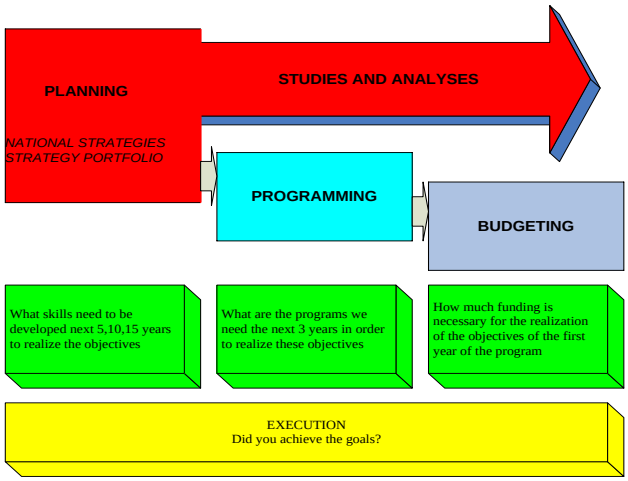


Figure 1: Phases of program budgeting

Monitoring the execution phase is a process by which supervision and control of the implementation of plans, programs and financial plan is done in order to achieve the expected results and achievement of goals. By analyzing the execution of plans, programs and financial plan the degree of achieving the goals, deviations, causes and proposal of corrective measures is determined.

With corrective actions consistent implementation of plans, programs and financial plan is achieved. Correction of plans, programs and the financial plan is done by a competent body in case of a change of the situation or when their execution is not possible. The execution phase is viewed through the implementation of plans and programs. However, following the execution of the financial plan, realization of activities, projects and programs is followed as well, for whose realization funds are necessary, so it is especially described in this phase.

Optimal management of execution of tasks in the planned dynamic requires the presence of back links that provide timely and accurate information on the functioning of the process of program budgeting.

Regardless of the reality of assessment of planned assumptions and rigor of the taken proceedings in relation to the planned regulation, it is normal to expect some differences and discrepancies between planned and actually completed tasks. To minimize the generated differences between the actual and planned conditions it is necessary to establish mechanisms for successfully organized collection and

transmission of data on the actual situation, determine the difference between the actual and planned conditions, and efficient functioning of corrective factors that include additional actions with a goal to minimize deviations of actual in relation to the planned situation.

The difference between planned and actual results may occur as a result of lack of data, thus misjudgment and ultimately inadequate plans. In addition, it can occur as a result of inefficient organizations and oscillations of influencing factors in the environment.

By monitoring the implementation of the annual plan by using computer technology or other standard procedures, variations of possible interventions are determined, with which the results of possible deviations will be reduced to tolerance limits. By choosing one of the possible variants of correction of the flow of information in the return turn continues, until the system is brought into balance.

3. PLANNING BASED ON RESULTS - TARGETED PLANNING

Planning based on the results or targeted planning, involves selection of the best action for the realization of the given goals and results of the defense system. As shown in Figure 2, the model of program budgeting, which is based on the results, in reality usually involves "confrontation" of defense's objectives and available resources.

System analysis allows, in this context, the decision-maker to select the preferred option among alternative choices and the program through selection of variants and models for estimating the optimal alternative (Method Pattern, CPE, Elektra, stochastic analysis, game theory and coalition, scenario method, Delphi survey, multi-criteria analysis, simulation model, matrices of realization of the objectives of Morris-Hills etc.). In essence, system analysis allows, "adaptive slipping" from the global long-term plan to an encrypted plan with iterative graphics, respecting aleatory boom variables and time horizons of alternative strategies in the simulation of the program (F.S.Quade). This basically determines the policy of distribution and allocation of resources within a long-term strategic planning, mid-term program orientation and annual operating budget choices.

The development process is different for each budget beneficiary. The development process of budget funds user can be viewed as a process of changing its structure and a way of functioning which has a goal to present the existing potential of the existing state (S0) into a new better state (S1). This conversion is a complex and dynamic process that, according to Nikola Čubra (1973), can be symbolically displayed in the following way (p.25):

„a) stages of development (translation) of the system from one state to another:

$$S0 \rightarrow S1 \rightarrow S2 \rightarrow S3 \ldots\ldots\ldots\ldots\ldots \rightarrow Sn \quad (1)$$

b) the quality of the system in each subsequent stage should be higher than the previous:

$$K0 < K1 < K2 < K3 \ldots\ldots\ldots\ldots < Kn \quad (2)$$

c) the intensity and speed of development show positive trends:

$$(K1-K0) < (K2-K1) < (K2-K3) < \ldots\ldots\ldots\ldots < (Kn-1) \quad (3)“$$

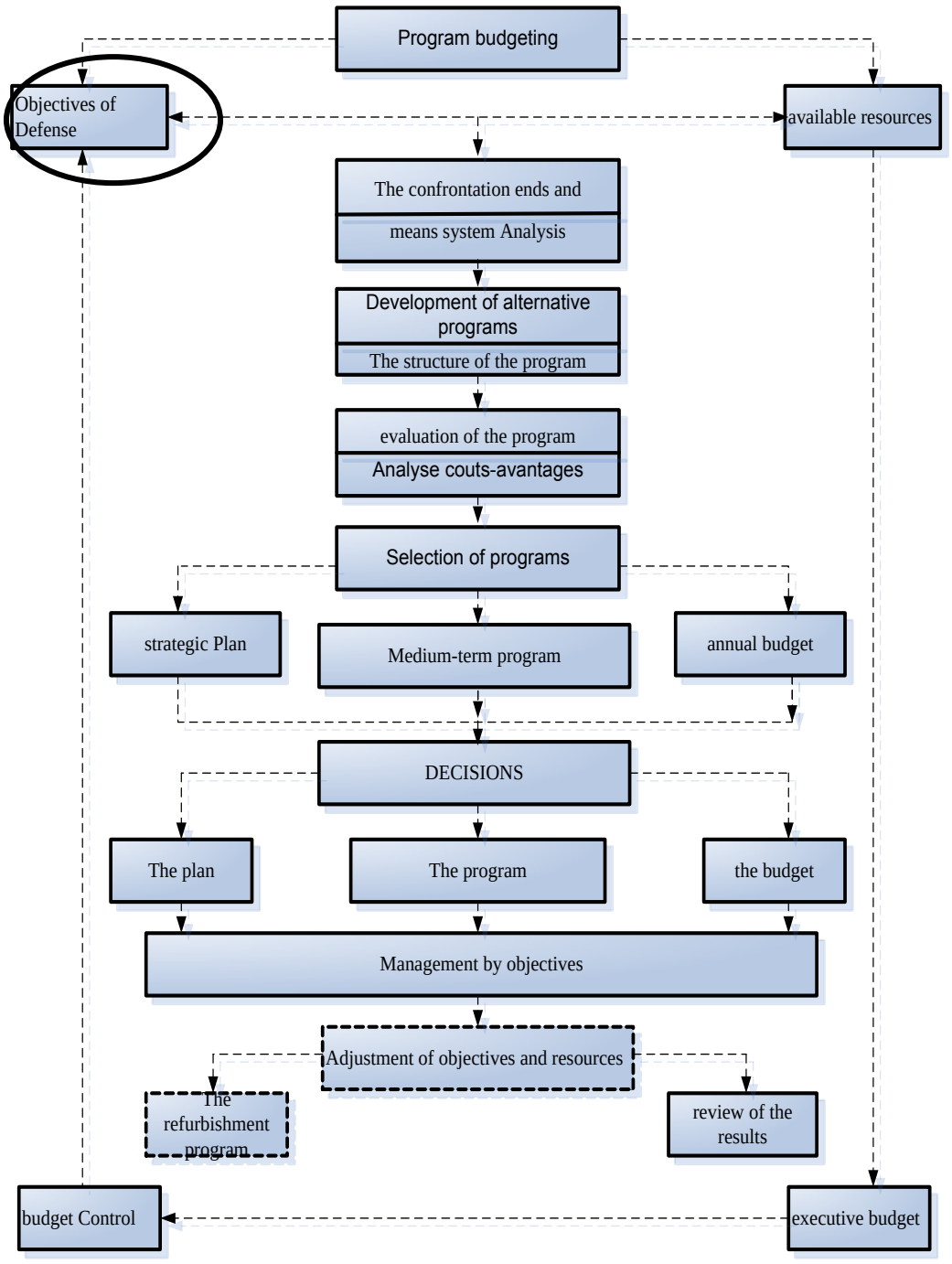
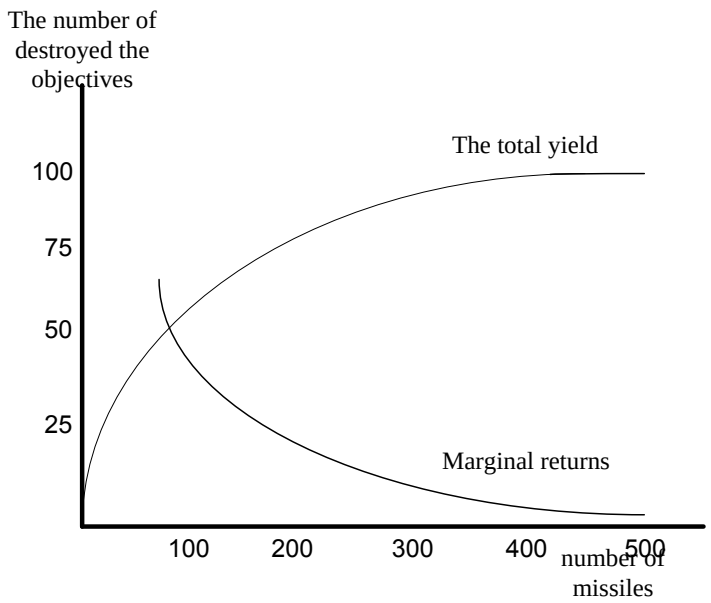


Figure 2: Ristic (1989) „The ratio of available financial resources and stated goals" (p.544)

Based on the presented data, we can conclude that the system evolves continuously, which means that it is not desirable that any development phase is skipped. However, the transition from previous to the next state can be significantly facilitated and accelerated if, among other things, in planning, budgeting and execution of needs and expenses of users of budget resources, such organizational solutions, methods and procedures are used by which even with unchanged material conditions, a greater efficiency, that is, higher level of efficiency and effectiveness of budget beneficiaries is achieved or, what amounts to the same thing, with less expenditure of funds for expenses of budget funds it maintains its current level of efficiency which is considered sufficient.

Graph 1 Stiglitz (2001) „The role of marginal analysis in defense" (p.340)



For example, the use of marginal analysis, according Hitch (1966) for assessment of whether you should spend more on defense, it is necessary to know how much additional "protection" will you get from additional expenses in the amount of one billion dinars. Let us assume that the probability of successful hitting of the target with a rocket is 50% and there are 100 targets to destroy. So 100 missiles launched at targets "would achieve an expected score of 50 hits, 200 rockets - 75 hits, 300 rockets - 87 Hits", as shown in **Graph 1** (p.50-51).

It is noticeable that there are very severe diminishing returns. Each target can be destroyed only once, and some of the missiles will fall on already destroyed target. While the first hundred missiles would destroy 50 targets, the number of missiles increased from 400 to 500 would increase the number of targets destroyed only by three. Therefore, one shouldn't ask the question whether the 97 targets destroyed are worth spending 500 missiles, but rather, whether the goal of destroying three extra targets is worth spending hundred additional missiles. This type of analysis is not easy. Linking defense expenditures with its goals and demonstrating what could be gained from additional expenditures, it can be expected that it will bring much more rational decisions about how much is enough.

In the above mentioned the basic aim and essence of modern planning, programming, budgeting and execution of the needs and expenses of defense is contained. The main measure of quality is, therefore not at any price greater efficiency but sufficient or the greatest possible efficiency of the defense system in the current (real, actual bearing) economic and overall social conditions.

Selection and matching of the needs and expenses that are required for high-quality performance of all activities in the organization and preparation of the defense system in terms of actual, economic and socially real opportunities is a necessary but not sufficient condition for the effective execution of the stated objectives of the organization. The quality of use and consumption of available resources, i.e. the degree of economic rationality, also has an impact on the effective achievement of set goals of an organization. This is achieved through adequate and modern normative legal regulation of the financial functions of the organization as well as quality management of its resources.

4. ESTABLISHING LINKS ON IMPLEMENTATION OF FINANCIAL ASSETS WITH REALIZATION OF THE GOALS

Execution phase in the process of program budgeting is a dynamic process that permeates all three previous stages of the process, according Trandafilovic & Knezevic (2013). It is important to note that as a result of the execution phase, as shown in Figure 3, an answer to the question of whether we

achieve the set objectives, as defined in point A and represent the desired state - point B is got, (p.210-214).

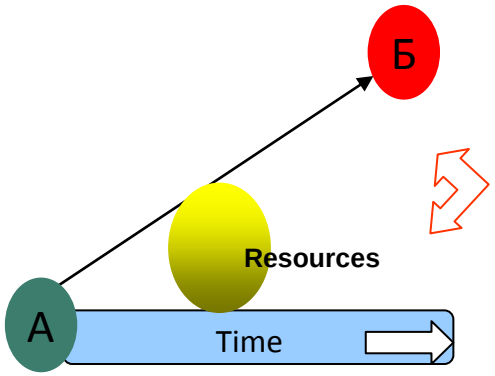


Figure 3: Defining the goals

If it is determined that the mid-term objective of the organization in the period from 2012 until 2014 is the following: "The financial position of employees is actually improved by 10% and the living and working conditions are favorable", and that for its implementation in 2012 is necessary to use 231.75 million dinars, in 2013. 297.90 million dinars and in 2014. 266.61 million dinars, which for the entire period amounts to 796.25 million, then it is precisely known for the projects and activities in the observed years how many of them contribute to the realization of that objective and how much it costs.

In Table 1, mid-term goals and projects are shown with activities for the realization of this goal in given years. Financial assets shown by years are expressed in millions of dinars. All three projects are shown, but for simplification, only the first project is presented with its activities while the second and third are with no activities with total expenditures by the observed years. Projects and activities are indicated numerically.

For the implementation of the mid-term goal, "The financial position of employees is actually improved by 10% and the living and working conditions are favorable" in the period from 2012 to 2014 were determined by three projects:

1. Redesign and construction of residential buildigs with signs O24, O25, O28, O29 and O32 at location "2 MZ Bežanijska hair" labeled 04-01-01;
2. Urbanization and construction of social housing marked 04-01-02 and
3. Buying apartments labeled 04-01-03.

During this period, expenditures are presented for the realization of the given projects for each year in total. However, in the project documentation all expenditure by economic classification of accounts are shown, so it is simplified to monitor the implementation of projects through the implementation of the financial plan and ultimately realization of the given mid-term objective.

In the framework of the given project activities for their implementation with related expenses per year are summarized. The sum of the costs of all activities in the project within one year is the cost of the project in a given year. The sum of all costs within the project during the entire period of its realization represents is its total cost.

Table 1. Realization of goals with projects

The financial position of employees is actually improved by 10% and the living and working conditions are favorable				
Designation of the project/activity	2012.	2013.	2014.	Total
IN TOTAL:	231.750	297.900	266.610	796.250
04-01-01	8.540	56.560	74.900	140.000
04-01-01-01	700			700
04-01-01-02	840			840
04-01-01-03	4.760			4.760
04-01-01-04	1.400			1.400
04-01-01-05	840	1.260		2.100
04-01-01-06		2.100		2.100
04-01-01-07		2.100		2.100
04-01-01-08		1.120		1.120
04-01-01-09		3.500		3.500
04-01-01-10		46.480	69.720	116.200
04-01-01-11			3.080	3.080
04-01-01-12			420	420
04-01-01-13			280	280
04-01-01-14			1.400	1.400
04-01-02	39.100	125.350	75.716	240.166
04-01-03	184.104	115.992	115.992	416.088

5. CONCLUSION

Introduction of program budgeting model by the Government of the Republic of Serbia is certainly a step towards to a more efficient and rational management of public expenditures. Compared to the old way of planning the budget, whose main focus was the appropriation by economic classification, i.e. budget

planning by expenditure items, the focus of program budgeting are the results that are realized and objectives that are achieved by engaging all of the planned resources (human and material). Thus, program budgeting is an approach, or a process whose goal is establishing a connection between the involved and proposed resources and the achieved results.

Defining objectives and building capacity is not at all an easy job, on the contrary. Because, in a situation of lack of financial resources, as is the case in recent years, goals must be redefined and some capacities have to give up from or accept the strategic gap and not give up anything that was already planned.

Programming creates the preconditions for the choice of the best variant implementation for the realization of set objectives using available resources. So, programming makes visible the connection between the abilities of the defense system and the budget, as well as between long-term vision and short-term plans, making them understandable to decision-makers and key stakeholders.

In order to link the execution of expenditure with realization of objectives, it is necessary to fulfill the following conditions: to ensure continuity in the planning, of long-term over mid-term till short-term

plans; for the programs to be compatible with mid-term plans (that arise from long-range plans); for programs and individual projects arise from defined long-term goals and present a realization of mid-term objectives; for the activities to be planned in the framework established by the program or projects and the expenses for the years are related to activities.

Observing short term positive effect of the introduction of program budgeting is that the purpose of the spending public funds is known. In long term growth of state institutions and organs is expected with optimal costs, and probably, the whole economy and society as a whole.

REFERENCES

Cubra, N. (1973). Planiranje razvoja oruzanih snaga, Vojno ekonomska akademija, Beograd.

Hitch, C.J., Decision Making for Defense, Berkli, University of California Press, 1966)

Ristic, Z. (1989). Fiskalna ekonomija, Savremena administracija, Beograd.

Stiglitz J., Ekonomija javnog sektora, Ekonomski fakultet, Beograd, 2001, str. 339-347

Trandafilovic, S. & Knezevic, M. (2013). Finansiranje sistema odbrane i programsko budzetiranje, Vojno izdavacki zavod, Beograd, ISBN 978-86-335-0385-3.

INNOVATIVE BUDGETING EXPENSES OF DEFENSE

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Abstract: *This document presents a system of programming budgeting, that is a model management with a goal of establishing relations between engaged and proposed resources, in fact achieved results. Special attention is dedicated to the need as well as to the achieved results of the applied model in order to dispose rationally and finally in order to conduct determined tasks efficiently..*

Keywords*:* programming budgeting, development, resources, management, defense system.

1. INTRODUCTION

Changes in society and therefore in state, that occurred in the last decade of the 20th century and in the first decade of the 19th century, have influenced by the fact that the rooted attitudes and opinions have changed within the society which are a reptil of old times when it was thought that the education and defense are too important from a political, sociological and human aspect to be able to undergo some kind of economic calculations. On the contrary, in the today's situation, management structure of the system of defense must act immediately and make concrete decisions according that and, also, being faced with the problem of limited resources.

The additional problem for the defense system of the early 21st century, is that the previous system of financial resources, particularly budgeting, was not sufficiently effective and did not corespond to the complex requirements that were demanded of the management structure of the defense system of Serbia. The planning area of the defense system of Serbia was largely undeveloped and the need to regulate this in a qualitatively new basis was reported as an imperative. There were no mechanisms to provide sufficient information if the planned goals and objectives of the defense system would successfully implemented, and whether if an appropriate allocation of the resources for the realisation of the planned objectives would carried out.

Managing of financial resources was reduced to an allocation of available financial resources, without interconnections between the tasks of defense and financial plans. Also, there is problem of converting strategic objectives into financial plans that can be linked to budget resources. The fact is, of course, that many aspects of pre-defined objectives are implemented within the regular activities in the defense, but without feedback.

Financial planning, mechanisms for the preparation of financial plans and regulations for their enforcement haven't, until recently, provided sufficient information on whether the defined objectives have implemented successfully in practice. Because of this it was very important to improve the links between financial plans and strategies, to provide appropriate mechanisms for monitoring the effectiveness of their implementation and consideration of future needs. The introduction of functional programmatic dimension into the existing budget classification was one of those mechanisms.

The modern view and the view of overcoming problems of increasingly limited incomes also in the public sector of the Serbian government, found the solution in the 'budget directed to results' or program budget. The role and place of the state in financing defense system is characterized by compromise in conflict resolution: to achieve the defined goal with minimal financial investment. The cause of this discrepancy is primarily the needs of the various growth opportunities that defense functions of the state require and its limited material and financial resources. However, the government of every state is obliged to, on the one hand, consider the economic situation of the country, and on the other hand, to give stable defense system, racionally using limited resources.

Management structures of the defense system, as an integral part of society and its problems were faced, already in the 20th century and in the first half of 21th century, on the one hand, with the problem of transmission of liabilities from year to year, rising debts to suppliers, costs of court udgements for the delay in payments, penalty and interests for late payments of accrued liabilities, and on the other hand, with limited

and insufficiently available financial resources. What necessarily required news and changes in management of financial and other resources of defense.

The significant changes have been implemented in the system of defense of The Republic of Serbia in recent years. The overall objective of the changes is the transformation of the system in line with modern security challenges and threats, that is needs and opportunities of The Republic of Serbia.

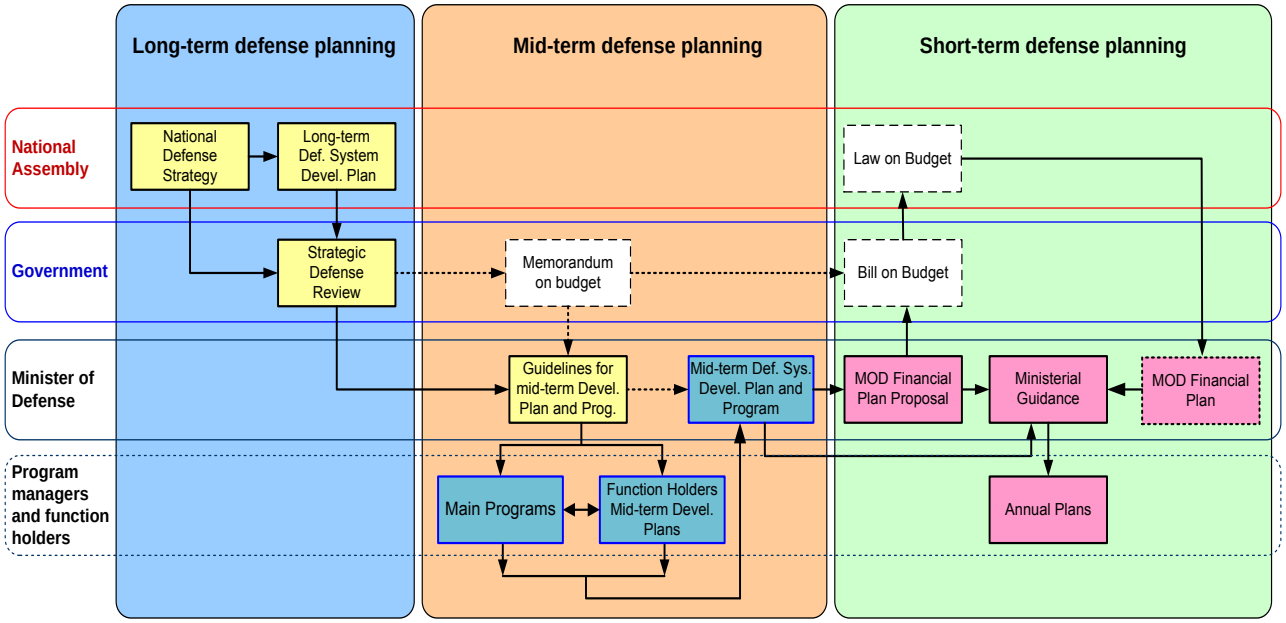
In order to ensure continuous growth in the quality of defense capabilities, increase efficiency of execution of the defense tasks, rational use of available resources, ensuring adaptability and flexibility of the process executing the defense tasks and coordination of development components of the defense system with the overall development of the State in the Ministry of Defense and the Army of Serbia in 2008. the system of planning, programming, budgeting and execution (PPBE) was introduced as a new management system of defense resources and in the final funding of developing programs and projects of defense system.

2. BUDGETING ANALYSIS OF DEFENSE SPENDING BEFORE AND NOW

Planning of the development of the defense system in the period before the introduction of program budgeting model was disintegrated and there was no continuity in the planning process. The development plans were made by the the office holders of the defense system each of them for themselves individually. Disintegration of planning functions, that existed before the introduction of a new defense resources management process, was a reflection of the existence of a large number of office hlders dealing with problems of planning. A particular problem was reflected in the lack of legislative and normative framework that would regulate this area.

Integration of the functions of development planning of the defense system, as it introduced a model known as program budgeting system PPBE, contributed to increase the overall performance of the Ministry of Defense and the Army of Serbia, because the defense system is viewed as a whole, fortified with all the tasks and resources required for their completion. Of course, the global financial crisis further complicates the problem, because the fundings for the tasks laid down by the Ministry of Defense and the Army of Serbia is getting more and more restrictive.

Decision makers in the defense system chose to introduce an integrated system of defense resource management, in order to bridge the created situation and to coordinate the requirements of the defense system and the possibilities of our society. Due to adoption and implementations of the PPBE system, integration of planning function as a first stage in the process of defense resource management comes into play.



Picture **1:** Model of Serbian Defense Planning-now

Continuity in the programming phase is ensured with the development and adoption of long-term development plans of the defense system on which the medium term plans and development programs are

made, which later serve for the development and implementation of short-term plans. Planning model which is represented in the defense system of the Republic of Serbia in 2011.is presented in picture 1.

Long-term planning is the process of setting objectives of the defense system for a longer period of time, as well as methods for their implementation. The long-term defense planning is an interdisciplinary process that involves many different activities. Activities are mutually dependent and precise coordination is needed. An interdisciplinary approach to planning requires close cooperation between the planners and military commanders, various specialists, political authority, etc.

The purpose of long-term defense planning is to consider the mission and tasks of the defense system and to establish realistic long-term objectives adjusted to the missions and tasks, as well as to determine the strategy of its realization. Long-term planning is oriented toward the relatively distant future and that represents a problem for planners as they face many difficulties that are the consequences of uncertainty in the future. Also, long-term defense planning should enable the appropriate development of defense system and avoidance of unwanteded effects.

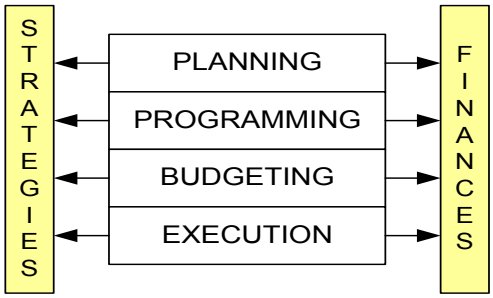
Medium-term planning is the process of determining the objectives of the defense system for medium-term planning period and the ways of their implementation. The objectives and priorities are determined by factors of development capabilities of the defense system that need to be realistic, purposive, implementable, measurable, time limited and classified according chronological and logical sequence.

Short-term planning is part of an integrated planning process that operationalized the medium term planning. In the defense system of the Republic of Serbia it includes a one-year planning period. Successful implementation requires the preparation of annual plans of a number of different plans that are differents in content, level of detailing, the time interval covered etc.

3. PROGRAMME BUDGETING EXPENDITURE OF THE DEFENSE SYSTEM

In the public sector reform and within it performance-based budget or PPBE system, expenditures are classified according to programs and projects, operational objectives of each program are determined , and performance indicators are established for each program and activity. PPBE system is one of the important components of a wider process of reform of public finances. Specifically, it means the introduction of an effective mechanism for monitoring the achievement of defined objectives.

In the current environment of public finances, it is difficult to translate strategic objectives into operational plans and projects of development of the defense system, which can be linked to the budget means (picture. 2). The fact is, of course, that many aspects of already defined objectives are being implemented within the ordinary activities of direct budget funding.



Picture 2: Converting strategic objectives into financial plans

However, operational planning, mechanisms for the preparation of financial plans and rules for the enforcement of them, within the line budgeting, which was represented by 2008. in the defense system, did not provide enough information about whether the defined objectives are being successfully implemented in practice. It was therefore important to improve the links between financial plans and strategies in order to provide appropriate mechanisms for monitoring the success of their implementation and consideration of future needs.

Therefore, the program budget is a comprehensive system of defense resource management - a system of monitoring results (performance management system). Key feature of the program budget is in a change of

budget focus from budgetary commitments on short-and long-term results and reached objectives of the defense system.

However, limited resources imposes, in fact, wanted it or not, accepting different, basically an economic standpoint, which is characterized by:

1. the need for the best utilization of resources available for the specific purpose
2. the influence by the consequences of decisions in the present to a quality of development in the future
3. the necessity to be efficient, which correspond to a care that the set objectives achieve with adequate real available resources and
4. the obligation to legally dispose and permanently control the expenditure of resources for implementation of planned needs.

To increase the efficiency of the management structures of the defense system, changes in the sphere of budget expenditures were necessary, just because of limitation and scarcity of available funding. Otherwise the time and attention of management structures would be focused on securing funding for a reconciliation of the regular needs of defense and would be lost to the efficiency of doing the basic tasks.

4. SECTOR PROGRAMS AS AN INOVATIVE WAY TO BUDGETS EXPENDITURES OF DONATIONS OF DEFENSE

Defense expenses are financed by funds from the budget and donations from the European Union through Sector Approaches (also known as Sector Wide Approaches – SWAps). Sector Approaches are usually seen as programme-based approaches (PBA) operating at the level of a sector. PBA is defined as follows, (European Commission, 2007):

„A programme-based approach (PBA) is a way of engaging funds EU in development sectors programme, such as a National defence strategy, a sector programme, a thematic programme or a programme of a specific organisation (defence).PBAs have the following features:

- ✓ leadership by the host country;
- ✓ a single comprehensive programme and budget framework;
- ✓ a formalised process of donor coordination and harmonisation of donor procedures for reporting, budgeting, financial management and procurement end
- ✓ efforts to increase the use of this systems for programme design and implementation, financial management, monitoring and evaluation.“ (p.24)

The European Commission (EC) is committed to delivering "more and better aid" for "legitimate strategies". One of the legitimate strategies is National defence strategy.

Sector approaches or sector-wide approaches (SWAps) are processes aimed at the development of coherent sector policies and strategies. They involve governments, donors and other sector stakeholders in a unified process and framework.

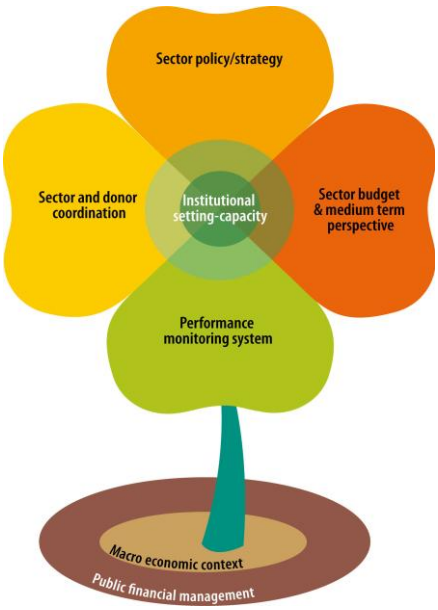
As mentioned above, EC decisions about whether and how to support a sector programme are based on assessments in seven key areas, (European Commission, 2007):

„The five elements of a sector programme

1. The sector policy and overall strategic framework
2. The budget and it medium-term perspectives
3. Sector and donor coordination systems
4. The institutional setting and existing capacities
5. Performance monitoring

And the two additional elements influencing the sector programme's performance

6. The macroeconomic framework
7. Public financial management (PFM) systems“ (p.27-35)



Limitations EC provide an insight into the basic concepts that are relevant to each assessment, identify key issues to be addressed and point to additional sources for more detailed guidance. The aim is to assist programme managers throughout the cycle of operations of EC support in reviewing the quality of sector programmes and deciding on appropriate support modalities.

Assessment of these areas would start during the programming and identification phases of the sector politics cycle, with the analysis then being completed during formulation. During implementation, these assessments would also need to be updated regularly in order to keep abreast of developments in the sector politics and each of the areas.

There are many overlaps between these assessments (for example, there are obvious connections between sector expenditure strategy, the macroeconomic assessment and the review of public finance management; all the other assessments may feed into the institutional and capacity assessment, and so forth).

Also, many of the assessments are also required for other aspects of EC work (e.g. a macroeconomic assessment will have been undertaken as part of limits preparation and to support any sector politics and so on. Those working on analyses should first of all draw on given limits, and if necessary update, existing assessments. Wherever there are relevant preexisting studies and materials, these should be drawn upon.

When it is possible, the EC works jointly with other donors, as well as with the partner government, on such assessments, and does so in ways that support the development of partner country capacity. The assessment required at the design stage of an politics sector is part of a continual process of monitoring and review of key issues. There are few, if any, absolute criteria involved in the assessments. Balanced judgements are required, which identify opportunities as well as risks, and which assess the direction of change as well as current levels of performance.

5. CONCLUSION:

The introduction of the new model of program budgeting, situation in the field of management of defense resource is changing drastically. Namely, there is a process that takes place continuously. All plans and programs are integrated into one unit. The financial plan of the defense, as a function of plan holders, serve to establish a connection between the proposed appropriation of resources and results achieved. Mechanisms for monitoring the implementation of goals achieved are being introduced, which is advantage compared to the state so far.

The system of financial management of defense resources is becoming a complex, dynamic, interoperable, and integrated process. The main purpose of this process is management of maintenance and capacity building of the Ministry of Defense and the Serbian Army to achieve the defense objectives of Serbia. Finally, the purpose of defense resource management process is the provision of conditions for achieving the mission and tasks of the defense system.

However, the process of resource management is not just a technical procedure, but also an important political process. In the event that there is no political will and consistency in terms of sustainability of the planned and predicted values, there is a risk that the budgeting process could turn back into the allocation of available financial resources, as it has been the case until the year of 2010.

REFERENCES

European Commission, (July 2007).Guidelines for ec support to sector programmes – short version

BASIC COMPONENTS OF INTERNAL CONTROL IN PUBLIC SECTOR, WITH A VIEW TO THEIR ROLE IN THE MINISTRY OF DEFENCE AND THE SERBIAN ARMY

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Abstract: *The basic concept of control is to create a process that ensures the achievement of objectives with quality, conservation and management of funds within the law compliance and other regulations and procedures, preparation and production of reliable financial and business reports. The compliance of the requirement means that the business is complied with applicable laws, regulations, standards, agreed policies, postulates and with all the forms of behavior that these processes make legal and socially acceptable . With the implementation of internal financial control in the defense system, it is achieved and provided an efficient and rational using of funds for financing the costs of defense, on the one hand, and on the other hand, considerably reducing the possibility of significant irregularities, fraud, corruption and the emergence of organized crime .*
Keywords: *Public sector, budget system, internal control, financial management and control, Ministry of Defence, Army*

INTRODUCTION

With signing of the Stabilisation and Association Agreement between the European Communities and their Member States on one hand and The Republic of Serbia on the other hand, in Luxembourg on 29 April 2008, The Republic of Serbia, among other things, signed commitment to gradually harmonize its legislation with the achievements of the Union and their consistent application. Article 92 of the Agreement regulates cooperation in the area of public internal financial control (PIFC) and external audit, i.e. public internal financial control (including financial management and control and functionally independent internal control) aand external audit systems in Serbia, in accordance with internationally recognized standards and methodologies as well best practices in the European Union.
The current projection of internal control in public sector defined by the Law on the Budget System and the existing internal regulations are good basis for establishment of a comprehensive integrated system of internal control in the MoD and SA, which the Strategy for the Development of internal financial control in the public sector of the Republic of Serbia relies on. The Strategy is projecting both common activities aand the activities related to internal control and to the implementation of financial management and control in public sector until December, 2014.

1. INTERNAL CONTROL IN PUBLIC SECTOR

Internal control is defined as a process that is carried out by employees in an organization with the intention to achieve certain goals. The definition is broad and it covers all aspects of business control, thus making direct concentration on the specific goals easier.
The system of internal control is defined by the International External Audit Standards as "a system that includes all policies and procedures of internal control which the management of a legal entity has accepted to assist in achieving its objectives in terms of ensuring that the business is conducted properly and efficiently to the greatest extent possible, including adherence to management policies, keeping of the assets integrity, prevention and detection of fraud and error, accuracy and completeness of financial records and timely preparation of reliable financial information." [1]
The goal of a system of internal control establishment is a successful management and accomplishment of the mission, i.e. the set goals of the organization, and providing conditions for good and economic managing of public funds.
When talking about internal control in the public sector, it should primarily be based on the analysis of: the system of internal financial control (PIFC) and the system of financial management and control (FMC) .

[1] Savez racunovodja i revizora Srbije, (2002), Ocena rizika i interna kontrola, Medjunarodni standardi revizije, Serbia: Belgrade, p. 173

2. INTERNAL FINANCIAL CONTROL (PIFC)

Internal financial control in public sector is a term developed by the European Commission in order to assist in understanding and application of well-developed control systems in the EU accession process.
Internal financial control in public sector is a comprehensive system of financial and other controls established by the head of an organisation in public sector, with the aim of successful management and achievement of the organization's objectives. [2]
Besides, the internal financial control in public sector includes the entire system which is established by the government in order to control use of the budget funds and it includes all measures for control of government revenues, expenses, assets and liabilities and all internal control systems as well as procedures in the public sector, thus helping to create conviction that public funds are spent and used purpesfully. [3]
Internal financial control in the public sector should be considered within the overall field of public finance, which extends from creation of the state budget, through the approval and its execution, to the safe deposit issue, fiscal and debt management, including accounting, reporting, procurements, internal control etc. The system of internal financial control in public sector also includes financial management and control in public funds, internal auditors of public funds and the harmonization and coordination of financial management and control and internal audit carried out by the Ministry of Finance - CHU.
"*Financial management and control* involve the entire system of financial and other controls and is implemented by the policies, procedures and activities with the mission to provide reasonable assurance that the organization will achieve its objectives.
The internal audit is an activity of independent and objective persuasion, but a consulting activity as well, designed with the aim of creating business improvement of an organization. It is functionally independent in its work, it is not a part of any business process or organizational unit of the organization, and in its work it is directly responsible to the manager of public funds. Functional independence is provided by independent decision-making about: the field of auditing, way of performing the auditing and reporting on the performed audit.
CHU is a special section in the Ministry of Finance which elaborates and directs the process of internal financial control in public sector. It carries out and is responsible for providing professional development, certification and monitoring of the internal auditors' work, professional development of managers and employees in public sector, in accordance with the internationally accepted standards. " [4]

2.1. The regulatory framework

The reform of internal financial control and internal audit in public sector in The Republic of Serbia which started in 2002 by adoptioning of the budget system Law as well as a number of secondary law acts, the internal audit on central level was established in the Ministry of Finance. Obligation of establishing the internal control system was regulated by the amendments of the Law on the Budget System [5] in October, 2006.
Based on this Law and in order to develop and implement the internal financial control in public sector as a comprehensive system of internal control, the bylaws regulating this area have been passed.
If certain laws passed in order to regulate this area are considered, two of them can be taken in special consideration - the new rulebook regulating the financial management and control and the rules governing the internal audit. Compared to the previous one, the new rulebook on financial management and control underwent minor changes in the title, while the major substantive has not been changed. Substantial changes primarily related the differences in defining of the terms, and defining of new terms, such as the managers' management responsibility, risk management, audit trail, etc. Other differences can be recognized in defining of the methods of reporting in such a way that the deadline by which the head-user of public funds has to report to the Minister of Finance on the adequacy and functioning of the financial management and control has been prescribed.
The system of internal financial control is built into the legislation and its aim is to provide the benefits of transparent and healthy system of internal control for numerous stakeholders in the entire process led by the

[2] Zugic, R., Kostic, R. (2012), Kontrola i revizija u funkciji izvrsenja finansijskog plana MO, SYMOPIS 2012, Serbia: Belgrade, p.1
[3] Leko, V., (2008), Vrhovna drzavna revizija javnih sredstava, Faculty of Law, Serbia: Belgrade, p. 304
[4] Zugic, R., Kostic, R. (2012), Kontrola i revizija u funkciji izvrsenja finansijskog plana MO, SYMOPIS 2012, Serbia: Belgrade, p.2
[5] Zakon o budzetskom sistemu, („Sluzbeni glasnik RS", no. 54/09, 73/10, 101/10, 101/11, 93/12, 62/13 ispr. i 108/13), articles 80 to 83 is defined establishing of a system of financial management and control, which should be carried out by policies , procedures and activities, with the main task to provide reasonable assurance that a user of public resources will achieve their goals.

government. Therefore, based on the legal framework, it is necessary to fully establish the organizational structures, job descriptions and criteria for monitoring and evaluation of the employees' work results, the way of delegating tasks and ways of reporting in the system of internal financial control in public sector. It should also be said that the Action Plan together with Strategy, is a plan of activities related to development of the internal financial control in public sector which includes: joint activities, activities related to internal audit and implementation of financial management and control, and the plan is scheduled to be carried out in the period from October, 2009 to December, 2014.

2.2. Directions of development of the internal financial control system

The concept of internal financial control in public sector developed by the European Commission, is functional in terms of raising awareness and prevention, primarily through a number of conceptual, legal and organizational activities. For this concept the starting point is that the government, recognizing the necessity of raising the level of transparency responsibility and accountability, should start analysis of its internal control systems. [6]

The abbreviation PIFC is often used inn literature relating internal financial control in public sector: [7]
P *- Public Sector;*
I *- Internal to the organization;*
F *- Financial systems mainly but not exclusively;*
C *- Control based on internationally accepted and recognized standards.*

PIFC involves a comprehensive system established by the Government, i.e. public sector organizations for financial management and control, internal auditing and reporting on the use of public and the EU funds. The aim is to ensure that the management and control of public funds (including foreign funds) are in accordance with the regulations, description of the budget and the principles of sound financial management i.e. efficiency, effectiveness, reasonable distribution and transparency.
Internal financial control can be defined as an activity undertaken by management, boards, and other factors of management of the systems in order to improve risk management and increase the likelihood of achieving the goals.
The internal control system is established by the head of the organization, or by a person authorized by the head to establish a system of internal control. Internal control is an important component of risk management. It is implemented on all levels, in all organizational units and all workplaces. When establishing the internal control, it is the head's obligation to to draw up Plans for establishing internal controls for all organisation units in its composition. After the first phase, i.e. the adoption of the Plan, the next step is creation of Procedures for financial risk management of the business and the Ordinance on internal control and internal control procedures.
Based on the foregoing, it can be concluded that the model of internal financial control in public sector covers not only the entire system of financial controls but also other sorts of control established by the head of the organization, with the aim to successfully manage and accomplish the objectives of the organization.
All the issues considered so far clearly show that the internal control, during the work-process, exercises control of the following issues: whether the business is conducted in accordance with the prescribed procedures, whether the solutions and decisions have been made in accordance with rules and regulations, whether the contracts are in accordance with the Regulation on job classification, whether coefficients of the workplace are in accordance with the Regulation, and whether the process of procurement has been conducted in accordance with the regulations, plans and financial plan.
PIFC is a system that takes into account all aspects, i.e. it combines internal control and internal audit into one system like with the COSO model, plus a new element ,i.e. a centralized organization which is responsible for harmonization and coordination of both internal control and internal auditing standards, as well as the rules applied to all parts of public sector.

2.3. The future role of PIFC

PIFC concept has evolved gradually as response to a variety of inter-related events. Since the internal control systems in the EU Member States were not harmonized, the candidate countries could not know

[6] De Koning, R., (2007). Initiative of the European Commission to build a new structure of public internal control in the candidate countries and third countries, Belgium , p.24.
[7] Zugic, R., Kostic, R. (2012), Kontrola i revizija u funkciji izvrsenja finansijskog plana MO, SYMOPIS 2012, Srbija: Beograd, p.1

which system was to be considered as example of good practice. That is why these countries asked the European Commission to recommend the best practices in terms of choosing the best system. They were advised to focus on introduction of the activities and institutions that would influence upon increase of the public interest in sound financial management in private and public sectors and upon creation of strong awareness of the far-reaching consequences of corruption, fraud and embezzlement.
PIFC concept has become a strategy in order to give an answer to a great concern that all countries have regarding corruption and to develop the principles of responsibility and transparency. The only system was the only one which could be, and actually is based on the principles of democracy and obeying the laws. It represents harmonization of the standards and procedures and synchronizes the public internal controls with the appropriate international standards. It should be emphasized that the harmonization concepts are logical and useful, so this concept should be enrooted and expanded in all the countries which have accepted it.
It is important that PIFC concept provides a strategic framework that is regularly reviewed and updated, which is available and supported by the highest authorities in charge of control. Within PIFC, CHU should develop and promote a self-assessment procedure in control and audit institutions. As for annual basis, a report on the state of PIFC should be made and submitted to the government. This concept has become a concept with a practical purpose, and its continues to develop as a tool by adopting latest relevant examples of good practice.

3. FINANCIAL MANAGEMENT AND CONTROL SYSTEM (FMC)

Financial management and control encompass the entire system of financial and other controls, including organizational structure, methods and procedures, not only the financial systems but also the operational and strategic systems of organizations in public sector.[8] This definition, as well as the entire contents of the basic principle of financial management and control, have been literally translated from the EU documents, i.e. the EU member states. However, by detailed analysis of individual member states, i.e. the ways in which certain terms are defined, the authors of this paper have presented and shown their way of understanding of financial management and control.
Financial management and control is the overall system of internal controls established by heads of the organizations in the public sector and the heads are responsible for that system. This system, through the risk management, provides evidenceassures that budget and other funds are managed and spent in a proper, ethical, economical, efficient and effective manner.
An internal control system is not an irrevocable chart carved in stone. On the contrary, an internal control system should be changeable according to the changes in its constantly changing surroundings and it should be constantly upgraded. This is especially important if the state leadership is in the early stages of the control nature changes, i.e. where the internal control system is on an early stage of development.

3.1. Purpose and importance of internal control

General purpose of internal control is supporting of public sector in achieving its mission.[9] Each organization should design its own internal control system in order to meet the needs and properly respond to the organization surroundings,environment of the organization, as well as to reach the set goals.
The first category of objectives is about compliance with laws, regulations, policies, plans and procedures relating the organization in public sector. It should be mentioned here that the laws and regulations represent a kind of mandate-authorization given to the organization in public sector in relation to the way of collecting and spending of the national and international means.
The second category of objectives deals with preparation of relevant, reliable and useful financial and management information, also including financial reports (interim and summary), which improve the decision making process and provide transparency and effective monitoring and surveillance.
The third category deals with *the main objectives* of a public sector organization, including level of its success (performances) and operational objectives, outcomes and results. "Effectiveness" refers to the objectives achievement, i.e. the extent to which the outcomes and results of specific activities, programs and projects correspond to the objectives or intended effects. "Efficiency" is the ratio between the already used

[8] Ministarstvo finansija RS, (2011), Centralna jedinica za harmonizaciju, Prirucnik za finansijsko upravljanje i kontrolu, Ernst & Young, Serbia: Belgrade
[9] CHU has defined in its internal documents (specifically Introduction to Internal kontorlu, Module 1, Ernst & Young , Belgrade , 2010), which are the official translation of legislation that is developed and applied by the EU, certain terms that need to be familiar with the beginning of the introduction to the basic characteristics of the financial management and control. The primary objectives of internal control are to ensure: 1) compliance with laws, regulations, policies, plans and procedures; 2) reliability and integrity of data and information; 3) the effectiveness and efficiency of operations and use of resources; 4) protection and preservation of resources.

resources and outcomes, and the results in achieving the goals. This means that the minimum resources should be invested to achieve the given result , i.e. the maximum result with the given quantity and quality of invested resources.
The fourth category includes protection and preservation of the organization's assets in public sector against misuse, losses, damage, mismanagement and mistakes. The key question related to the assets safeguarding is asset management, i.e. procurement, use and way of managing the assets.
Successful internal control system helps in streamlining processes and improves the level and quality of services, providing a reasonable assurance that the general objectives will be achieved. Internal control should increase the possibility to detect the frauds, to reduce the damage, misuse or mistakes, to prevent inappropriate activities, thus improving compliance Internal control is also the responsibility of all the employees and each ministry should provide conditions for integration of the internal control into these activites. The employees should be trained in methodology and concepts related to the internal control system.

3.2. The functions of compoonents of COSO model

COSO model describes internal control through its five basic elements-components, or financial management and control includes the following elements:

- Control environment;
- Risk management;
- Control activities;
- Information and communication and
- Surveillance and monitoring.

The internal control consists of five major interrelated components that are inherent in the way how the management lead the organization. These components are mutually connected and they are used as criteria for determining of the internal control effeciency. Among these five components (control environment, risk management, control and internal control activities, information and communication, and monitoring) there is a synergy and connection through which an integrated system that dynamically responds to the changed circumstances is formed. The internal control components are mutually connected and stem from the way in which business entities conduct business and they are integrated into the management process.
Control environment establishes the "tone" of the organization and influences upon awareness of the employees about the controls. It is the foundation for all other components of internal control, providing discipline and structure. If the foundation is not strong and if the control environment is not positive, the general system of internal control will not be effective enough.
Risk management involves identification, assessment and control of potential events and situations that may have an adverse effect on the achievement of the objectives of the public funds users. The precondition of risk management is defining of the general and specific objectives the organization should achieve. The task of risk management is to provide reasonable assurance that the objectives will be achieved.
Control activities are written policies and procedures and their implementation established to provide reasonable assurance that the risks of achieving the objectives are reduced to an acceptable level defined in procedures for risk management. They are implemented throughout the whole organization, on all levels and functions, by all employees and in accordance with the established business processes and job descriptions.
Communication is the exchange of useful information among employees and organizations as *support* to the decisions and coordination activities. The information should be transferred to the management and other employees who need them, in the form and within the timeframe that will help them to accomplish their duties.
Monitoring involves the introduction of a system for monitoring the financial management and control by assessment of adequacy and effectiveness of its functioning. Monitoring and evaluation of the system include consideration of the activities and transactions of the organization in order to assess the quality of work in a certain period and to assess the effectiveness of controls. Management should direct the monitoring activities toward the system of controls and accomplishment of the organization's mission. Monitoring and assessment of financial management as well as control done by checking of current situation, self-assessment and internal audit.

4. INTERNAL CONTROL IN DEFENCE SYSTEM

In order to provide conditions for the implementation of the budget as originally planned and approved by the highest authorities (Parliament), the budgetary control is organised in all contemporary budget systems.

As for establishing a safe and effecient internal controls in the defense system, the commanders are those who are responsible. The internal control process is carried out permanently in business activities with the beneficiaries through a formal, substantive check as well as control of the figures in the accounting and accompanying documents. [10]

Formal control of accuracy of the accounting documents determines if the documents have all the essential elements - attributes (the completeness of the documents and its preparation in accordance with applicable regulations are the issues that are determined).

Essential control of accounting documents accuracy determines whether the transaction contained in the accounting document has really been created by volume, structure, quality, time and other features.

Control of arithmetic accuracy of accounting documents determines the accuracy of the required calculations and accuracy of the results presented in the document. Control of formal, essential and arithmetic accuracy is confirmed in the accounting document by putting the clause "controlled by", the signature of the person who controlled the document and the date when the control was carried out. [11]

On the other hand, the system of financial management and control systems are established with all public funds beneficiaries. The person who gives orders is responsible for establishment of a financial management and control system, and both the person and the employees implement it in practise. Financial management and control system are established in accordance with the adopted regulations which regulate establishment and development of the Internal financial control system in public sector of The Republic of Serbia .

Monitoring is a special form of internal control and it is part of regular duty of the managers of organizational units of the Ministry i.e. commanders of material and financial authority on all levels, as well as the persons on other duties who are responsible for organization and implementation of financial and material business activities. This is a very efficient and cost-effective form of control, because it binds and integrates the component of control into the function of command and control, and builds it into the system of responsibility and accountability assumed by a subordinate, and all that in accordance with the principle of subordination. Monitoring is carried out: *on daily basis* by personal insight into work of the subordinates and *occasionally* by personal insight into the state, keeping and maintaining of the the property. Each MoD member, irrespectively of the duty MoD or SA, after detecting violations and irregularities in work and use of the resources, has obligation to submit a written report to the commander in charge and to suggest the measures to be taken to solve the found irregularities.

As for the aspects of use and management of budgetary resources of The Republic of Serbia, there are the following forms of internal financial control in Ministry of Defence and the Serbian Armed Forces (Figure 1): [12]

- *monitoring* – constant, daily control of resources and work carried out by army officers who are in charge of giving the orders;
- *control of legality, correctness and preparation of documents relating business transactions,* done by expert services personnel and financial agencies functioning as bookkeepers;
- *control in the Accounting centre*;
- *inspection activities of defence in Defence Inspectorate* which is, besides other activities, in charge of control of material and financial operations;
- *detecting and giving evidence of organised crimes, money laundering and corruption* (abuse of power, trading in influence, bribery) by the Military Security Agency and Military Police Agencies.

[10] Ministarstvo odbrane i VS, (2011), Pravilnik o finansijskom poslovanju u MO i VS, („ Sluzbeni vojni list“, no.17/11)

[11] Ministarstvo odbrane i VS, (2011), Pravilnik o finansijskom poslovanju u MO i VS, („ Sluzbeni vojni list“, no.17/11), article 93

[12] Zugic, R., Kostic, R. (2012), Kontrola i revizija u funkciji izvrsenja finansijskog plana MO, SYMOPIS 2012, Srbija: Beograd, p.3

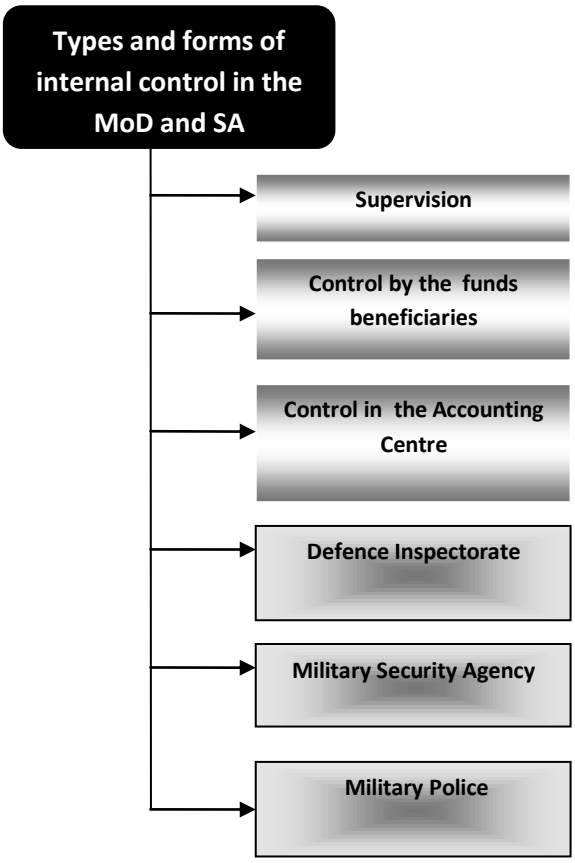

Figure 1: Types and forms of internal control in the MoD and SA

Based on the aforemntioned facts, it can be said that there is an organized system of internal control of spending and use of the budget funds in the Ministry of Defence and the Army. The system is based on accounting - financial data with the direct perpetrators of the approved budget funds and the Accounting Center of the Ministry of Defence.

5. FUTURE DIRECTIONS OF DEVELOPMENT OF INTERNAL CONTROL

The current system of control has been established neither in relation to the objectives planned by the public funds beneficiaries nor the risks which can influence upon achievement of the objectives. The existing controls are mainly directed to providing legality and regularity, but not to economy, efficiency and effectiveness.

To improve functioning of the internal controls in public sector of The Republic of Serbia, among other things, it is necessary to:

- prepare, harmonize and adopt the rules and procedures for financial management and controls in ministries and public sector organizations;
- develop a strategy for training of persons responsible for financial management and control in public sector organizations;
- establish the mechanisms for cooperation and monitoring development of financial management and control system;
- completely apply the Law on Public Procurement and controlled use of public expenditure in order to reduce the level of corruption.

To improve functioning of the internal control in the system of defense, it is necessary to:

- upgrade and improve the existing regulations, practices and organization of work in order to increase efficiency of material and financial operations and inspections;
- especially upgrade and improve model of instruction - the reminder for exercising the control of material and financial operations in the Army of Serbia, in order to prevent the occurrence of failures and eliminate risks in business and in inspections;
- especially exercise control of material and financial operations, that is to say, not within the control of compliance with laws, rules and regulations, or

- if control of material and financial operations is carried out within the control of compliance with laws, rules and regulations, to prolong the time for exercising the control;
- harmonize the existing standards of control in order to reduce the number of controls of all kinds and from all levels, and to provide the conditions for prolonging the time for exercising the controls.

It should be kept in mind that the entire system of internal control can only help public sector organizations to achieve their goals. It is not an "all-purpose remedy" and it can only provide control information related to progress or lack of progress of the organization in terms of achieving the goals.

CONCLUSION

Internal control means integration of the activities, plans, attitudes, policies, resources and efforts of the employees in an organization who work together in order to achieve all the goals and missions of the organization. Accordingly, the internal control is concentrated on the organization's mission.

Internal financial control in public sector, as a new concept of the budget system of the Republic of Serbia, establishes efficiency of public expenditure management along with introduction of multiple control systems. The emphasis is primarily on introduction of the internal control system of direct and indirect budget beneficiaries and mandatory social insurance.

The essence lies in the fact that it is necessary to improve the internal control of national and international budget funds, i.e. it is necessary to take certain steps which will guarantee long-term success in achieving benefits for public sector.

Financial management and control in public sector and in the defense system should be fully established and directed in such a way that the focus of the control exercising is not on the legality and regularity, but on the economy, efficiency and effectiveness of spending the public expenditure. Accordingly , the financial management and control system will function in an easier way and it will deal less with irregularities in business activities, thus being able to pay more attention to prevention and giving advice to the management. In that way, the risks in business will be reduced and the management will be assisted in making better decisions.

As a concrete conclusion, it can be emphasized that this issue should be constantly analyzed and updated, and that each organization should create its own system of internal control which will meet its needs and the environment in which it functions.

REFERENCES

Zugic, R., Kostic, R. (2012), Kontrola i revizija u funkciji izvrsenja finansijskog plana MO, SYMOPIS 2012, Serbia: Belgrade

De Koning, R., (2007). Initiative of the European Commission to build a new structure of public internal control in the candidate countries and third countries, Belgium

Leko, V., (2008), Vrhovna drzavna revizija javnih sredstava, Faculty of Law, Serbia: Belgrade

Zakon o budzetskom sistemu, („Sluzbeni glasnik RS“, no. 54/09, 73/10, 101/10, 101/11, 93/12, 62/13-ispr i 108/13)

Ministarstvo odbrane i VS, (2011), Pravilnik o finansijskom poslovanju u MO i VS, („ Sluzbeni vojni list“, no.17/11)

Ministarstvo finansija RS, (2011), Centralna jedinica za harmonizaciju, Prirucnik za finansijsko upravljanje i kontrolu, Ernst & Young, Serbia: Belgrade

Savez racunovodja i revizora Srbije, (2002), Ocena rizika i interna kontrola, Medjunarodni standardi revizije, Serbia: Belgrade

THE IMPORTANCE OF A PUBLIC - PRIVATE PARTNERSHIP FOR TRANSITION COUNTRIES

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***Abstract**: Long-term practice of developed countries shows that partnerships between the public and private sectors are an effective way to achieve the objectives of the public and private sectors. The interest of the public sector is that, as a partner who defines the type and scope of work or services, to transfer the business of services to the private sector, and the interest of the private sector as a partner is earning profits, with a commitment of quality fulfillment of contractual obligations. Various forms of cooperation are used within which the public and private sector pool resources and capabilities in order to facilitate their effective use.*
Last year records showed a significant increase in cooperation between the public and private sector countries in transition such as Serbia. The PPP project is aimed at developing infrastructure and infrastructure management, public utilities, health care, environmental protection.

***Keywords:** public - private partnership, sustainable development, transition countries*.

1. INTRODUCTION

The need for public-private partnership was gradually developed since the beginning of the 80s of XX century, when serious criticism appeared on the inefficiency of public service providers and their inability to respond to identified needs. The role and importance of public-private partnerships as an effective way for a more rational use of limited resources and potential for development was growing. Peteri (2010) point out that "a partnership between the public and private sector are used to promote the business of stakeholders from different sectors in all countries" (p. 8).

Public-private partnership is based on the concept of risk sharing. There are a number of factors that influence the success of management of joint public - private projects. Large and technically complex infrastructure projects, with complex funding scheme, depend to a large extent on external factors. Peteri (2010) point out that "this is especially true in situations where the demand for these services is influenced by political decisions on the justification, the price to be paid for the service and the level and form of social subventions (p. 10).

The possibility of failure due to any of these factors is just one of the risks of success with public-private partnerships. There are other, internal risks, which are influenced by internal factors, such as the construction, management and technology. There is no single agreed definition on the concept of public-private partnerships. In practice, there are various definitions relating to the substance of public-private partnerships.

In a broader sense, the public-private partnership is defined as the implementation of all known types of cooperation between public and private partners, which, in many cases, leads to the establishment of joint ventures. Vladkov and Markov (2010) point out that "European Commission guidelines for successful public-private partners, define a public-private partnership as a partnership between the public and private sectors for the purpose of delivering a project or service traditionally provided by the public sector" (p. 22). Through this partnership, the strengths of each of the two sectors (public and private) are complemented in the provision of services or construction of facilities for the benefit of specific communities. Since each of the sectors is doing what it is best in, the services and infrastructure are offered to society in the most effective way, in economic terms. Such partnerships are characterized by the division of investment, risk, responsibility and profit among partners institutionalized public-private partnerships include the establishment of a joint venture by the public and private partners. The joint venture has a task to perform community service or providing public services.

In Member States, entities of public authorities sometimes resort to these structures, especially in the area of public service delivery at the local level. Institutionalized public-private partnership may be established either

by establishing a joint venture by the actors of the public and private sectors or taking control of existing public company by a private sector entity.

2. EXPECTED BENEFITS FROM THE PUBLIC-PRIVATE PARTNERSHIPS

Public-private partnership is one of the possible forms of cooperation, and it's based on recognition of the benefits that both the public and private sector achieve by pooling financial resources, knowledge and expertise to provide quality services to all citizens. For countries in transition this model is significant because it represents an alternative to full privatization. This partnership model provides a combination of social responsibility on the need to resolve a number of infrastructure problems and providing of quality services to citizens with finance, technology, efficient management and entrepreneurial spirit of the private sector.

Taking into account the advantages and disadvantages in providing public services, it is important to note that the most important role of public-private partnership to act as a new model of financing capital projects.

The main argument for the establishment of public-private partnership is the ability to obtain benefits for service users and local authorities, as a result of participation of private partners in investments in infrastructure, public services and public service management. In some countries, such as, for example, Hungary and Serbia, where public institutions, because of the legal and administrative constraints, were less able to respond to the needs of private companies, state government hoped that the stakeholders from the private and NGO sector be able to provide more and better.

Aleksic (2009) point out that "public-private partnerships are necessary during the fiscal restrictions, when the pressure on the public sector to reduce the number of employees and the total cost is extremely powerful. In some forms of public-private partnerships, public sector employees are employed by the private partner or licensee, thereby reducing the number of employees in the public sector. Public-private partnership aims to attract more resources into the public sector" (p.74).

The form of public-private partnership allows the public sector better access to modern equipment and management techniques. It is expected that the public-private partnership are going to improve the economy, because the existence of contractual obligations means that projects are completed on time and that their costs are rarely grow during implementation. The role and importance of public-private partnership is different and depends on the achieved level of social and economic development as well as the experiences, both positive and negative, in their implementation. The research practice shows significant benefits of public-private partnerships, as well as the problems that arise in their implementation.

Bogdanov (2010) point out that "the contribution experiences of public-private partnerships are relatively modest in countries in transition as the cooperation of the public to the private sector is still new and still have enough relevant empirical data to confirm the feasibility of cooperation. It can be concluded, based on the stages of development of public-private partnerships in developed market economies (U.S., UK, Denmark, Germany, etc...) that, in countries in transition, the cooperation between the public and private sectors are at the level of the first phase of development" (p. 221).

However, public-private partnerships must be used with great care. They are, without a doubt, more effective than the traditional means of public investment. Public-private partnerships can be used to exclude from the budget the investment and the need of the country to borrow. Yet on the other side of the state still bears most of the risk and potentially faces significant costs that could be borne by taxpayers. Each partnership is specific considering its form, duration of certain phases, the speed of the transition to the next phase, the intensity of cooperation and level of involvement. Because changes are permanent, it is necessary to continuously review the position of each actor. "Risk matrix" consisting of three different groups of risk: (http://www.easwmc.org/download/postconf/Hans%20Wiesmeth.pdf)

Table 1: Benefits and problems in the implementation of public-private partnerships

Use	Problems
Stable economic and social development of certain sites or companies	Insufficient experience in cooperation between the public and private sectors

The cooperation of a number of different stakeholders contribute to positive changes and improvements in various areas of the economy and society	Greater focus on the form and inadequate focus on the content of the cooperation within the framework of public-private partnerships
More efficient use of the limited resources of the community and the company, risk sharing	Incorrect assessment of the potential benefits, the necessary resources and credibility of partners in public-private partnership
Creating new capabilities and competitive advantages as a result of learning, acquiring and distribution of knowledge	Asymmetrical competence and power of stakeholders
Efficient implementation of strategies of all the entities involved	Abuse of political and economic power in the establishment of public-private partnerships
The affirmation of the concept of social responsibility of public and private sector	Institutional complexity of public-private partnerships and imprecisely defined partner accountability
Greater synergy effects and successful positioning of all stakeholders	Uncertainty in the design of new policies and strategies of public and private sector
Stable public-private partnerships bring greater flexibility of different subjects and groups, improving the image of certain locations (municipalities, cities, regions, countries) and businesses subjects	Blocking of new ideas as a result of delegating decision-making to others and the increased bureaucratization of decision-making
Enhancing national, regional, local and business competitiveness	Issues in the evaluation and implementation of control strategies

Source: Nenezić, Radulović, 2012, p. 67

Risks of construction consist of the following:

- Who is responsible for planning investments?
- Does the contract primarily specify the volume and quality of the services or the conditions relating to the characteristics of the property that is necessary for the provision of services (size, design and technical quality of the assets that will be used)?
- Does the state or contractor of public-private partnerships bear the risks arising during the implementation of the investment (for example, the risk of increased costs, and risk of financing due to poor project/performance)? What sanctions can be applied by the client in the event of failure, delay or inadequate realization of the investment?

Availability risk involves the question of whether the entire risk is borne by the state or a private contractor: (http://www.easwmc.org/download/postconf/Hans%20Wiesmeth.pdf)

- Who bears the risks that may occur during the operation (for example, the risk of downtime due to failures or natural disasters)?
- What are the sanctions that apply if the contractor is temporarily unable to ensure the availability of resources in the quality which is specified in the contract?
- Can it be possible that the state must contribute to finance property maintenance?
- Which party is responsible for maintenance and insurance of the property?
- What are the sanctions applied by the relevant ministries in the event of inadequate quality of service?
- Who bears the risk of an increase in operating costs?

Demand risks include: (http://www.easwmc.org/download/postconf/Hans%20Wiesmeth.pdf)

- Who bears the risk of demand?

- Is the private partner entitled to compensation in the event that the demand is less than expected or the one specified in the contract?
- Who bears the costs in case of a higher demand than expected or those specified in the contract?
- Can the contractor use the created goods for providing services as part of their activities to third parties?

Most of the project risks are allocated to the private partner, while mainly risks that they are considered to be a sector with a greater possibility of influence and management are allocated on the public sector. The entire risk of construction and demand risk and availability risk is expected to bourn by the private partner.

Ilic an Pasic (2011) point out that "public-private partnership aims to attract more resources into the public sector. PPP helps public companies to comply with restrictions relating to the public debt. It is of great importance in the EU member states with regard to the fact that one of the criteria is that the public debt should not exceed 60% of GDP. Form of PPP allows the public sector better access to modern equipment and management techniques. It is expected that the PPP will improve the economy, because the existence of contractual obligations means that projects are completed on time and that their costs are rarely grow during implementation" (p. 507).

3. CONCLUSION

For the success of public-private partnership it is essential that the partnership is established and developed on strong and sound foundations. It should be borne in mind that each partnership, as well as public-private, can be successfully implemented only if the objectives of the key players are compatible. In the case of public-private partnership that would include an appropriate level of quality service at a reasonable cost and with reasonable levels of return on assets.

In order for PPP to be successful it needs to have the character of long-term and stable cooperation between the partners. We should also not ignore the very important fact that PPPs increases the efficiency of use of public funds, and with the introduction of competition, reduces the corruption that is in the interest of all citizens and society as a whole.

It can therefore be concluded that the PPP is the future of joint financing, construction and management of infrastructure facilities, especially in countries in transition, in which the quality of infrastructure is a bottleneck in overall economic development and every quality investment in infrastructure is motivating impulse for the dynamic development of economy as a whole.

REFERENCES

Aleksić, V., (2009). Organizacija preduzeća, Kragujevac: Ekonomski fakultet.

Ilić, S., Pašić, V. (2011). Perspektiva javno privatnog partnerstva u Srbiji, rad objavljen u SPIN '11 VIII Skup privrednika i naučnika: Operacioni menadžment u funkciji održivog ekonomskog rasta i razvoja Srbije 2011- 2020, Beograd: Fakultet organizacionih nauka, Centar za operacioni menadzment i Pivredna komora Srbije, str. 505-512.

Nenezić, D., Radulović, B. (2012). Analiza mogućnosti i modaliteta finansiranja i mera finansijske podrške javno-privatnog partnerstva u Srbiji, rad objavljen u Kvartalni monitoring br. 30, Beograd: FREN, str. 62-71.

Peteri, G., (2010). Partnerstvo javnog i privatnog sektora: Dobre i loše strane, rad objavljen u Partnerstvo javnog i privatnog sektora: Dobra i loša iskustva u odabranim zemljama u tranziciji, Beograd: Palgo centar, str. 7-19.

Vladkov, S., Markov, A. (2010). Javno-privatno partnerstvo u Bugarskoj: Marketizacija javnih usluga na opštinskom nivou, rad objavljen u Partnerstvo javnog i privatnog sektora: Dobra i loša iskustva u odabranim zemljama u tranziciji, Beograd: Palgo centar, str. 21-45.

Wiesmeth, H., (2008). Investment Opportunities in Waste Management through the Private Finance Initiative, http://www.easwmc.org/download/postconf/Hans%20Wiesmeth.pdf (15.04.2014.)

INCREASING CAPACITY LEVEL OF FINANCIAL MANAGEMENT IN PUBLIC SECTOR

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Abstract: *Target of this paper is to, in an adequate way, articulate activities of financial management in public sector, and therefore, to make the research and recommend adequate measures for increasing capacity level of financial management in public sector, consecvently providing rational managing of public sector' assets.In the paper are used appropriate and adequate commonly used scientific research methods. Assessed is utilization of available legal and professional regulations for the follow-up and utilization of public assets.*
During the research and preparation of this paper, we came to the following conclusions:

- *financial management in public sector has a specific task: determining of needs for assets from public sources, their legalized utilization, with a purpose and availability of control over public sector*
- *financial management in public sector gets a new role and task by transferring to programing budget: obtaining of efficiency and effectiveness in providing public services*

It is specifically stressed (and to that conclusion, as a novelty, we came to in the paper) that all managers in public sector should participate in financial management, considering that budgeting, allocation, funds' management, accounts' setting, are very important skills of all managers in public sector. The paper can be used for the improvement and modification of public sector.

Keywords*: public sector, budget, program budget, financial management, efficiency and effectiveness of public sector' management, financial reporting, supreme audit institution of public assets****.***

1. INTRODUCTION

Public assets are the base for the application of public policies, and therefore for the realization of all basic functions that state has the obligation to provide. In the past, in all of the developed countries of the world, by custom, it was enough to present that the assets are utilized in accordance with appropriate laws, regulations and standards. Traditional responsibility finalized by providing simple proofs on execution according to legislations, whereas results measurement was based on respect of regulations and proof of respecting limitations defined by the budget.

Democracy development and development in general have drastically increased of the state responsibility. Many new democratic, social and other functions have been introduced. These are the characteristics of reached level of national development and national standard, having as a consequence increase of public sector and public expenditures. By increasing level of democratic development, public expectations are changed as well as of the citizens on the questions of transparent expenditures of public assets, and on effectiveness of the policies government is applying. In contrast to private sector, where the optimal effectiveness is equal to the optimum of high standards, in public sector this is not the case and benefit for citizens must be supplied by another way, whereas the final target has to be maximal efficiency of public sector and in given circumstance maximal benefit for nation.

Financial management function in public sector, therefore, acquires significant meaning.

This paper is particularly speaking on the subject of development and increase of the capacity level of financial management in public sector and contains specificities, needs and necessity of its establishment and functioning. Especially, it pursues analysis of responsibilities (accounts' setting of financial management).

2. STRUCTURE OF THE PAPER

The paper consists of the following parts:

- Main characteristics of the public sector
- Specificities of financial management in the public sector
- Capacity development of financial management in public sector
- Responsibilities (account setting) of financial management of public sector
- Concluding remarks

3. MAIN CHARACTERISTICS OF THE PUBLIC SECTOR

Public sector are the state and all of its entities having access to public assets and state property. These are: state agencies, public administration, army, central bank, entities of local self-government, independent regulatory bodies, and legal entities in which state or municipalities have major allotment. Public sector is a synonim for a government sector.

Purpose of public sector existance is satisfaction of public needs and performing of public functions. Public sector is, by IAS and IASPS in relation to national government, regional regulatory bodies, local municipalities, and similar governmental entities.

Public sector consists of:

- All beneficiaries of public assets
- Territorial autonomies and local administration
- Organization of obligatory social insurance
- Budget public funds
- National bank (in the part considering utilization of public assets)
- Public companies founded by the public assets client
- Public companies founded by the state
- Public companies in which capital or management are public assets client

4. SPECIFICITIES OF FINANCIAL MANAGEMENT IN THE PUBLIC SECTOR

Financial management in public sector comprises of affirmation of needs for funds from public sources, its assigned expenditure, keeping of accounting evidences and reporting on results and money spending. It has significant emphasis on legal functioning of governmental institutions and corporate management of state companies. It provides supervision over public sector and represents important factor of credibility of governmental institutions and companies.

Financial management represents aggregate of methods and techniques that provide public sector to manage funds in a systematic, effective, transparent and legalized way.

> Provides information for decision makers, introduces controls that prevent frauds and are creating motivation for sound public service and are helping public sector in money collection, funds' allocation, funds' expenditures, measurement of expenses and benefits of various programs, keeps evidence on funds, reports on funds' quantity used and plans on a long term.

Financial management encompasses methods and techniques for management of assets under disposal of public sector.

Institutions and companies from public sector possess significant fixed assets, and its' evidence, valuation, and amortization is subject to financial management. Budgeting of capital investments (building of facilities and purchase of equipment) also represents one of the domains of financial management. It provides respect of procedures, keeping of evidences and reporting. All of this is crucial for determining controls in institutions and companies of public sector, as well as public awareness that the needs of citizens are appropriately serviced and that budget assets are used in a legal way.

Financial management in public sector consists of three segments: Budgeting (obtaining and allocation of funds), Control of budget achievement (control of money spending), Reporting on budget accomplishment (accounts placing for spent money).

Budgeting comprises of money collection and allocation of resources. Major part of money in disposal of public sector originates from taxes, fees and other government incomes. Public sector incomes are not linked with defined assignments, but are allocated in the process of budgeting on various activities. There are also exceptions, when specific taxes and fees are allocated to specific programmes. Budget indicates to the publicity in which way the government intends to spend funds collected from the citizens. Budget represents limitations for expenditures, and at the same time certifies state representatives to spend budgeted assets.

Control of budget accomplishment. From the state representatives is expected to spend appropriately funds from public funds. Therefore, financial management implies existence of expenditure control. Government has to periodically and systematically supervise cash flow and to report to publicity. In this way it is ensured that accomplished financial activity will be aligned with the planned financial activity. Roles and responsibilities of different subjects, as well as dynamics of reporting, are defined by law. Information systems in public sector should assist these roles, in order to follow-up their development in achievement of planned financial activity.

Reporting on budget accomplishment. Public sector must prove to the publicity that collected funds are spent as per assignment. Usually information expected represent answers to the following questions: is the money appropriately allocated, is the money spent in assigned and legal way, are the expected results achieved, can we check the way of funds expenditure, is the external overview carried away or audit of financial reporting. Financial business in the past must be presented, revised and compared with the budget, in order to provide to the government and publicity proof that the funds are appropriately spent. Financial reports of governmental institutions and companies represent basic documentation on which evaluation of financial business in public sector is assessed.

5. CAPACITY DEVELOPMENT OF FINANCIAL MANAGEMENT IN PUBLIC SECTOR

Ability to provide resources necessary for realization program targets (budgeting), maximization of programing benefits in the budget scope (allocation), effective managing of budget assets (funds management) and realization of the results in a legal way (accounts setting), represent important skills of all managers in public sector. In practice, all managers should take roles in financial management.

Financial management means engagement of all managers. Managers in public sector often do not perceive themselves as managers who manage available resources, but rather managers who are carry out policies of certain specialized functions in the sphere of public sector. Due to complexity of public sector, financial function has its managers who are performing separately from managers on other functions (operational

managers). Often, certain pressures occur between financial and operational managers and they are considered as expected, even useful if contribute to solving problems in work.

Financial management in public sector should cover, i.e. establish methodology and strategy of development of three basic segments: budget methodology, control methodology and reporting methodology.

Budget methodology

Budgeting should have two main goals: determination of priorities of spending and effectiveness and efficiency of given services by public sector.

Fact that budget in public sector annual plan of expenditures in monetary units is legally defined. Expenditures are linked to satisfaction of population needs, but is timely limited plan, by which resources needed for goals' realization in each unit of public sector are defined. Budget is in fact a document by which different opinions, contained in governmental policies, are transformed into specific activities by resources' allocation. It articulates expectations on incomes and expense of government ministries, agencies and other institutions and therefore, presents basis for control of organization's work in public sector.

In terms of on financial management in public sector, managers have direct tasks:

- To manage cash assets during the current monetary year
- To participate in planning of cash assets for the following year and
- To justify utilization of cash assets in the past, as well as the way the funds have been used.

From this, it stems that the main goal of this way of budgeting control of expenses and responsibility of financial managers is to maintain expenditures of some categories of expenses on budget level. However, financial management should compare effectiveness and efficiency of public expenditure through linking of financing of organizations of public sector with results achieved (information could be used on the effect for realization of this link as for example evaluation ratio, results of the program, etc.). Primary goal of such financial management-budgeting is better determination of priorities in expenses, as well as establishment of closer link between financing and results. Especially such, as newer way of budgeting, is developed in the last three decades. Only in such way it is possible to increase pressure on public sector organizations to improve its effectiveness and efficiency of services provided. Financial management of public sector must provide more clear picture on the level of services provided, the amount of money, and with which results, in other words to link budget assets with the results.

Further development of the financial management level, actually capacity level of financial management should go in the way of program budgeting establishment, meaning to show purpose of expenditures or the way in which public assets are allocated by specific program. Assets are assigned, allocated to operational organization units or specialized programs in the way they will be spent. In such way, expenditures will be in a direct way linked with the purpose, actually with the goals of assets' beneficiaries, meaning that expending of public assets will be done in a meaning way.

Programing budgeting contributes to strengthening of responsibilities as people are appointed for each responsibility in some programs of public sector organizations and from them is expected to report on realization of those programs (such way of budgeting in Serbia in financial management of public sector should be applied from the year 2015).

Process of preparation and budget approval represents one of the most important tasks in each organization of public sector. Such task can be more or less complex depending on the business of each organization. Budget process must be transparent. Possibility of review is assumed in all activities that contributed in budget approval. Organizations' budgets from public sector are the subject of intensive

supervision. Not only by the management itself and the ministries, but also by all beneficiaries of goods and services that are financed through budget assets. Especially is important role of managers in public sector during the budget apporval process, as it is expected from them to „defend“ financing of their organizations and programmes.

Control methodology

Control of budget realization and expenditure of public assets should be organized through:

- Management control
- Risk management
- Cash flow management

From this, it is concluded that entire burden of control is not only on the financial management.

Management control system consists of organizational structure, processes and systems developed in public sector organizations for achievement of their goals. All of this can be perceived as series of different controls or control framework meaning: defined organization goals, delegated responsibilities and roles, standards for different types of effect, system for risk management, defined policies and controls, system for the follow-up of achieved results and system of internal and external audit. In which extend this system (control framework) will be effective depends generally on the importance of the controls in public sector organizations. Especially it is important that managers, on the highest levels of decision-making in the organizations, promote importance of the controls by their own behaviour and performance. Managers on the lower levels of decision-making should also participate in development of the system of management control and in their own sector respect requests from the system. Effective system contributes to achieving high level of performance on all organizational levels and more successful understanding of risk and decreasing of effects of adverse circumstances on the organization.

Risk management represents core of management control. Control implementation means anticipation of risks and diminishing of adverse consequences coming from different types of risks. For risk management it is crutical to establish steps and management systems for identification and risk assessment, as well as for diminishing their influence on the organization. In the context of financial management, risk management is related to the risks that could bring to financial losses and to risks that could adversely influence to the organization goals achievement.

Cash flow management includes step-by-step control during the monetary year related to follow-up of financial performances. These are additional steps, apart from „ex ante“ and „ex post“ procedures. It allows to make changes in the approved budget, in case of necessity. It allows answers on various questions set during the monetary year. System of cash flow management is effective if provides: projected cash flows on which comparison between achieved cash inflows and outflows is made, reports to responsible management levels on budget achievement, on necessity in budget changes and on reallocation of assets surplus and timely information related to assets inflow and their expenditures and on results organization is achieving and on which basis decisions could be made on possible changes in budget, on obtaining additional assets, as well as on reallocation of unnecessary assets. Goals of system development are: disposal of cash for payment of bills (liquidity), utilization of budget assets by purpose, but in a way that they wont be unused, expenses in the framework of approved budget, assurance of organizational assumptions and resources for timely reaction on program changes and activity plans and reallocation of available funds for financing

urgent, short-term priorities. In public sector organizations cash inflow happens according to the approved budget, therefore providing of funds for reconciliation of debts should not be an issue for managers. Therefore, more attention is given to expenditures’ management, in other words on cash outflow.

Reporting methodology

Reporting on budget achievement should cover accounting-financial reporting (accounting standards and principles, accounting basis, types of financial reporting, responsibilities for used public assets as well as audit of financial reports).

Budget accounting provides qualitative financial information and has following characteristics: it is based on the principals for collecting and presenting of financial information, prepares financial reports with the summary of all transactions effects, prepares information on achieved results for comparison with planned results, and exists for the public interest, as it shows in which way money is spent from the public funds. It covers various activities that are repeated in cycles, therefore for the functioning of accounting characteristic is accounting cycle.

Financial reporting presents process of building of financial reports at the end of accounting cycle, considers application of standard methods and given reporting forms, provides to publicity overview into organizational functioning in public sector. Result of reporting process are the most important financial reports: Balance sheet, Income statement and Cash Flow report.

Financial reports could be based on accounting or cash basis of accounting. We will give just in brief basic characteristics of both accounting basis, having in mind that from their choice depends improvement of financial management in public sector organizations.

Accounting basis of accountancy, is based on the principal of causality. Recognition (evidence) of incomes in accounting evidences when “earned” and recognition of expenses when goods and services are “used” for creation of incomes. Purpose is measurement of activity results th?at are achieved during the accounting period. It is more complex then cash base, as in accounting two additional important accounts are introduced: Receivables from customers and Payables. Allows more qualitative financial management as it provides complete picture on financial position of the organization. Provides better view on expenses that are not limited on one year. Application of accounting basis of accountancy presents condition for improvement of financial management in public sector organizations.

Cash basis of accounting. Incomes are recognized when money is received, and expenses when the payment is made. Accounting measures cash amount received and paid during the accounting period, therefore, activity result during the period cannot be measured. It is simple and easy to be understood. It does not provide full picture on financial position of the organization, therefore it provides limited possibilities for financial management. Cash basis of accounting is applied nowadays in many countries, but, on international level, it is noticed tendency of gradual transition to accounting basis. To this fact, necessity to improve financial management in public sector organizations contributes, therefore, results of the program made by these organizations are viewed over the longer period then one year.

Public sector in Serbia is used cash basis of accounting, but as well so called **modified accounting** basis. Modified accounting basis can be seen as partial application of accounting basis.

6. RESPONSIBILITIES (ACCOUNT SETTING) OF FINANCIAL MANAGEMENT OF PUBLIC SECTOR

Special concept of responsibilities in public sector has a broad sense, and implies obligation of an individual or the organization to justify its activity, to accept responsibility for those activities and to reveal results of those activities in a transparent way. Also, it implies responsibility for cash or other given property. Application of such concept consists of three elements: taking into account that population believes that the job for which someone is responsible will be done, providing detailed information on activities done and on

achieved results and accepting responsibility of results. Main characteristics of such concept are: delegation of authorizations and resources to individual or organization, account setting for results and results for which achievement someone is responsible, request to report on results, compliance with legislations and procedures and on efficiency of activity performance, as well as the evaluation on application of this concept which is given by the supreme auditor.

Financial management presents important instrument in application of account setting concept. Effective financial management is one of the most important conditions for establishment and application of account setting concept.

Effective application of responsibility concept provide transparency of public sector organization activity and imposes their credibility. The broadest population is convinced that public funds are spent in a legal way and that the public interest in this domain is respected in a appropriate way. Establishment of responsibility mechanism is useful and represents also one of the crucial factors of success of public sector organizations. Unfortunately, public sector organizations are disposed to different risks from the environment, therefore constant improvement of responsibilities and control is the best way to decrease adverse effects. Expenses of introduction and maintenance of control mechanisms should be appropriate to mentioned risks.

Role of audit in application of account setting concept

Audit contributes to effective application of this concept, as it provides confirmation: that the information given by the management are applicable by the standards and that they provide real situation in the organization, that it is truthful what is given in the reports, that the results organization achieved are in compliance with approved plans and programs and that the results are achieved in a legal and efficient way. Audit of financial reports refers only to financial information. Audit provides confirmation that the reports are made according to the international accounting standards for public sector. This type of audit in public sector is called supreme audit, and its function is to, in the public interest: verity legal aspects in performing tasks in public sector organizations, including expenditures and control of cash assets and other resources, provides opinion on financial reports given by the organization and checks effectiveness in program application which are under the responsibility of the organization. Independent from the government and other state institutions and directly reports government body (parliament). Quality of supreme audit is not oly reflected in its technical capacities to perform its functions, but also in the capabilities to perform audit which results might not be favourable for the organization that is under the subject of audit, and also to make available these results to the publicity.

Its performance and results of the work will definitely improve development and improvement of the financial management and the responsibility it has.

7. CONCLUDING REMARKS

By performing analysis of financial management function in public sector and having perception on possibilities of development of capacity level, with all their specificities, we came to the following conclusion:

- Restructuring of the public sector and public finances, indicated on numerous weaknesses in present functioning of the system, as well as the necessity for changes. Changes have been introduced into the budget system, and a significant step represented establishment of independent body that has a purpose to control process of public assets (Law on budget system, Law on Supreme audit institution).

- Completely different approach to management of public finances is introduced with the accent on establishment priorities and rationalization of expenditures, in order to boost business activities and effectiveness and economical providing of public services (transfer to Programming budget from year 2015).

- Financial management is very specific in public sector as it consists of determination of needs for money from public sources, its' appropriate expenditure, keeping of accounting evidences and reporting on results and spent money. Also, it has a huge impact on legal functioning of state institutions and corporate governance of government institutions. It provides supervision over the entire public sector and represents important factor of credibility of public institutions and companies.

- Complexity of public sector imposes to financial function of public sector numerous requirements. One of crucial, basic is that all of the managers have to take roles in financial management, as budgeting, allocation, money management, results achievement in a legal way, account setting, and represent important skills of all managers in public sector.

- Condition for effective financial management and maintenance of public trust in the legislative way of its performance is decision making in the organizations of public sector based on qualitative and available financial information.

- Changes of budget principals require changes of improvement, development of financial management, as well as increased engagement and necessity of crucial changes, in order to, as soon as possible, expect positive important results.

- Realistic limitations that could be expected in the development of financial management capacity of public sector are:

    - Limitations of capacity and training of employees in public sector
    - Inappropriate technical and professional support
    - Lack of adequate strategic plans of beneficiaries of public assets which would be the basis of adequate and appropriate choice of programme, but as well the indicators of success measurements.

LITERATURE

Dabović M. (2006), Planning of budget incomes, journal Accounting, audit and finances
Dabović M. (2007), Public finances system and state budget, Ministry of Finance, Podgorica
Ilić-Popov G. (2003), Public finances lexicon, Institution for management and rentability of business, Beograd
International Monetary Fund (2001), Government Finance
Leko V. (2003),Budget method and budget control, Faculty of Law, Belgrade
Leko V., Leko D. (2008), Methodology of state audit of public assets, Economics Institute, Belgrade
Leko V. (2008), Methodology of budget accounting, Economics Institute, Belgrade
International accounting standards for public sector (2004), Association of accountants and auditors of Serbia
International accounting standards (2004), Association of accountants and auditors of Serbia
Popović D. (2008), Tax Law, Faculty of Law, Belgrade
Popović D., Dabović M., Pavlović M., Gnjatović D., Guzijan J., Popov M., Angelovska-Bezovska A. (2004), Budget method and budget control, Faculty of Law, Belgrade
Raičević B. (2005), Public finances, Faculty of Economy, Belgrade
Raičević B., Ilić-Popov G., Leko V., Pavlović M., Tesche J. (2004), Budget method and budget control, Faculty of Law, Belgrade
Law on budget system
Law on supreme audit institution
Bylaw on budget accounting

HEALTH CARE MANAGEMENT

MULTIVARIATE MODELS FOR FORECASTING DEMAND IN AMBULANCE SERVICES

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Abstract: *A highly complicating, but challenging factor that influences demand of health care services is randomness. Thus, the traditional planning techniques, which assume that the demand of ambulances is known upfront, are not applicable to this scientific problem. It is necessary to take into account demand variations over time and to implement them into forecasting models. In this paper original data are collected from local ambulance service in Subotica. Complex data analyses on the number of ambulance requests per day are performed in order to identify certain correlations and seasonal patterns based on the day of the week and the month of the year. In the next step multiple regression models are applied to obtain the forecast of demand. By checking goodness of fit to our data and accuracy of their short term forecasts, the models have been compared. Also practical relevance and usage of those models is discussed.*

Keywords*: forecasting, multivariate time-series models, multiple linear regression, health care management, modeling emergency medical services*

1. INTRODUCTION

In life-threatening situations where every second is important, an effective response of ambulance services can make difference between life and death. Thus, managing operations of ambulance services and other health care organizations is a question of extraordinary social relevance. Nowadays, health care systems are facing extreme pressures to obtain a desired service level in spite of the rapidly changing environment, scarce resources and financial challenges. Effective resource allocation is both a consequence and a solution for overcoming these challenges. Moreover, today's health-care systems are characterized by multiple objectives, multiple evaluation criteria, and multiple decision-makers within the system, while resources and budget are extremely limited. Managing scarce resources on the best possible way is the main task of operations research, since it focuses on the application of analytical methods to facilitate better decision-making. Application of operations research techniques can surely be very valuable for managing health care organizations, in order to achieve their objectives and obtain desired service level. The World Health Organization report stated that, “One of the most important roles of the World Health Organization is to assist countries in making optimum use of scarce health resources.” This is also a role for operations researchers. These public safety systems have received a great deal of attention in the operations research community, since they provide important services and the problems are amenable to mathematical modelling and solution.

Operations Research or Management Science exists as a scientific discipline since the 1930’s and the first papers dealing with the health care problems date from 1950’s. Despite the proliferation of papers in the academic literature, there are still major issues around getting quantitative models widely accepted and used as part of mainstream decision-making by clinicians, health managers and policy makers. Some possible reasons for this include (Teow K.L., 2009):

- Low levels of managerial/mathematical background in the health care sector
- Scientific papers are often written for operations research professionals, focusing on specialised and technical topics, and not reaching healthcare professionals
- Lack of process-related data for modeling
- Lack of in-house operations research expertise
- High cost of engaging external operations research consultants

The main goal of this paper is to present advantages that can be obtained by using quantitative models to aid decision making in health care sector, specially addressing demand forecast in ambulance service.
Most cities in the developed world have organizations that provide pre-hospital care and transport to medical facility. Demand for such services is increasing and the same trend is expected in the future. On the other side, due to global economic crisis and serious financial difficulties in most of the countries budgets became even more limited and reduced. Tighter budgets make efficient use of resources extremely important.

Goldberg (Goldberg J.B., 2004) mentions that “ability to predict demand is of paramount importance”, but this area has seen little systematic study. A highly complicating but challenging factor that influences the demand of ambulance services is randomness. Call arrival patterns tend to be highly time and location dependent. Also the availability of ambulance vehicles and personnel is random due to uncertainty in their occupancy times. Mostly, demand forecast for ambulance services can be divided into two categories, first dealing with spatial distribution of demand and second that investigates how demand evolves over time. In this paper we will examine if there are some patterns and regularities that explain variations of demand for ambulance services over time.

2. DISPATCHING PROCESS AND PRELIMINARY DATA ANALYSIS

In this paper we will investigate the data provided to us by Ambulance Service in Subotica, city of Vojvodina province, Serbia. Demand for emergency medical services (EMS) is presented as daily number of calls that arrived to the ambulance station. The data set which we use in this research provides us information about the daily number of EMS calls for three years period, from February 15th 2009 until February 15th 2012. We will use the data from February 15th 2009 to January 21st 2012 to estimate multiple regression models. The rest of the data will be used as a test set to validate models and forecasts. The analyses are carried out by Statistica and EViews software packages.

The preliminary data analysis is done to explore if the data of the number of ambulance requests show correlations and typical yearly and weekly arrival patterns. During three years period approximately 30 calls per day were dispatched. Figure 1 shows number of daily ambulance rides throughout our data set, so we can conclude that there is no clear trend visible over time. On 1st of January and 1st of May there are visible peaks, so larger number of emergency calls can be expected on these holidays. Figure 2 shows that the busiest months are May and March, and the less frequent months are September, June and August. On the figure 3 we can see that the largest amount of calls arrives on weekends and on Monday and the middle of the week is less frequent period.

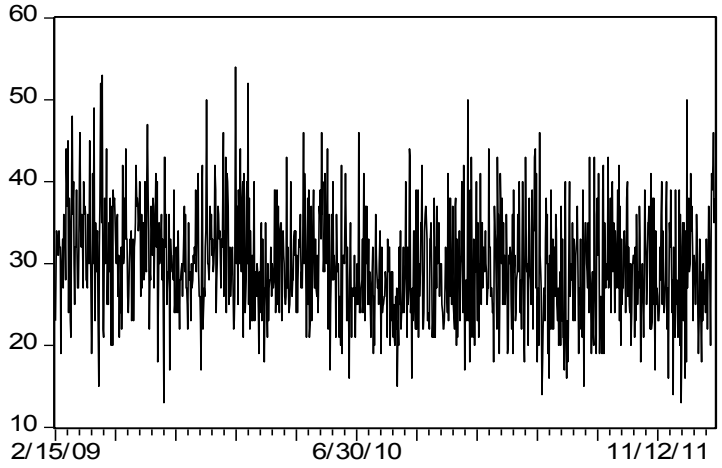

Figure 1: Number of daily ambulance rides

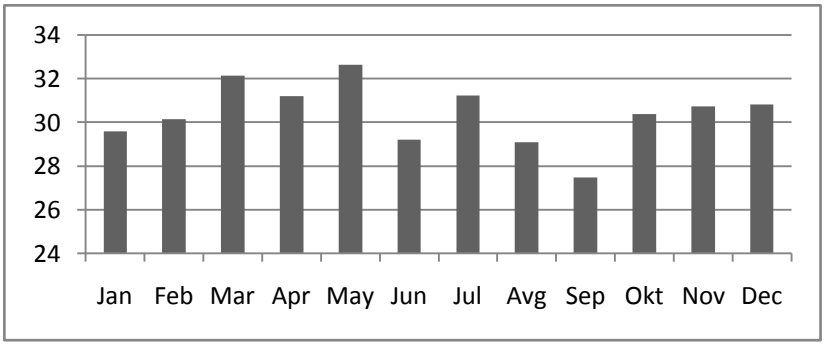

Figure 2: Mean number of ambulance rides per day, for each month of the year

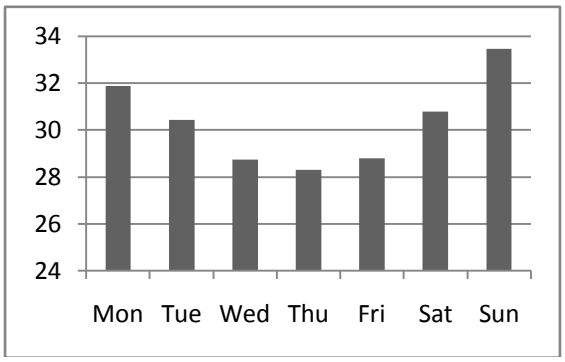

Figure 3: Mean number of ambulance rides per day, for each day of the week

3. TEST FOR CORRELATION OF THE DAILY NUMBER OF AMBULANCE CALLS

Figure 1 indicates that on a number of days a large number of rides occurred. To make a good analysis of the data first we need to determine the outliers and to omit them from further analysis. We define a data point as an outlier when its value is lower than the first quantile minus 1.5 times the interquantile range, or when its value is higher than the third quantile plus 1.5 times the interquantile range. In our dataset we identified eight outliers and they are omitted from analysis for correlation.

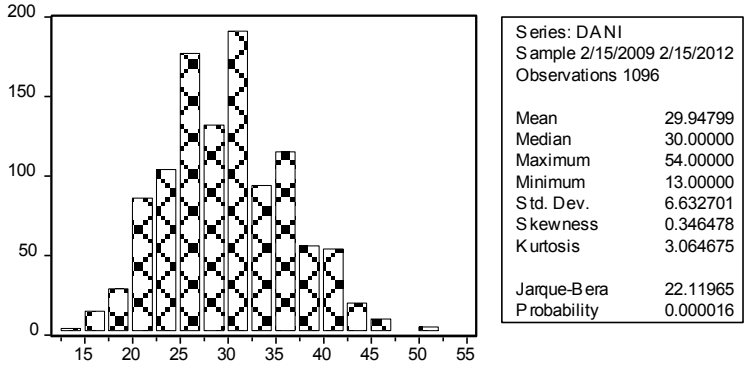

Figure 4: Histogram and basic statistics for number of ambulance rides per day

By looking for extreme values, yearly and weekly patterns we are able to categorize the number of daily calls by their distinct behaviour. Based on the value of Jarque Bera test of normality, that incorporates both skew and kurtosis, we reject the null hypothesis that the distribution is normal. Spearman's rho statistic is used to estimate a rank-based measure of association between bivariate data. This test is non-parametric and can be used if the data does not necessarily come from a normal distribution (Diebold F.X., 2004). The Spearman's rho statistic is based on the coefficient of correlation of the two groups of rank numbers x_i and y_i. For a sample of size *n,* the n raw scores X_i, Y_i are converted to ranks x_i and y_i, and ρ is computed from these:

$$\rho = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i (x_i - \bar{x})^2 \sum_i (y_i - \bar{y})^2}} \quad (1)$$

After performing tests based on Spearman's rho we can conclude that the number of ambulance rides per day is positively correlated with the number of ambulance rides on a previous day ($p < 0,05$). The number ambulance rides per day is also positively correlated to the number of rides two days earlier and seven days earlier, both with $p < 0,01$.

4. MULTIPLE REGRESSION MODELS

Our preliminary analysis confirms the presence of the month of year and day of week effects, so we can use multiple regression to model behavior of number of ambulance rides per day. We have multiple explanatory variables, month of the year and day of the week, which we model in a linear manner. The multiple regression model, which we will use to forecast the daily demand of EMS is

$$Y_t = a + \sum_{i=1}^{12} b_i B_{i,t} + \sum_{j=1}^{7} c_j C_{j,t} + u_t \quad (3)$$

where Y_t is the t-th observation of the number of daily rides, indicator $B_{i,t}$ has value 1 if the month of day t is the i-th month of the year and value 0 otherwise, and the indicator $C_{j,t}$ has value 1 if day t is the j-th day of the week and 0 otherwise. Parameters of the regression model are b_i, c_j and u_t is the error term. The application of the regression model demands that residuals are i.i.d. Gaussian distributed. Estimates of the

parameters are obtained by using least square method to minimize the sum of squares of the residuals. To avoid the problem of multicollinearity it is necessary to set the linear constraints on parameters as following:

$$\sum_{i=1}^{12} b_i = 0, \quad \sum_{j=1}^{7} c_j = 0 \qquad (4)$$

Estimated multiple regression model for daily number of EMS calls is:

$$Y_t = 29{,}79 + 2.060C_{1,t} - 0{,}403C_{2,t} - 1{,}852C_{3,t} - 1{,}808C_{4,t} - 1{,}252C_{5,t} + 0{,}336C_{6,t} + 2{,}918C_{7,t} - 1{,}026B_{1,t} + 0{,}937B_{2,t} + 1{,}136B_{3,t} + 1{,}225B_{4,t} + 0{,}476B_{5,t} - 1{,}191B_{6,t} + 0{,}440B_{7,t} - 0{,}181B_{8,t} - 1{,}539B_{9,t} - 0{,}127B_{10,t} + 0{,}190B_{11,t} - 0{,}341B_{12,t} + u_t \qquad (5)$$

In this multiple regression model significant factors for the parameters month of the year and day of the week, (p< 0,05) are April, June, September, Tuesday, Wednesday, Thursday, Saturday and Sunday. Based on the results shown in the table 1, the largest amount of EMS demand can be expected in April, especially during the weekend.

Table 1: Significant parameters of multiple regression model

Parameter:	*a*	*b4*	b_6	b_9	
	Constant	April	June	September	
Coefficient:	29.79027	1.224539	-1.19056	-1.53877	
Parameter:	c_2	c_3	c_4	c_6	c_7
	Tuesday	Wednesday	Thursday	Saturday	Sunday
Coefficient:	-1.851524	-1.80774	-1.25211	2.918253	2.059951

To obtain relevant and adequate forecasting model it is necessary to examine the presence of autocorrelation of residuals. We applied the Ljung-Box test to the residuals after fitting the regression model to our data. The p-values are plotted in the next figure and since some p-values are smaller than 0,05 presence of autocorrelation of residuals can be identified. Hence, we need to improve the examined multiple regression model in order to exclude residuals' autocorrelation. It has been achieved by fitting an autoregressive (AR) model of order p to the residuals u_t.

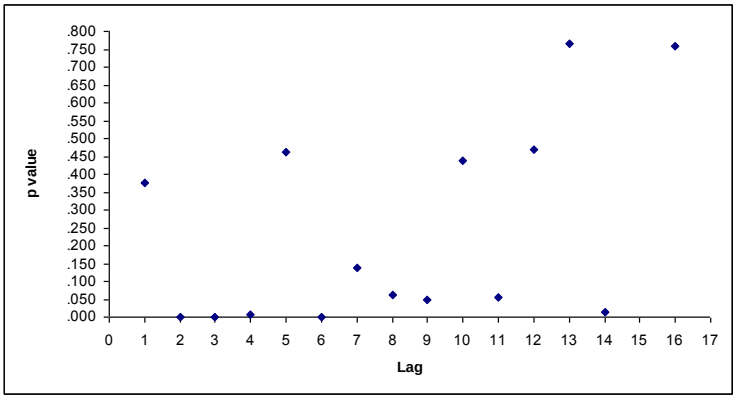

Figure 5: p-values of the Ljung-Box test applied to the residuals for the regression model with factors day of the week, month of the year

The improved multiple regression model for daily number of EMS demand becomes:

$$Y_t = a + \sum_{i=1}^{12} b_i B_{i,t} + \sum_{j=1}^{7} c_j C_{j,t} + \alpha_1 u_{t-1} + \ldots + \alpha_p u_{t-p} + e_t \qquad (6)$$

where e_t is i.i.d. normal distributed. In the previous section we tested for correlation between the number of rides per day and the number of rides seven days earlier. The outcome was significant hence we will take p equal to 7, the parameters α, which appear to be insignificant to the model will be omitted later on. The estimated improved multiple regression model with all parameters is presented by the following equation:

$$Y_t = 29{,}681 + 2{,}160C_{1,t} - 0{,}499C_{2,t} - 1{,}904C_{3,t} - 1{,}848C_{4,t} - 1{,}128C_{5,t} + 0{,}181C_{6,t} + 3{,}037C_{7,t} - 1{,}511B_{1,t} + 1{,}202B_{2,t} + 1{,}155B_{3,t} + 1{,}309B_{4,t} + 0{,}332B_{5,t} - 0{,}944B_{6,t} + 0{,}438B_{7,t} - 0{,}028B_{8,t} - 1{,}479B_{9,t} - 0{,}149B_{10,t} + 0{,}281B_{11,t} - 0{,}608B_{12,t} + 0{,}009e_{t-1} + 0{,}055e_{t-2} + 0{,}051e_{t-3} + 0{,}028e_{t-4} + 0{,}090e_{t-5} + 0{,}048e_{t-6} + 0{,}023e_{t-7} + u_t \qquad (7)$$

The estimated improved multiple regression model with significant parameters only (p<0,05) is presented by the following equation:

$$Y_t = 29{,}681 + 2{,}160C_{1,t\,t} - 1{,}904C_{3,t} - 1{,}848C_{4,t} - 1{,}128C_{5,t} + 3{,}037C_{7,t} + 1{,}309B_{4,t} - 1{,}479B_{9,t} + 0{,}090e_{t-5} + u_t$$

(8)

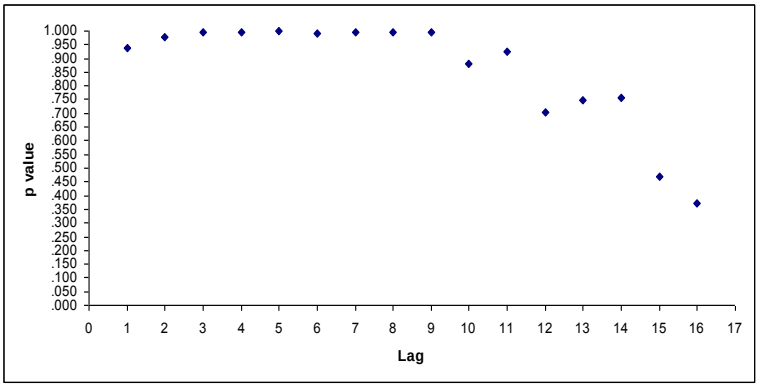

Figure 6: p-values of the Ljung-Box test applied to the residuals for the improved regression model with factors day of the week, month of the year

5. FORECASTING

In order to obtain adequate short-term forecast for daily number of ambulance rides we will discuss two regression models. First, we will use the improved multiple regression model with all introduced parameters (7) and secondly the model with only significant parameters (8). To decide which of the models is the most accurate to forecast the ambulance calls per day we look at forecasts generated by our models and compare them to our test set. Extrapolation will be done to generate forecast for the next 14 days.
There are different ways to measure the exactness of a forecast. In this research we will use three indicators: Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE).

$$\text{RMSE} = \sqrt{\frac{1}{S}\sum_{s=1}^{S}(Y_{t+s} - P_{t,s})^2} \quad (9)$$

$$\text{MAE} = \frac{1}{S}\sum_{s=1}^{S}\left|Y_{t+s} - P_{t,s}\right| \quad (10)$$

$$\text{MAPE} = \frac{1}{S}\sum_{s=1}^{S}\left|\frac{Y_{t+s} - P_{t,s}}{Y_{t+s}}\right| \cdot 100\% \quad (11)$$

Those indicators examine the exactness of a forecast by calculating the forecast error, as the difference between original value Y_{t+s} in the test set S (s= 1,2 ..., S) and forecast value $P_{t,s}$ at day s. The smaller values of indicators suggest the better quality of forecast. The next table presents the values of RMSE, MAE and MAPE for both multiple regression models, for estimation period (February 15th 2009 to January 21st 2012) and for the test period (January 21st 2012 to February 15th 2012).

Table 2: Values of RMSE, MAE and MAPE for Multiple Regression Models

	Estimation period			Interpolation (test period)		
	RMSE	MAE	MAPE (%)	RMSE	MAE	MAPE (%)
Improved Multiple Regression Model	6,268113	2,541237	0,17875	4,211435	2,102894	0,19779
Improved Multiple Regression Model (significant parameters only)	6,54172	2,64712	0,18021	4,05712	2,185642	0,199785

By comparing the RMSE. MAE and MAPE values for regression models, we can conclude that the multiple regression model with all parameters generate the better forecast than the model with only significant parameters.

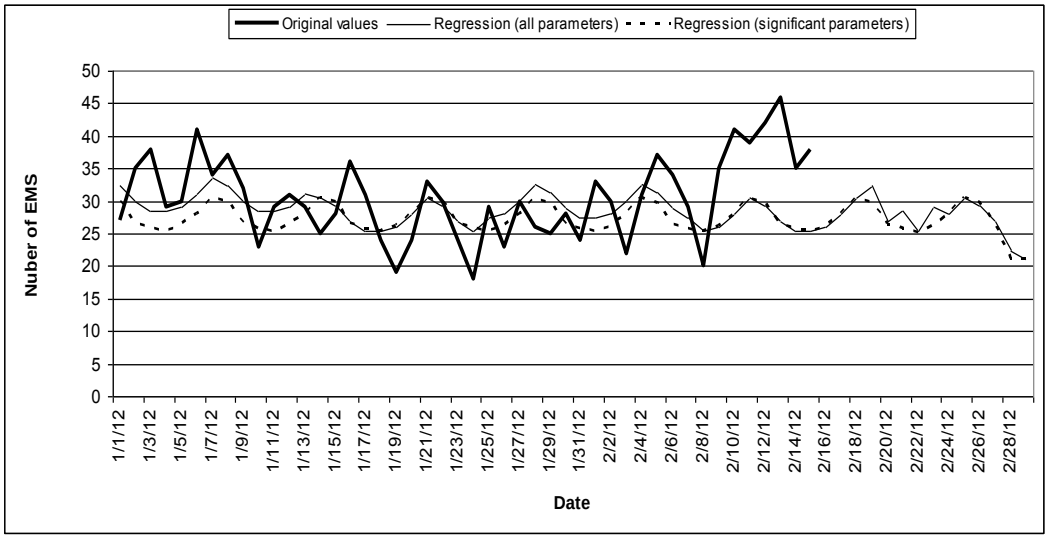

Figure 7: Original data and forecasts obtained by multiple regression models

6. CONCLUSION

Modelling the practical issues in field of health care management is a great challenge, both for health care specialists and managers. Implementation of obtained results provides the valuable basis for decision making process and leads to efficiency improvement, which is one of the most important goals for health care system.

This paper showed that the number of ambulance rides per day follows some patterns, which depend on the month of the year and the day of the week. These regularities can be of great importance for decision makers, when they determine the staff level or the necessary number of vehicles. Multiple regression models that take into account influence of the day of the week and the month of the year were used to forecast the daily number of ambulance services. In further research different forecasting models will also be examined in order to find even better way for predicting future number of daily ambulance rides.

REFERENCES

Brandeau M.L., Sainfort F. & Pierskalla W.P., (2005). Operations research and health care: a handbook of methods and applications, Springer Science + Business Media, Inc.

Channouf N., L'Ecuyer P., A. Ingolfsson & A. N. Avramidis, (2007). The application of forecasting techniques to modeling emergency medical system calls in Calgary, Alberta, Health Care Manage Science, 10 (1), 25-45

Diebold F.X., (2004). Elements of forecasting, Thomson South-Western

Goldberg J.B., (2004). Operations research models for the deployment of emergency services vehicles, EMS Management Journal, 1, 20-39.

Matteson, D.S., McLean, M.W., Woodard, D.B. & Henderson, S.G. (2011). Forecasting emergency medical service call arrival rates. Annals of Applied Statistics, 5 (2B), 1379-1406.

Ozcan, Y.A. (2009). Quantitaive methods in health care management: techniques and applications. John Wiley & Sins Inc., San Francisco.

Teow, K.L. (2009). Practical operations research applications for healthcare managers, Annals Academy of Medicine Singapore, 564-566.

COMPARATIVE REVIEW OF ICT DEVELOPMENT IN THE FIELD OF HEALTH CARE SYSTEM IN SLOVENIA AND SERBIA

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Abstract: *Strategy of each country is care and maintenance of a healthy population. Information and communication technologies in the health care system have led to many changes. Their introduction has improved the quality of health care services to patients, rational spending time and reduce costs. This paper presents a parallel review of the development and implementation of e-health system in Slovenia and Serbia. Slovenia is a very good example of a successful development of information and communication technologies in healthcare system. Slovenia was one of the first countries to introduce health insurance chip cards and IT solutions are widely used in healthcare. In Slovenia, there is a project called eZdravje. eZdravje project consists of five modules. These are: A National Health telecoms network, e-Health portal, electronic health record, an Organizational module featuring the creation of the National Centre for e-Health, and a Training and Skills Development module. The implementation of electronic services in the health system of Serbia will be concluded in 2015. At this point, the implementation phase of hospital information systems is taking place. Introduction to hospital information systems and training is done by the team prepared for educating hospital staff and configuring and customizing the hospital information systems for the needs of the hospital.*

Keywords*: e-health, hospital information systems, Serbia, Slovenia*

1. INTRODUCTION

A state health care system is one of its most complex. Due to the importance and impact upon the status of health of its population and stemming from the relevant economic influence thereof, the state implements a large number of measures in health care system planning and management in order to ensure steady financing and a rational, high quality health care system, as well as to ensure basic health protection to all of its citizens within its available resources (Jovanovic Milenkovic, 2011, Frenk, 2010, Vujin, Jovanovic Milenkovic, 2012).

It should be noted that one of the major problems in health care and modern medicine in general, is the collection, handling, processing and use of data collected on a daily basis in large quantities and in the form of extensive documentation within medical institutions. Persons in their lives visit various medical facilities that are, by their geographical position, very often distributed. Therefore, sources of medical data generation are also distributed. Data can be also generated in the field (in temporary clinics or during home visits) which presents an additional factor of physical distribution (Jovanovic Milenkovic, Radojicic, Milenkovic, Vukmirovic, 2009).

Information and Communication Technologies (ICT) offer great opportunities and have an overall impact on national economies and global competition in the health care system. There are many papers that emphasize the importance of ICT through the inclusion of Internet users and IT literacy as indicators of socio-economic development (Jeremic, Markovic, Radojicic 2011, Jeremic, Vukmirovic, Radojicic, Djokovic (2011). ICT have the potential to be used in order to help citizens and health professionals for safer, better, more rational and better integrated health care. ICT is a mean to achieve the strategic goals of the health care system, i.e. (Jovanovic Milenkovic, 2011):

- Developing and improving management in all aspects of the system, by making decisions based on evidence from health professionals, consumers.
- Creating conditions for sustainable financing of health care system.
- Measuring critical dimensions of the health care system, such as accessibility, parity, quality and efficiency.

Ten years of experience in the medical application of information technology in health care in developed countries has shown high economic and medical reasons for investing in this area (Al-Lagilli, Jeremic, Seke,

Jeremic, Radojicic, 2011). The relative costs of investing in medical informatics today are very low compared to other costs in health care, and the effects of proper use are greater savings through rationalization of costs and the possibility for better planning and management in all aspects of the system. These effects are based on information generated and shared between the segments of the system, which allows for making better decisions and plans based on quality and updated information about the needs and the state of resources (Hillestad, Richard et al. 2008, Blaya, Fraser, Holt, 2010).

2. RANKING OF EUROPEAN HEALTH CARE SYSTEMS BY EHCI 2013 INDEX

Today, health systems in all countries play a bigger and more influential role in people's lives than ever before. Health systems of some sort have existed for as long as people have tried to protect their health and treat diseases (World Health Organization, 2000). The Euro Health Consumer Index (EHCI) 2013 is the seventh study made on European health care systems. The Index takes a consumer and patient perspective. This ranking takes into account six sub-disciplines:

- Sub-discipline 1 - Patient rights, information and e-health;
- Sub-discipline 2 - Accessibility (waiting times);
- Sub-discipline 3 - Outcomes;
- Sub-discipline 4 - Range and Reach of services provided;
- Sub-discipline 5 - Prevention;
- Sub-discipline 6 - Pharmaceuticals.

Index for year 2013 already includes all 28 European Union (EU) member states, Albania, Iceland, FYR Macedonia, Norway, Switzerland and Serbia (Björnberg, 2013). According to the survey, Slovenia is located at 18th position and Serbia occupies the last place on the list. Of the possible 1,000 points, the Serbian health system received 451 points (Figure 1.). The graph shows that the Netherlands is in the first position with 870 points.

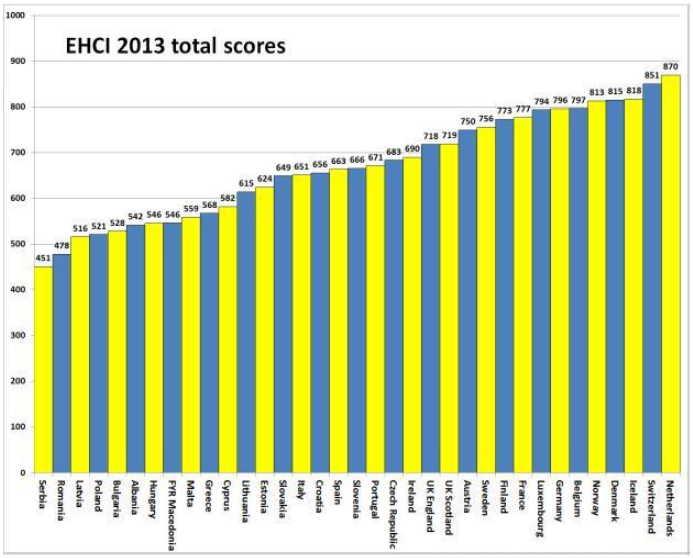

Figure 1: Ranking of European health care systems by EHCI 2013 Index (Björnberg, 2013)

Slovenia and Serbia are two countries which until 1991 constituted the former Yugoslavia. Due to this fact, the paper will provide a parallel review of the health systems in these countries. Considering the sub-discipline e-health included in the study EHCI 2013, the paper will review the development of e-health in Slovenia and Serbia.

2.1. DEVELOPMENT OF E-HEALTH IN SLOVENIA

Slovenia was the first of the former Yugoslav republics that became a member of EU, in 2004.

Slovenia is advanced in the area of social determinants of health (SDH)/health inequalities (HI), and yet there is need for a national framework which will clearly establish coordinated objectives and priorities for different sectors at the national and local levels, and enable the measurement of the effect of various policies on health (WHO Regional Office for Europe, 2014, Prijatelj V., Rajkovič, U., 2009).

Table 1. shows the basic statistical data related to the population of Slovenia and their life expectancy.

Table 1: The basic statistical data related to the population of Slovenia and Serbia and their life expectancy (WHO, 2014)

	Slovenia	Serbia
Total population (2012)	2,068,000	9,553,000
Gross national income per capita (PPP international $, 2012)	27,240	11,430
Life expectancy at birth m/f (years, 2011)	77/83	72/77
Probability of dying under five (per 1 000 live births, 2012)	3	7
Probability of dying between 15 and 60 years m/f (per 1 000 population, 2011)	118/51	175/86
Total expenditure on health per capita (Intl $, 2011)	2,519	1,195
Total expenditure on health as % of GDP (2011)	9.1	10.4

In terms of infrastructure 97% of Slovenian doctors use computers. 82% of practices have Internet connection. When it comes to the use of e-Health applications, 86% of Slovenian doctors use electronic patient data (European Commission, 2010).

Slovenia was one of the first countries to introduce health insurance chip cards and health care professionals are avid users of health ICT solutions. The missing piece was infrastructure to connect local systems allowing exchange of information to facilitate care coordination (Marand, 2014).

The objectives that the Slovene national project aims to meet are the following
(EUREGIO III Case study - National e-Health Project, 2011):

- Offer to all health care providers, specialists, general practicioners, pharmacists unified, secure and reliable access to all key patient information via a standardized Electronic Health Record (EHR) and other data sets;
- Facilitate better planning and management of the national health care system on the basis of good quality, accurate administrative, clinical, and economic data; improve access to all necessary information and the ability of citizens to participate in the development of quality health care services;
- Promote an active role and responsibility of citizens for their health and health care services;
- Improve access to health care for persons excluded due to disability, age or other reasons.

In Slovenia, there is a governmental project called eZdravje. It was initially designed to comprise five project modules (Figure 2.). These are:

- Three system delivery modules of

(a) A national health telecoms network - *zNET*,
(b) E-Health portal - *zVEM* and
(c) EHR dataset, components of the national electronic Health Information System (eHIS),

- An organizational module featuring the creation of the National Centre for e-Health, and
- A Training and Skills Development module.

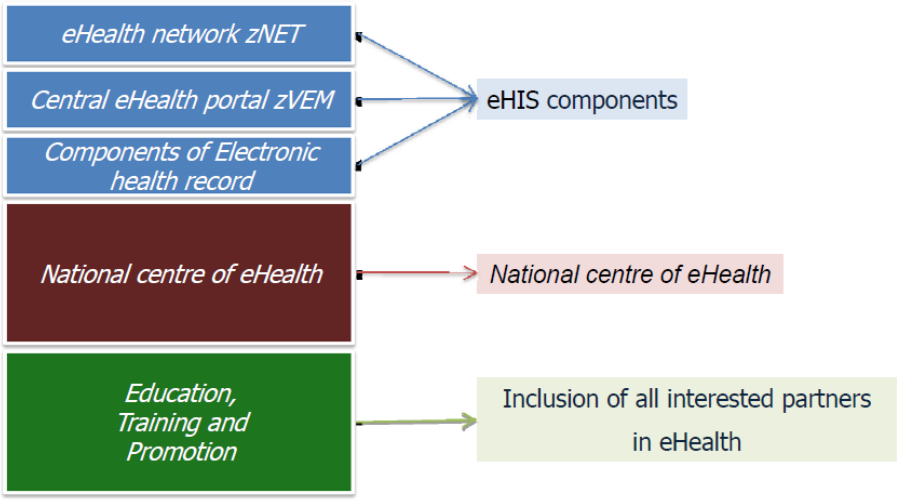

Figure 2: Project *eZdravje* and five project modules (EUREGIO III Case study - National e-Health Project, 2011)

Innovations anticipated by expert informants during the operational phase of the *eZdravje* system modules include (EUREGIO III Case study - National e-Health Project, 2011):

- Collaboration between ministries in operating the e-health telecoms network;
- The operation of the national EHR, and the perceived right and responsibility of individual citizens to access and keep their records updated;
- Use of the national electronic health insurance (HIC) user terminals for authentication.

Certain pilot projects progressed, *Lab-Poštar*, a pilot electronic personal health data exchange between laboratories and physicians by e-mail, moved into implementation during 2011. Work started on the EHR in late 2010 and resumed in 2011. Creating a team of experts to form the National Centre for e-Health also commenced, with them based at the Ministry of Health in the first instance. The Education and Training module progressed according to plan (EUREGIO III Case study - National e-Health Project, 2011).

A new pilot project has also been introduced, ePrescription, and is scheduled for implementation in regions where system platforms of stakeholder organizations are already interconnected. EPrescription will include the eTransmission of a prescription to the pharmacy and into a medication record.

The Health Insurance Institute of Slovenia has announced that it will introduce a new electronic health insurance card system across the country. Initially will be used to obtain information on insurance. The electronic health card is the basis for access to EHR and getting e-prescription.

The national roll-out follows a pilot at the Dr Franc Deganc General hospital in the Nova Gorica region of Slovenia, which was completed in March 2009. After the pilot ended the system was extended to more than 100 organizations in the Gorenjska and Primorska regions. In 2010 electronic health cards were used by more than 30,000 health professionals and two million patients. The system is the first in the country to cover both public and private insurance organizations (EHealth Insider, 2009).

Currently there are no telemedical services implemented at the national level in Slovenia. However, there are some pilot projects in the field of telemedicine carried out by specialized hospitals.

2.2. DEVELOMPMENT OF E-HEALTH IN SERBIA

Serbia is a democratic state located in the central part of the Balkan Peninsula, on the most important route linking Europe and Asia. Serbia has made significant progress in recent years, as it has seriously pursued social, economic, and political reforms in order to continue its progress towards eligibility for EU membership.

The Table 1 shows the basic statistical data related to the population of Serbia and their life expectancy.

Serbian Healthcare, for the second year in a row, took the last – 35th – place in Europe in the ranking of health care systems, according to a survey conducted for the needs of European Parliament. The World Health Organization (WHO) Country Office in Serbia was requested by the Ministry of Health and the EU to implement the EU IPA-funded Project: “Implementation of the Hospital Information System (HIS)”. One of the main goals of this Project is to customize and implement HIS proposed by the Ministry of Health in selected hospitals and to integrate them with the EHR system.

In Serbia, in line with the strategic implementation of the document e-Health 2015, hard-work on the development of health information systems has been done (Figure 3). In this moment, the development of HIS have three phases. The first phase of the project was health information Think Thank and IT development. The second phase was pilot testing and the third phase is full implementation of proposed IT solutions. The third phase will be completed during 2014.

According to the Action Plan, a strategic document e-Health 2015 first iteration of computerization of the health sector will be completed by year 2015 (Jovanović Milenković, et al. 2012). In an integrated health information system, all institutions and facilities in the health system will be interconnected (Ministry of Health, National Health Insurance Fund, the institutes of public health, health centers, hospitals, clinical centers, pharmacies ...) (Ausford et al. (2005).

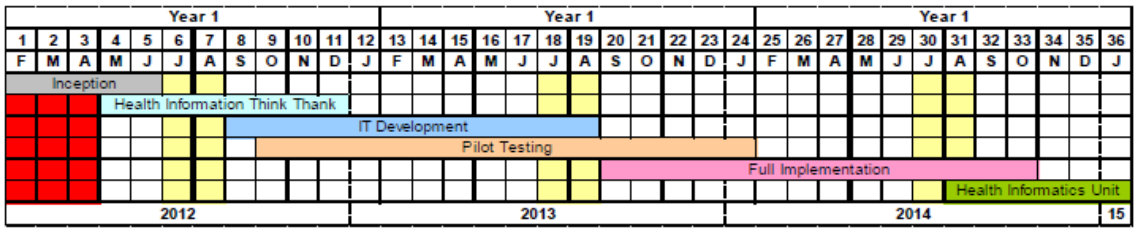

Figure 3: Phase of the project (The EU-IHIS project, 2013)

An analysis of the introduction and implementation of health information systems has been performed for three observed years: 2007, 2010 and 2013 (Table 2). The results showed that (The EU-IHIS project, 2013):

- Year 2007 was a base of policyholders and that only 40% of the insured were entered into the information system.
- Year 2010 was characterized by adoption of information systems in health centers and hospitals use, but EHR is still not used.
- In 2013 HIS was installed in 50% of hospitals, central base of insured beneficiaries is completed and usage of the EHR is in progress

Table 2: Analysis of the introduction and implementation of health information systems (The EU-IHIS project, 2013)

	Base of insured	Cental resource base	Hospital health care	Primary health care	EHR
2007	40%	0%	0%	5%	0%
2010	85%	60%	15%	15%	0%
2013	90%	100%	50%	85%	9%

The implementation of computerization of medical institutions of primary health care was in accordance with the project plan and the indicator of 85% computerized institution is achievable by the end of the project.

The introduction of HIS into organizations included in the project is designed to provide a set of elements that enable the improvement of the work process in health care sector. It is done in order to enable users to obtain a functional unit that will improve the quality of hospital business by a milestone. The implemented solution will become a foundation for improved internal communication and availability of information, avoiding multiple entries or copying data, data entry at the source with the implementation of appropriate coding, as well as better tracking of items that are billed to health insurance.

Introduction to HIS and training is done by the team prepared for educating hospital staff and configuring and customizing the HIS for the needs of the hospital. The introduction of the HIS aims to improve the treatment of the patient support, management and increasing the efficiency of administrative work. End-user training includes familiarization with the system, its features and functionality, as well as complete introduction to practical use in the workplace.

Project introduction of HIS shall be concluded by February 2015. The introduction of the HIS is planned in 19 hospitals, which will lead to further development and improvement of integrated health information systems in Serbia.

For now the introduction has been concluded in the following hospitals:

- The University Children's Hospital in Belgrade, in addition to previously implemented using ICT in the ambulatory work, HIS is covers full clinical practice.
- HIS in The Institute for Oncology and Radiology of Serbia - In addition to the system used in the wards and clinics, online appointment system of consultative examinations has been implemented successfully.
- Activities General Hospital Smederevo are completed on time and in the daily work of continuously increasing use of the system in the treatment of patients, approximately 20% per month. With such tendency of growth we soon expect all data on the treatment of patients to be administered through HIS.
- While the system was introduced during the summer months in general hospital Pančevo, professional approach to hospital management and employees is important to facilitate the work of the EU-IHIS team, which resulted in more than 90% of the users being trained for daily use of HIS.
- Implementation of HIS in the General Hospital Sombor, introduced in October 2013, resulted in much shorter times used for following the health card protocol. The program is easy to use and significantly reduces administration times.

EU IHIS project teams began the process of implementing HIS at the General Hospital Kruševac in January 2013, and in February 2013 at the General Hospitals in Čačak, Kikinda and Pirot. Until the end of May 2013, over 95% of users and IT staff at the General Hospital Kruševac were trained and the system was implemented in outpatient rooms and departments despite the lack of equipment necessary for full production. Even though the Health care Center "Dr Dragiša Mišović" in Čačak is in the process of separation from the General Hospital and the Primary Health care Center, the focus of hospital's management and health professionals remained using HIS. At the General Hospital Čačak, approx. 90% users have been trained. The work is also completed in the General Hospital Kikinda and the system is being used in the entire hospital, even though the hospital has only one IT expert. Thanks to the professional approach of hospital's management and commitment of users, HIS was implemented on time in all outpatient rooms and departments of the General Hospital Pirot. Thereby, the experience in HIS implementation in this hospital represents an example of good practice that will serve as a role model for system implementation in other hospitals involved in the project.

The Republic Fund of Health Insurance introduced electronic health cards during 2013. The cards were first introduced during the pilot project. The pilot project is taking place in Valjevo. Valjevo was chosen because all health centers, hospitals and pharmacies share a computer network with The Republic Fund of Health Insurance. The Fund plans to change million cards in 2014, and the rest in the following three years (The Republic Fund of Health Insurance, 2012). This kind of medical identification will enable faster and easier communication between medical doctors and pharmacies.

Early in 2015, patients will no longer receive paper prescriptions in health centers. Prescriptions to pharmacies will be forwarded electronically. All physicians in 158 medical centers in Serbia and 1,000 pharmacies will be networked into a system of making and issuing electronic prescriptions. Annually more than 60 million paper prescriptions are issued. They will be replaced by electronic prescription.

3. CONTRIBUTION AND FURTHER DEVELOPMENT

Development and implementation of electronic services in the health care system will contribute to the overall development of the health system of any country.

Implementation of the system should speed up organized and synchronized computerization of health care institutions in accordance with standards and accepted rules. Gradual interconnection of a larger number of computerized health care institutions will increase representativeness, importance and usefulness of data stored in databases (Jovanovic Milenkovic, Radojicic, Milenkovic, Vukmirovic, 2009).

All partners in the system must give contributions to the development of e-Health. Advantages of using this system are:

- Better communication between partners in electronic health system,
- Data collections for better patients care,
- Better medical documentations,
- Increase efficiency of work in health institutions,
- Increase standards of health care,
- Advanced statistical data analysis,
- Increased safety for patients and health care professionals (Rajkovič, Dinevski, Šušteršič, Rajkovič, 2011.)

4. CONCLUSION

The health care system and the directions of its development are the subject of interest of international organizations, agencies and other institutions, such as the World Health Organization, World Bank, the International Committee of the Red Cross and others. Application of ICT has fundamentally changed medical practice in developed countries, allowing for increased quality and efficiency of health services. Years of experience in applying ICT in the health care system show high economic and medical reasons for development and investment in this area.

This paper describes the main ICT trends in the field of health care systems. The paper provides a parallel view of two analyzed countries, Slovenia and Serbia.

Slovenia is a very good example of a successful development of ICT in health care system. Its major benefits can be summarized by a check-list as follows: benefits for citizens: speed, ease of use; benefits for the health care administration: costs control, and time savings. Development of the Slovene HIS is an on-going intensive process, and at present, provides a good opportunity for introducing of others solutions.

The introduction of electronic services in the health system of Serbia was launched. We conducted a pilot project. The implementation of health information systems in hospitals in Serbia is in progress and shall be concluded by the end of 2015. The speed of development and application of these systems in the world indicate that the implementation in Serbia is not a matter of necessity and cost-effectiveness, but only a matter of time.

This paper provides further perspective of using e-Health applications, through the use of specific electronic services. Health care requires continuous and systematic innovation in applying ICT for effective and timely decision-making quality.

REFERENCES

Al-Lagilli, S.A.M., Jeremic, V. , Seke, K., Jeremic, D., Radojicic, Z., (2011), Evaluating the health of nations: A Libyan perspective, Libyan Journal of Medicine, Volume 6, Issue 1, ISSN 1993-2820, Pages 1-2

Ausford A., Campbell N., Gaudette D., MacGregor J., (2005), Implementing an EHR: is it possible to sustain the momentum? E Health 2005 Conference, Toronto, Canada

Björnberg A., (2013), Euro Health Consumer Index 2013 Report, Health Consumer Powerhouse, Retrieved from http://www.healthpowerhouse.com/files/ehci-2013/ehci-2013-report.pdf

Blaya J., Fraser H., Holt B., (2010), E-Health Technologies Show Promise In Developing Countries, Health Affairs, ISSN 0278-2715, Pages 244-251

EHealth Insider, (2009), Slovenia rolls out e-health card, Retrieved from: http://www.ehi.co.uk/news/primary-care/4860

Euregio III Case study - National eHealth Project – Slovenia 2007-2013, (2011), Retrieved from www.euregio3.eu – eHealth Project, Slovenia

European Commission, (2010), Retrieved from http://ehealth-strategies.eu/database/documents/Slovenia_CountryBrief_eHStrategies.pdf

Frenk J., (2010), The Global Health System: Strengthening National Health Systems as the Next Step for Global Progress, PLoS Medicine, ISSN 1549-1277, doi:10.1371/journal.pmed.1000089

Hillestad, Richard et al.(2008), Can Electronic Medical Record Systems Transform Health Care? Potential Health Benefits, Savings, and Costs, Health Affairs, ISSN 0278-2715

Jeremic V , Markovic A., Radojicic Z. (2011), ICT as crucial component of socio-economic development, Management, Vol. 60, ISSN 0354-8635, Pages 5-10

Jeremic V, Vukmirovic D, Radojicic Z and Djokovic A (2011). Towards a framework for evaluating ICT infrastructure of countries: a Serbian perspective. Metalurgia International, 16(9), ISSN 1582-2214, Pages 15-18

Jovanovic Milenkovic M., (2011), Interest of the population in Electronic Communication in the Health Services Provision – Research Results, Management, Vol. 59, ISSN 0354-8635, Pages 79-86

Jovanović Milenković M., Milenković D., Dobrota M., (2012), Communication via the Web and SMS services in the health care system in the Republic of Serbia, Actual problems of economics, Vol 12**,** 364-369

Jovanovic Milenkovic M., Radojicic Z., Milenkovic D., Vukmirovic D., (2009), Applying electronic documents in development of the healthcare information system in the Republic of Serbia, ComSIS Vol. 6, No. 2, ISSN 1820-0214, Pages 111-126

Marand, 2014, Retrieved from http://www.marand-thinkmed.com/news-title/23-marand-signs-contract-to-deliver-slovenia-s-national-ehealth-infrastructure

Prijatelj V., Rajkovič, U., (2009), From e-health to integrated health care: theory and practice. Connecting health and humans: proceedings of NI2009, Studies in health technology and informatics, Vol. 146, Amsterdam, pp. 74-78.

Rajkovič U., Dinevski D., Šušteršič O., Rajkovič V., (2011), Multi-attribute model for patient health evaluation, 23rd Conference on System Research, Informatics and Cybernetics, Advances in simulation-based decision support, Volume II, Tecumseh: International Institute for Advances Studies, Baden-Baden, Germany, pp. 16-20

The EU-IHIS project, Integrated Health Information System, (EU-IHIS), (2013), Retrieved from http://www.eu-ihis.rs

The Republic Fund Of Health Insurance, (2012), Electronic health cards, Retrieved from http://www.rfzo.rs/index.php/component/content/article/338-2011-12-28-09-30-12

Vujin V., Jovanovic-Milenkovic M, (2012), Implementation of Cloud Computing in the Health Care System.

Metal Int, 17 (9), 161 (2012).
WHO Regional Office for Europe, (2014), Retrieved from http://www.euro.who.int/en/countries/slovenia/areas-of-work
WHO Regional Office for Europe, (2014), Retrieved from http://www.euro.who.int/en/countries/slovenia/areas-of-work
WHO, 2014. Retrieved from http://www.who.int
World Health Organization 2000, (2014), The world health report 2000, Retrieved from http://www.who.int/whr/2000/en/whr00_en.pdf

UPGRADING THE EHCI INDEX: A STATISTICAL APPROACH

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Abstract: *Healthcare systems are one of the EU major concerns, and during the past years, more and more initiatives have been taken at the international and national levels in order to strengthen national healthcare systems as core components of the global health system. EHCI is one of the most popular methodologies for evaluating healthcare systems, which is introduced more than a decade ago, and in 2012, for the first time, it included Serbia in the evaluation process. This paper strives to upgrading the ECHI, using the I-distance methodology, and thus improving its flaws and drawbacks. It gives the special concern to Serbia and its position in the overall healthcare system ranking, and points out to the most wholesome directions to improve the Serbian global health.*

Keywords*: EHCI, I-distance, health, healthcare system*

1. INTRODUCTION

The topic of health is the subject that could never become obsolete. In the terms of globalisation, global health, as the public health of populations in a global context, is becoming more and more compelling. Therewithal, the term of the healthcare system has been defined, and, since 2000, more and more initiatives have been taken at the international and national levels in order to strengthen national healthcare systems as the core components of the global health system (WHO, 2014).

Healthcare systems can vary substantially from country to country, and in the last few years, comparisons have been made on an international basis. Back in 2000, the World Health Organization (WHO, 2014) have provided a ranking of health systems around the world according to criteria of the overall level and distribution of health in the populations, and the responsiveness and fair financing of health care services. Still, direct comparisons of health statistics across nations are quite complex.

This is why healthcare systems have attracted a significant amount of researchers' attention (Kringos et al., 2013; Smith, 2013; Parkhomenko, 2013; Schnitzer et al., 2013), especially regarding their economic impact and their efficiency (Hadad, Hadad, & Simon-Tuval, 2013). According to Bohm et al. (2013), there are five types of OECD healthcare systems, with three core dimensions: regulation, financing, and service provision, and three types of actors: state, societal, and private actors. Similarly, Lima de Freitas and da Silva (2013) argue that they have a large impact on optimal economic growth. Some countries invest a large amounts of money in their health (Blank, 2012), and until today, they have already entered the healthcare systems transformation process (Blank 2012; Lin, 2012; Steel & Morris, 2013). In this regard, due to reduced financial means and increasing demands on provision of service in healthcare and nursing, the time will come when prioritization in healthcare systems will be necessary (Beske, 2012).

A good healthcare system delivers quality services to all people, when and where they need them. The exact configuration of services varies from country to country, but in all cases requires a robust financing mechanism; a well-trained and adequately paid workforce; reliable information on which to base decisions and policies; well-maintained facilities and logistics to deliver quality medicines and technologies. One of the most popular healthcare systems methodologies is the Euro Health Consumer Index (EHCI), which was created in 2005. Therewith, EHCI was presented in Belgrade on December 18, 2013, along with the health outcomes of Serbia.

EHCI methodology consists of six indicators, and their sub-disciplines, and is described in detail in Section 2. The main limitation of the EHCI methodology is the fact that the weights assigned to each of these indicators are biased weights, as comprehended by experts who participated in ECHI construction. In order to overcome the limitations, we proposed an upgrade to ECHI methodology by applying I-distance method to set of six consisting indicators. Mathematical modelling of healthcare systems and e-health has always been a common topic (Zaitseva & Rusin, 2012; Milenkovic, Milenkovic, & Dobrota, 2012; Grigoroudis & Phillis, 2013; Hadad, Hadad, & Simon-Tuval, 2013; Adeyemi, Demir, & Chaussalet, 2013). I-distance method

creates the synthesized multi-criteria indicator, which does not imply the biased weights proposed by experts, but is based on the multi-criteria distances between entities instead. Furthermore, it can provide the insight to which of the indicators are most important for ranking countries. This is the main precedence for upgrading the original EHCI index, using the proposed I-distance methodology. The methodology is explained in detail in Section 3.

2. EHCI INDEX

The Euro Health Consumer Index (EHCI) is the study made on European healthcare systems, which takes consumer and patient perspectives in consideration. The EHCI 2013 is seventh study in a row, published by the Health Consumer Powerhouse (HCP, 2013), which offers reality checks for policy makers, empowerment to patients and consumers and an opportunity for stakeholders to highlight weak and strong aspects of healthcare (EHCI, 2013). In order to become a powerful actor, building the necessary reform pressure from below, the consumer needs access to knowledge to compare health policies, consumer services and quality outcomes. The Euro Health Consumer Index (EHCI) is an effort to provide healthcare consumers with such tools.

The HCP has become a centre for visions and action promoting consumer-related healthcare in Europe. It monitors and compares healthcare systems among 35 countries, including all EU member states as well as Canada, providing guidance to patients and citizens and reality checks to governments. In 2005, the HCP launched its first EHCI, which provides country policy recommendations for improvement, advising governments and healthcare systems on how to improve performance and strengthen the position of the healthcare consumer. Today the European Commission regards the EHCI to be the most informative and influential assessment of European healthcare (EHCI, 2013).

For a decade, the HCP has been publishing a wide range of comparative publications on healthcare in various countries. By ranking the 21 county councils by 12 basic indicators concerning the design of ”systems policy”, consumer choice, service level and access to information, they introduced benchmarking as an element in consumer empowerment. HCP aimed to select a number of indicators describing to what extent the national healthcare systems are “user-friendly”, thus providing a basis for comparing different national systems. Furthermore, since 2008 the HCP has enlarged the existing benchmarking program considerably. Last year's edition of Euro Health Consumer Index covers 48 healthcare performance indicators for 35 countries (EHCI, 2013).

The EHCI is built up with indicators grouped in six sub-disciplines, which cover 48 different indicators. The aim has been to select a limited number of indicators, within a definite number of evaluation areas, which in combination can present a telling tale of how the healthcare consumer is being served by the respective systems.

The ECHI 2013 sub-disciplines:

1. Patient rights and information
    - 1.1. Healthcare law based on patients' rights
    - 1.2. Patient organisations involved in decision making
    - 1.3. No-fault malpractice insurance
    - 1.4. Right to second opinion
    - 1.5. Access to own medical record
    - 1.6. Registry of *bona fide* doctors
    - 1.7. Web or 24/7 telephone HC info with interactivity
    - 1.8. Cross-border care seeking financed from home
    - 1.9. Provider catalogue with quality ranking
    - 1.10. EPR penetration
    - 1.11. Patients' access to on-line booking of appointments?
    - 1.12. e-prescriptions
2. Accessibility/Waiting time for treatment
    - 2.1. Family doctor same day access
    - 2.2. Direct access to specialist
    - 2.3. Major elective surgery < 90 days
    - 2.4. Cancer therapy < 21 days
    - 2.5. CT scan < 7days
    - 2.6. A&E waiting times
3. Outcomes
    - 3.1. Heart infarct case fatality
    - 3.2. Infant deaths

    3.3. Cancer deaths relative to incidence
    3.4. Preventable years of life lost
    3.5. MRSA infections/Abortion rates
    3.6. Undiagnosed diabetes
    3.7. Depression
4. Range and reach of services ("Generosity")
    4.1. Equity of healthcare systems
    4.2. Cataract operations per 100 000 age 65+
    4.3. Kidney transplants per million pop.
    4.4. Is dental care included in the public healthcare offering?
    4.5. Informal payments to doctors
    4.6. Long term care for the elderly
    4.7. % of dialysis done outside of clinic
    4.8. Caesarean sections
5. Prevention
    5.1. Infant 5-disease vaccination
    5.2. Blood pressure
    5.3. Smoking prevention
    5.4. Alcohol
    5.5. Physical activity
    5.6. Undiagnosed diabetes
    5.7. HPV vaccination
    5.8. Sugar intake
6. Pharmaceuticals
    6.1. Rx subsidy
    6.2. Layman-adapted pharmacopoeia?
    6.3. Novel cancer drugs deployment rate
    6.4. Access to new drugs (time to subsidy)
    6.5. Arthritis drugs
    6.6. Schizophrenia drugs
    6.7. Antibiotics/capita

The performance of the respective national healthcare systems were graded on a three-grade scale for each indicator, where the grades have the rather obvious meaning of *green* equals good, *amber* equals medium, and *red* equals not-so-good. A green score earns 3 points, an amber score 2 points and a red score (or a *not available*, *n.a.*) earns 1 point.

Having six non-EU countries in the Index, who should not be stigmatized for not being EU member states on indicator *Free choice of care in another EU state*, forced the introduction of a new score in the EHCI 2009: *not applicable*. These countries therefore receive the *n.ap.* score, which earns 2 points. That score was also applied on indicator *Provider catalogue with quality ranking* for Iceland and Malta, as they essentially have only one real hospital each.

In 2013, a *purple* score, earning 0 points, was introduced for particularly abominable results. It has been exclusively applied on indicator *Abortion rates* for countries not giving women the right to abortion.

Since the 2006 Index, the same methodology has been used: for each of the sub-disciplines, the country score is calculated as a percentage of the maximum possible (e.g. for *Waiting times*, the score for a state has been calculated as % of the maximum 3 x 6 = 18). Thereafter, the sub-discipline scores were multiplied by the weight coefficients given in the Table 1 and added up to make the final country score. These percentages were then rounded to a three digit integer, so that an *all green* score on the 48 indicators would yield 1000 points, while *all red* gives 333 points.

Table 1: Sub-discipline weights

Sub discipline	Relative weight (max 1000)	Points for a *green* score in each sub-discipline
Patient rights and information	150	12.5
Accessibility/Waiting time for treatment	225	37.5
Outcomes	250	35.71
Range and reach of services ("Generosity")	150	18.75
Prevention	125	15.63
Pharmaceuticals	100	14.29

Consequently, as the percentages of full scores were added and multiplied by (1000/Total sum of weights), the maximum theoretical score attainable for a national healthcare system in the Index is 1000, and the lowest possible score is 333. The preview of EHCI 2013 is given in Figure 1.

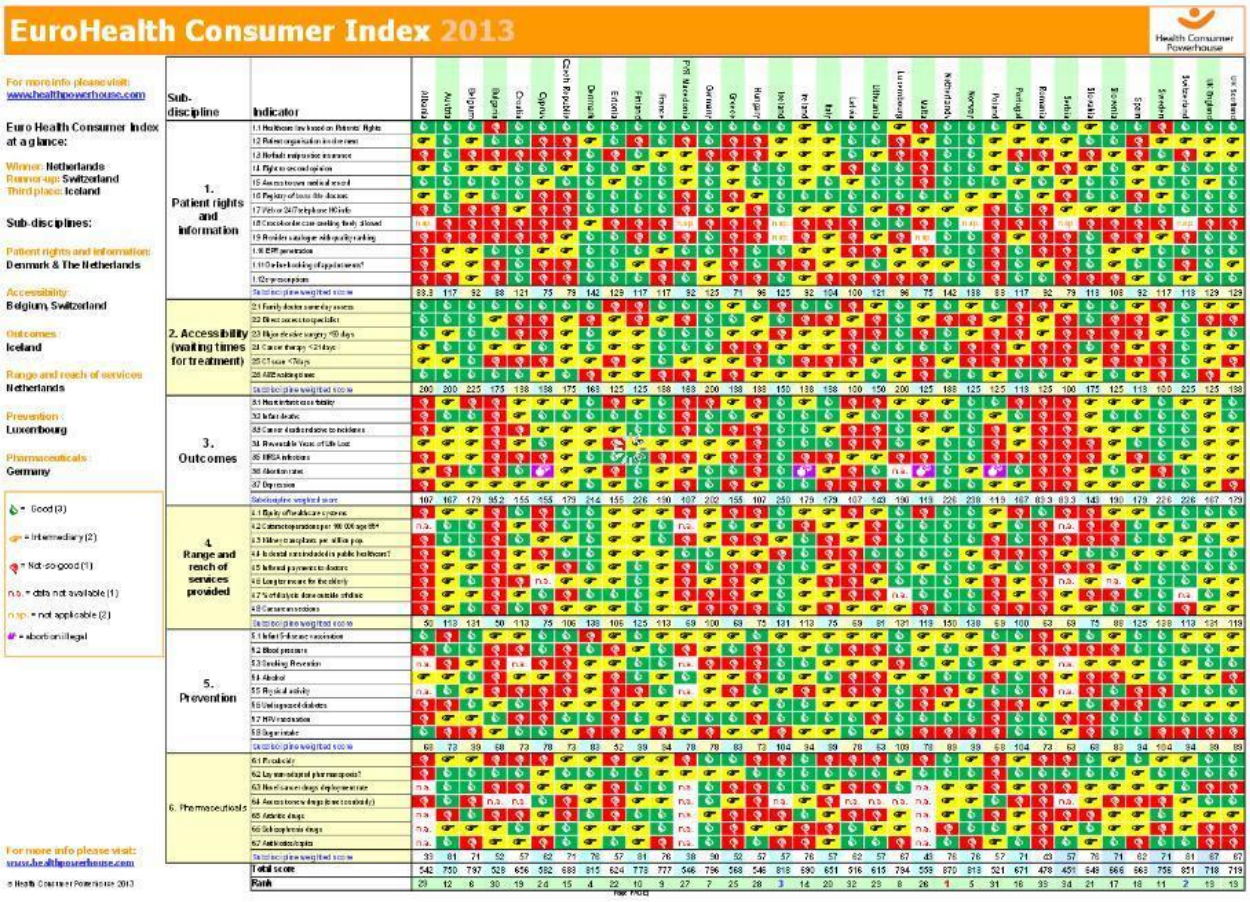

Figure 1: EHCI 2013 (EHCI, 2013)

3. I-DISTANCE METHODOLOGY

The common case with different ranking methods is that their bias and subjectivity can affect the measurements and evaluation. This problem can somewhat be surpassed using the I-distance method, a metric distance in an n-dimensional space, which has recently made a significant breakthrough (Jeremic et al., 2011a; Radojicic & Jeremic, 2012; Jeremic et al., 2012; Dobrota et al., 2012; Jeremic et al., 2013a; Jeremic et al., 2013b). It was originally defined by professor Branislav Ivanovic (Ivanovic, 1973; Ivanovic & Fanchette, 1973), who devised this method to rank countries according to their level of development based on several indicators, where the main issue was how to use all of them in order to calculate a single synthetic indicator, which will thereafter represent the rank.

For a selected set of variables $X^T = X_1, X_2, \ldots X_k$ chosen to characterize the entities, the I-distance between the two entities $e_r = x_{1r}, x_{2r}, \ldots x_{kr}$ and $e_s = x_{1s}, x_{2s}, \ldots x_{ks}$ is defined as

$$D(r,s) = \sum_{i=1}^{k} \frac{\left| d_i \; r,s \right|}{\sigma_i} \prod_{j=1}^{i-1} 1 - r_{ji.12\ldots j-1} \tag{1}$$

where $d_i(r,s)$ is the distance between the values of variable X_i for e_r and e_s, e.g. the discriminate effect,

$$d_i \; r,s = x_{ip} - x_{is} \quad i \in 1,\ldots k \tag{2}$$

σ_i the standard deviation of X_i, and $r_{ji.12\ldots j-1}$ is a partial coefficient of the correlation between X_i and X_j, $j < i$ (Ivanovic, 1973; Ivanovic, 1977).

In order to surpass the problem of negative coefficient of partial correlation, which can occur when it is not possible to achieve the same sign mark for all variables in all sets, it is suitable to use the square I-distance. It is given as:

$$D^2\ r,s\ = \sum_{i=1}^{k} \frac{d_i^2\ r,s\ }{\sigma_i^2} \prod_{j=1}^{i-1} 1-r_{ji.12\ldots j-1}^2$$

The I-distance measurement is based on calculating the mutual distances between the entities being processed, whereupon they are compared to one another, so as to create a rank. It is necessary to fix one entity as a referent in the observing set using the I-distance methodology. The ranking of entities in the set is based on the calculated distance from the referent entity.

4. RESULTS

The results of the I-distance method, as well as a comparison of the I-distance and the EHCI ranking, are shown in Table 2.

Table 2: ECHI Scores and Ranks, and its comparison to I-distance Scores and Ranks for 2013.

Country	EHCI Score	EHCI Rank	I-distance Score	I-distance Rank
Switzerland	852	2	35.56	1
Netherlands	871	1	34.81	2
Norway	814	5	31.49	3
Germany	795	7	29.91	4
Iceland	817	3	29.35	5
Denmark	816	4	28.68	6
Belgium	797	6	28.02	7
Finland	773	10	27.01	8
Luxembourg	793	8	26.7	9
Sweden	756	11	26.03	10
France	778	9	24.8	11
Austria	751	12	22.82	12
UK England	718	14	19.37	13
UK Scotland	721	13	18.38	14
Portugal	672	17	17.49	15
Ireland	692	15	16.98	16
Czech Republic	683	16	15.05	17
Slovenia	665	19	14.68	18
Slovakia	650	22	14.37	19
Spain	665	19	13.83	20
Italy	652	21	13.6	21
Croatia	657	20	11.25	22
Estonia	624	23	10.51	23
Lithuania	615	24	9.24	24
Albania	541	30	8.16	25
Cyprus	583	25	7.72	26
Greece	568	26	6.78	27
Bulgaria	528	31	6.09	28
Latvia	516	33	5.5	29
FYR Macedonia	547	28	5.39	30
Hungary	546	29	5.07	31
Malta	559	27	4.92	32
Poland	521	32	3.66	33
Romania	479	34	2.36	34
Serbia	451	35	2.2	35

Before commenting on the results, it is important to note that I-distance methodology as apposite for measuring the European healthcare systems, as ECHI is, since the Pearson correlation coefficient between the two is significant ($r=0.98$, $p<0.001$). Spearman correlation of ranks is also significant and strong ($r_s=0.98$, $p<0.001$).

As can be seen from Table 2, Switzerland obtained better score than the one gained by simple EHCI addition method, thus forcing its way to the top position, and repressing Netherlands to second position. Top five countries are Switzerland, Netherlands, Norway, Germany and Iceland, and thereby Norway and Germany have significantly improved their positions, while Iceland and Denmark were thrown back. Hungary, Malta, Poland, Romania and Serbia are the worst positioned countries, where Malta has significantly fell down, while for example Albania dug its way up the ranking list.

Some explanations for these changes in ranking positions can be found in Table 3.

Table 3: Importance of consisting indexes

Consisting index	Correlations
Outcomes	0.905**
Range and reach of services (“Generosity”)	0.796**
Pharmaceuticals	0.758**
Patient rights and information	0.667**
Prevention	0.652**
Accessibility/Waiting time for treatment	0.470**

** $p<0.01$

Table 3 presents the importance of the six consisting indicators that constitute EHCI. Most important indicator for the ranking process is *Outcomes*, and this is in accordance with the EHCI weight. It is followed by *Range and reach of services*, and *Pharmaceuticals*. Here within, differences are more conspicuous: *Range and reach of services* is middle weighted and *Pharmaceuticals* is least weighted by original EHCI. *Accessibility/Waiting time for treatment* is secondly weighted by EHCI, but according to I-distance method it is the least important for the ranking process. These results indicate that the weights assigned by experts are biased and non-objective, and, since I-distance is a statistically based methodology, it is obvious that it would generate nonbiased, objective, and more realistic results.

It is surely interesting to examine the position of Serbia within these results. Serbia takes the last place according to both EHCI and I-distance methodology. Figure 1 could somewhat explain these bad results: Serbia has very bad results regarding *Outcomes*, scoring the lowest (all red), which is similarly to Romania, who takes second worst position. Very bad results are also for *Range and reach of services* and *Prevention*. Since *Outcome* and *Range and reach of services* are most important for the ranking process, Serbian bad scores are somewhat expected, and it is clear that Serbia will have to work hard in order to improve its overall healthcare system position.

The first step has already been made. In the Serbian parliament health committee, there was a strong wish to learn from the EHCI findings, on how to improve Serbian healthcare, placed last in 2013 Index. When EHCI 2013 results were published, Serbia reacted very quickly by inviting HCP to come to Belgrade, to explain the outcomes and advise how Serbian healthcare can improve. Accordingly, Dec 18-19 the HCP management visited Belgrade as guests of the Serbian parliament (EHCI Belgrade, 2013).

Consequently, a number of reports emerged from these efforts. According to Milovanovic (2014), antiquated equipment and a lack of medical experts, as well as the poor condition of the health infrastructure itself, are only some of the problems in Serbia. Yet, Serbia took steps to improve its troubled healthcare system, as it started negotiations with the European Union. "We are working hard to improve the situation, but we are encountering numerous problems," Health Minister Slavica Đukić-Dejanović said. She also said that major changes are expected next year regarding patient waiting lists, and that an electronic information system, that will provide up-to-date data, is being rapidly developed (Milovanovic, 2014). The first centralised acquisition of medical supplies for hospitals in Serbia is also under way, a procedure that could save the state up to 25 million euros. The new procedure will be under the supervision of the health ministry, reducing the opportunity for corruption.

5. CONCLUSION

This paper’s results can lead to many various conclusions. As evidenced from Figure 2, European healthcare generally continues to improve but medical outcomes statistics is still appallingly poor in many countries.

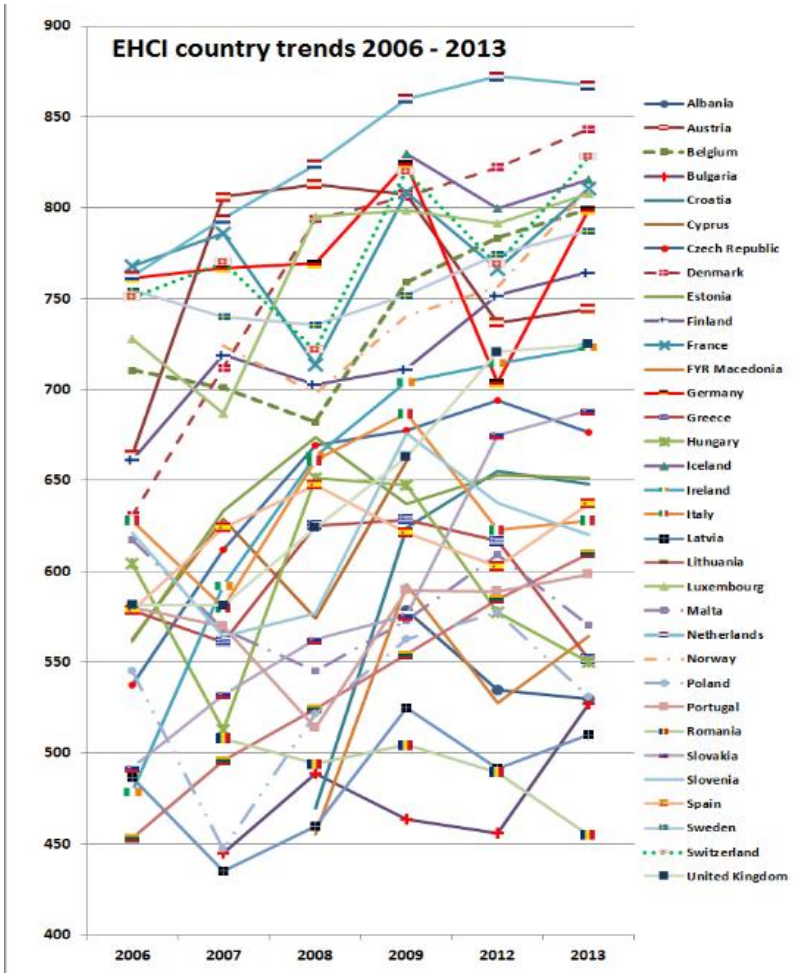

Figure 2: EHCI country trends (EHCI Belgrade, 2013)

Though still a somewhat controversial standpoint, HCP advocates that quality comparisons within the field of healthcare is a true win-win situation: the consumer will have a better platform for informed choice and action; governments, authorities and providers will have the sharpened focus on consumer satisfaction and quality outcomes; to media, the ranking offers clear-cut facts for consumer journalism with some drama into it. This goes not only for evidence of shortcomings and method flaws but also illustrates the potential for improvement (EHCI, 2013). This paper provides an important improvement regarding the introduction of unbiasness and objectiveness into healthcare systems ranking process.

Special attention is regarding Serbia, and the interpretation of its currently last position within ECHI 2013. Officials said that in order to reach European standards, Serbia needs to have more modern medical equipment and instruments in hospitals, and more medical residents and specialists, especially radiologists, cardiologists and oncologists (Milovanovic, 2014). "We need to have better organisation in our healthcare system. We have to use our sources and our knowledge in the most productive way," Djukić-Dejanović said.

What the EHCI was evaluating is of crucial importance for patients, such as rights of patients to information, waiting time for medical treatment, outcome of medical treatment, range of offered services and pharmaceutical means. Serbia does need to focus to improving these elements, especially the outcomes of medical treatments, as well as investments in healthcare system, in order to keep up.

REFERENCES

Adeyemi, S., Demir, E., & Chaussalet, T. (2013). Towards an evidence-based decision making healthcare system management: Modelling patient pathways to improve clinical outcomes. *Decision Support Systems, 55*(1), 117-125. doi:10.1016/j.dss.2012.12.039

Beske, F. (2012). Prioritization in the healthcare system. Options and limits. *Urologe, 51*(8), 1083-1084. doi:10.1007/s00120-012-2938-y

Blank, R.H. (2012). Transformation of the US Healthcare System: Why is change so difficult? *Current Sociology, 60*(4), 415-426. doi:10.1177/0011392112438327

Bohm, K., Schmid, A., Gotze, R., Landwehr, C., & Rothgang, H. (2013). Five types of OECD healthcare systems: Empirical results of a deductive classification. *Health Policy, 113*(3), 258-269. doi:10.1016/j.healthpol.2013.09.003

Dobrota, M., Jeremic, V., & Markovic, A. (2012). A new perspective on the ICT Development Index. *Information Development*, *28*(4), doi:10.1177/0266666912446497

EHCI (2013). *Euro Health Consumer Index 2013*. Retrieved on March 15th, from http://www.healthpowerhouse.com/files/ehci-2013/ehci-2013-report.pdf

EHCI Belgrade (2013). *Euro Health Consumer Index 2013*. Retrieved on March 15th, from http://www.healthpowerhouse.com/files/ehci-2013/EHCI-2013-Belgrade-131218.pdf

Grigoroudis, E., & Phillis, Y.A. (2013). Modeling Healthcare System-of-Systems: A Mathematical Programming Approach. *IEEE Systems Journal, 7*(4), 571-580. doi:10.1109/JSYST.2013.2251984

Hadad, S., Hadad, Y., & Simon-Tuval, T. (2013). Determinants of healthcare system's efficiency in OECD countries. *European Journal of Health Economics, 14*(2), 253-265. doi:10.1007/s10198-011-0366-3

HCP (2013). *Health Consumer Powerhouse*. http://www.healthpowerhouse.com/

Ivanovic, B. (1973). *A method of establishing a list of development indicators*. Paris: United Nations educational, scientific and cultural organization.

Ivanovic, B. (1977). *Classification Theory*. Belgrade: Institute for Industrial Economic.

Ivanovic, B., & Fanchette, S. (1973). *Grouping and ranking of 30 countries of Sub-Saharan Africa, Two distance-based methods compared*. Paris: United Nations educational, scientific and cultural organization.

Jeremic, V, Bulajic, M., Martic, M., Radojicic, Z. (2011a). A fresh approach to evaluating the academic ranking of world universities. *Scientometrics*, *87*(3), pp. 587-596, doi:10.1007/s11192-011-0361-6.

Jeremic, V., Bulajic, M., Martic, M., Markovic, A., Savic, G., Jeremic, D., & Radojicic, Z. (2012). An Evaluation of European Countries Health Systems through Distance Based Analysis. *Hippokratia, 16*(2), 175-179.

Jeremic, V., Jovanovic-Milenkovic, M., Martic, M., & Radojicic, Z. (2013a). Excellence with Leadership: the crown indicator of SCImago Institutions Rankings IBER Report. *El Profesional de la Informacion, 22*(5), 474-480.

Jeremic, V., Zornic, N., Jovanovic-Milenkovic, M., Markovic, A., & Radojicic, Z. (2013b). Proportion of Collaborative Publications as an Ultimate Indicator of Leiden 2013 World Best Universities Rankings. *Management, 68,* 5-12. doi:10.7595/management.fon.2013.0020

Kringos, D.S., Boerma, W.G.W., van der Zee, J., & Groenewegen, P.P. (2013). Political, cultural and economic foundations of primary care in Europe. *Social Science and Medicine, 99*(SI), 9-17. doi:10.1016/j.socscimed.2013.09.017

Lima de Freitas, M.A., & da Silva, A.S. (2013). The influence of the healthcare system on optimal economic growth. *Economic Modelling, 35*, 734-742. doi:10.1016/j.econmod.2013.08.023

Lin, V. (2012). Transformations in the healthcare system in China. *Current Sociology, 60*(4), 427-440. doi:10.1177/0011392112438329

Milenkovic, M.J., Milenkovic, D., & Dobrota, M. (2012). Communication via the Web and SMS Services in the Healthcare System in the Republic of Serbia. *Actual Problems of Economics, 138*, 364-369

Milovanovic, B. (2014). *Serbia tackles healthcare system reform*. Retrieved on April 15, 2014 from http://www.setimes.com/cocoon/setimes/xhtml/en_GB/features/setimes/features/2014/01/10/feature-02

Parkhomenko, A. (2013). The strengths and limitations of the Ukrainian Healthcare system. *European Heart Journal, 34*(45), 3465-3466.

Radojicic, Z., & Jeremic, V. (2012). Quantity or quality: What matters more in ranking higher education institutions? *Current Science, 103*(2), 158-162.

Schnitzer, S., Grittner, U., Balke, K., & Kuhlmey, A. (2013). Health-Care Reforms and Insurees' Preferences: A Cluster Analysis with Data from the Representative KBV Survey 2010. *Gesundheitswesen, 75*(12), 789-796. doi:10.1055/s-0033-1333728

Smith, A. (2013). Chronic Condition: Why Canada's Healthcare System Needs to be Dragged into the 21st Century. *Canadian Public Administration, 56*(4), 659-661.

Steel, K., & Morris, J.N. (2013). The Need to Reshape the Healthcare System. *Journal of The American Geriatrics Society, 61*(3), 473-474. doi:10.1111/jgs.12120

WHO (2014). *World Health Organization*. http://www.who.int/en/

Zaitseva, E., & Rusin, M. (2012). Healthcare System Representation and Estimation Based on Viewpoint of Reliability Analysis. *Journal of Medical Imaging and Health Informatics, 2*(1), 80-86. doi:10.1166/jmihi.2012.1067

CONFLICT MANAGEMENT - CONFLICTS IN PRIMARY HEALTH CARE

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Abstract: *Conflicts are a general phenomenon that can be observed at all levels of human life. They appear in the form of relationship between individuals, groups, families and in workplaces. This paper deals with the conflicts in health care organizations that are very specific regarding the types of services they provide, as well as the specificity and diversity of service users or patients who come to health facilities for various health needs. It also analyzes the factors that have resulted in the appearance of a conflict, and finds the possibilities of more efficient management and conflict resolution. The survey was conducted in private and public institutions of primary care, and displays reasons, origin, development, management, and possible ways of resolving the conflict. The paper provides the background how to identify latent conflict, remove it, manage and solve it.*

Key words*: Conflict, health care, conflict management, primary care*

1. INTRODUCTION

Conflict is a social condition in which at least two parties (individuals, groups, states) that have different starting points at first glance irreconcilable and when the differences which are important come to the surface making it impossible to continue working in harmony. The parties then seek different objectives that can be achieved and use different means for achieving certain goals. The differences are emphasized, whether they are real or perceived in relation to the objectives, needs, ideas or starting points between the parties.

The term *conflict* is of Latin origin *"conflictus"* which means "to hit each other." Ross (Ross 1993) defines conflict as a "conflict of motives ... a situation where a person is due to the conflict of motives called a conflict situation". Krkeljić and Slobig (Krkeljić and Slobig, 2001) define conflicts as "a state of antagonism with conflicting needs and desires (included at least two parties who want to win)." By analyzing the different views of conflict, many of them can be subsumed in whole or in part, on the one of the two views, or at least to contain some of their characteristics. They all agree that conflict is a process, is inevitable and is a normal part of life.

The simplest definition of a conflict is that it represents disagreements between human beings. It means that conflicts are part of life and every change with the ability to transform into a source of energy provides the ability to manage, in a constructive way. Creative potential conflict situations are emphasized in this paper as a part of our approach to resolving conflicts bearing in mind that there is no universal definition for such complex concepts. Much more important than the definition is the understanding of the nature of the conflict. The nature of conflict is two-fold, while on the one hand, conflicts can lead to violence and unintended consequences, on the other they may be a chance to change the current situation for the better and establish a new, productive relationships in the community in which we work. All interpersonal relationships are much more complex than we realize at a first glance. By analyzing various factors and circumstances that have an impact on the level of quality of interpersonal relationships, we come to the fact that the conflict in all spheres of human life is usually inevitable. There are many studies on interpersonal relations in various domains of psychological, sociological, cultural and other fields of knowledge, but as long as we are trying to expand their awareness of the information that we receive from different forms of science, we never have a complete picture about themselves or about others. Because of these different perceptions it comes to a halt in communication, which is usually manifested in the form of a conflict. There are many possibilities for the development of a conflict situation within a group, between the two groups, between the two people, as well as within the same individual. The essential feature of any form of conflict is a conflict of interests of opposite sides, the conflict of nations, ideologies and political groups, conflicts of race and religion, family conflicts or conflict at work.

Conflicts, however it seemed to have a social dimension that takes place between two or more persons, basically have a psychological core in which usually lies the frustration of basic needs. Importance of psychological dimensions of conflict is particularly important in the process of resolving or managing them. Conflict resolution implies that conflicts can be finished, completed, overcome, or permanently settled. Conflict management suggests a process view of the choices and behaviors that come into play during

conflicts implying that it is not an "on" or "off" phenomenon.[1] Some conflicts are enduring and the best we can hope for is to manage the level and manifestation of conflict - to sustain a good working relationship free from negative behaviors or violence.

2. CAUSES AND TYPES OF CONLICTS

2.1. Causes of conflicts

Causes of conflicts can be varied events in living and working environments arising from different interests and values which represent the core of all conflicts. The conflicts are caused by different factors: disagreements, differences, difficulties, or competition. It is impossible to give a precise list of all the possible causes of conflict. One of the reasons for the large individual differences between people is that one can never be completely sure that the behavior of someone causes adverse reactions. Many professionals involved in the conflict have tried to categorize of large number of possible causes of conflict. Christopher Moore (Moore, 1986) classifies the causes of conflicts in five categories of interests, values, data structures, relationships. In real life, people still do not comply with the satisfaction of a need for a specific order. Therefore, it is important to find out how the participants in conflict define their needs and priorities of the moment. Identifying the basic needs behind the views expressed in conflict situations is further complicated by the fact that the world around us perceives everyone in a different way.

2.2. Types of conflicts

The types of conflicts indicate the seriousness of the conflict, its intensity, and the approach to the solving process. Deutch (1969) created a view of conflict that remains a usable framework today claiming that the negative or positive nature of conflict can be determined by people's behaviors and produce either dysfunctional, destructive and unproductive responses (destructive conflicts) or, on the other hand, functional, constructive and productive responses (constructive conflicts). Finding compromise solutions within the objectives of the organization that will partially satisfy the demands of the opposing party is the best and the final outcome of each conflict.

2.2.1. Destructive conflicts

These conflicts usually reflect behaviors from rigid, competitive systems and are difficult to resolve and transformed into constructive conflicts. The characteristics of destructive conflicts are inability of the groups whose members are in conflict to find a solution to the problem so the conflict parties forget the substantive issues and transform their purposes to getting even, hostile to each other, which causes a negative emotional charge. In destructive conflict, no one is satisfied with the outcome, possible gains are not realized and the negative taste left over at the end of one conflict episode is carried over to the beginning of the next conflict

2.2.2. Constructive conflicts

Constructive conflicts are the conflicts characterized by the search for the solution of the problem. They are adaptive to the situation; person and issues of the moment are functional and constructive.These conflicts are assessed as a positive phenomenon in which optimal solution is promoted because they appropriately balance the interests of both parties to maximize the opportunities for mutual gains. In constructive conflict two sides are contradicted and may be in conflict showing an acceptable level of hostility or even aggression followed by an increased level of intolerance. Conflicts at the level of tolerance should be maintained and led to finding optimal solutions. Sometimes these conflicts transform into apathy and then nothing happens between the parties, which demands to express opinions and arguments of both parties, organize discussions and solve conflicts. Constructive conflicts contain creative adaptation born from a realization that one must know both one's own and the other's interests and goals and is able to find a mutually acceptable outcome.

[1] http://www.cios.org/encyclopedia/conflict/Cnature1.htm (27/03/2014 13:52)

2.3. Conflicts in Primary Health Care

The National Health Service Act[2] defines health as a state of complete physical, mental and social wellbeing and not merely the absence of disease or incompetence. This definition of health has been amended and according to the Ottawa Declaration[3], "health means a positive concept emphasizing social and personal resources, as well as physical capacities". Health and providing health services constitute the core of the primary health-care and is a conceptual model that relates to the processes and the ways it is organized as an integral part of national health care system. The essence of the primary health care in the narrow sense means prevention of illnesses and promotion of health guided by the principles of access, equity, essentiality, appropriate technology, multisectoral collaboration, and community participation and empowerment (WHO, 1978). Basis of primary health care lies in the affordability, fairness, equality, and continuity of these processes within the national health system and represents the first level of contact of individuals and families.

In primary care health institutions we usually encounter interpersonal (between two people), intergroup (between two groups), intrapersonal (within the individual) and organizational conflicts. Their cause may be found in the discrepancy of two or more members of the organization, which occurs due to sharing of scarce resources, tasks and different goals, attitudes or perceptions. Conflicts between patients and health care workers belong to external conflicts, affect and carry emotional frustration, unhappiness, sufferings, and usually cause psychosomatic illnesses. Therefore, the importance of studying the problem of conflicts in primary health care is essential very complex and requires a multidisciplinary approach.

3. SURVEY

The survey presented here was initiated by the findings of the experimental survey conducted for the purpose of collecting data based on our hypotheses about conflict management. The starting point of our assumption was that there was a greater level of conflicts that have led into worsening of the relationships in primary health care. The conflicts in this area can have various causes on the personal, group, organizational and inter organizational level, but also often negative consequences for individuals, groups and whole organization. The survey provided basic guidelines for working on this subject and outlined a general form and scale of the problem in the treated area. The survey has been done in the field of primary care (PC) denoting the health care services which play a role in the local community and providing services to patients same day with appointment or walk-in bases. Consequently, the health care employees must possess a wide breadth of knowledge in many areas.

3.1. Aim of Survey

The overall aim of our survey was to provide an insight into the current state of conflict management in primary health care while its particular aim was to gain insight into the issues related to which extent and in which way the conflicts could be resolved and managed. The results of this analysis may help facilitate mutual understanding of conflict situations and predominantly contribute to the harmonisation of relationships and better communication since primary health care professionals act as a first point of consultation for all patients within the health care system.

3.2. Sources of Survey

A specific target group, a poll of 168 respondents of four institutions of primary health care has been questioned – three private primary health care centers "Vizim" and "Jedro" from Belgrade and "Hemikal" in Valjevo and Public primary health care center in Valjevo. The tested employees at public and private health care institutions systematically provide personal and population-based preventive, curative and rehabilitative care services in primary care. These professionals are divided into two groups consisting of 79 primary care physician, such as a general practitioner (35 from public and 44 from private health centers) and 89 physician assistants or nurse practitioners (42 from public and 47 from private health centers).

[2] The National Health Service Act, 1946

[3] The Ottawa Charter for Health Promotion, First International Conference on Health Promotion, Ottawa, November 1986

3.3. Questionnaire analysis

A survey in the form of a questionnaire was conducted and conclusions were drawn on respondents' answers. The questionnaire consists of questions divided into Block A and Block B. Block A comprises questions that directly relate to personal information about respondents, while block B examines their views and answers to the posed questions.
The questions are divided into several categories and investigate the socio-economic characteristics of respondents, the nature and frequency of occurrence of certain types of conflicts, the reasons and the consequences of conflicts, the ways and solving strategies of conflict situations including questions which sought to understand how conflicts affect individuals and what their views on various aspects of the conflict are. We obtained interesting results and identified several problems.
The collected data were categorized and tailored for entry into Excel spreadsheet. By using the available functions and program measures data were separated and compared. Classification was made according to two parameters: educational level (university level and vocational affiliation level) and the type of health institutions (private and public).
For the purpose of this paper we are presenting some important figures showing some of the results of the treated problems.

3.3.1. Defining conflicts

We observed significant differences between employees in the private and public sector, regardless of the educational level in provided answers relating to the essential understanding of the onset of conflicts. In the private sector respondents think that none of the definitions of the conflicts represent the essence of the conflict, while in the public sector respondents agree with the given definitions. In both types of health care institutions, the most common reason for the conflict is a conflict with superiors as a type of interpersonal conflicts, followed by confrontation with patients as shown in public institutions, and disagreement with individuals from other departments in private institutions. The conflict generated from the relationship with patients is characteristic of the public sector in which, because policy makers under the present public health system, the end user - the patient is not highly valued and properly treated. In the private health sector the relationship with the patient is highly valued, and the complex demands of patients are not recognized as a source of conflict, or considered very rare. There is a noticeable difference regarding the educational level since respondents with university education see a source of conflict in relation to the patient three times more than those with a high school diploma. Perceived principle suggests that a sense of health care as a service activity is constantly fading with the level of education.

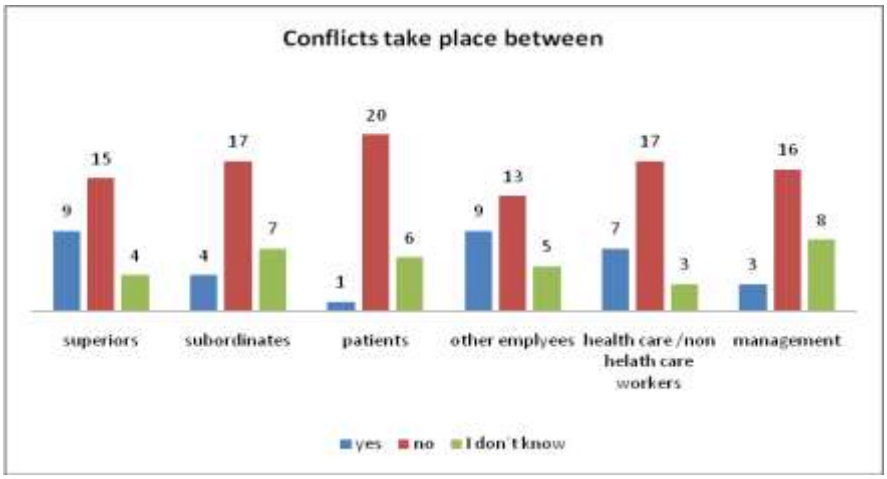

Figure 1 Defining conflict

In regard to the types of conflict that arise in primary health care, the analysis has shown that there are two groups of conflicts with the high frequency of appearance: the conflict between the individual and conflicts among groups. There is no statistical difference in the perception of values as the cause of conflict between levels management (adjusted on the table rarely/often). Also, there is no statistically significant difference in the distribution of responses among levels of education in terms of clearing the goals as conflicts. There was

no statistically significant difference in the incidence of conflicts due to cultural characteristics among respondents of different education levels.

3.3.2. Causes of conflicts

The most common cause of conflict in both private and public sector including both levels of education is the lack of information. This suggests that conflicts arise mainly due to organizational problems in both types of institutions and in insignificant number due to personal problems. Here we present two figures showing two most common causes of conflicts in primary health care: personal and organizational causes of conflict.

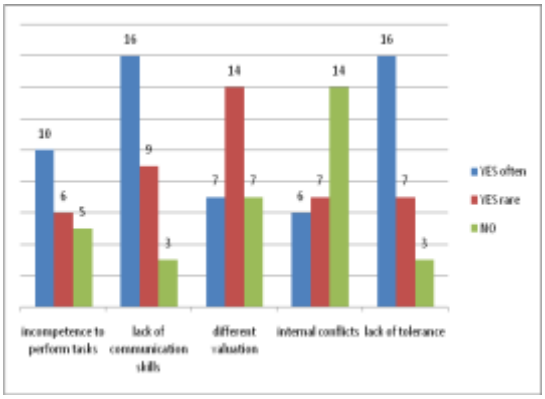

Figure 2 Personal causes of conflict

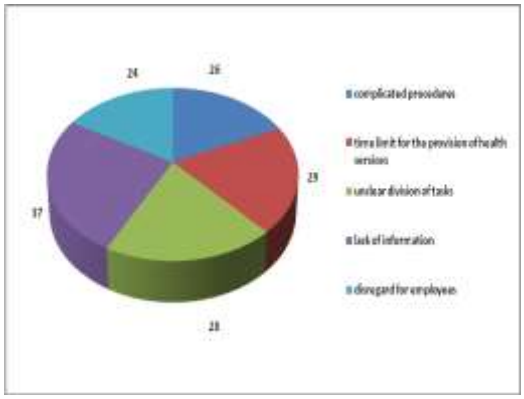

Figure 3 Organizational causes of conflict

Relating to personal causes of conflict, lack of tolerance has been chosen as the principal cause of conflicts by the largest number of respondents with high school education, connected with their view that the conflict relates to the relationship with superiors. Both groups pointed out that the lack of communication skills is the distinctive source of conflict and misunderstanding. The internal conflict in both groups is less frequently identified as a cause of conflict, but those respondents with a university degree are as double self-critical when it comes to this cause.

Significant number of respondents in the public health centers noticed that the causes of the conflict are the organizational issues and solutions offered by the management of the institution. The respondents from the public health care with high school education see the cause of the conflict in the disregard for employee and an unclear division of tasks, while respondents with university education state that the problem lies in the lack of time to provide health services. The private sector respondents with university education believe that the primary organizational causes of conflict are unclear division of tasks and a time limit for the provision of health services while the respondents with high school education have a problem with complicated procedures.

Lower wages, poorer working conditions, lack of equipment and a large flow of patients are seen mainly by employees in public institutions. In private sector, which creates a climate of better organization and concern for employees, those factors are less present.

3.3.3. Resolving and managing conflicts

The respondents in public health care express the process of resolving and managing conflicts in a different manner than employees in the private health centers. The difference is observed in the segment of the time limit for the provision of health care as stated by the public employees, especially those with a university degree, and to a much milder extent this problem is highlighted in the private sector. The introduction of a third party in conflict situations is acceptable for employees with higher education unanimously. Employees with a high school diploma are much more likely to opt for withdrawal. The position of both groups is balanced in terms of confrontation, ignorance and coercion.

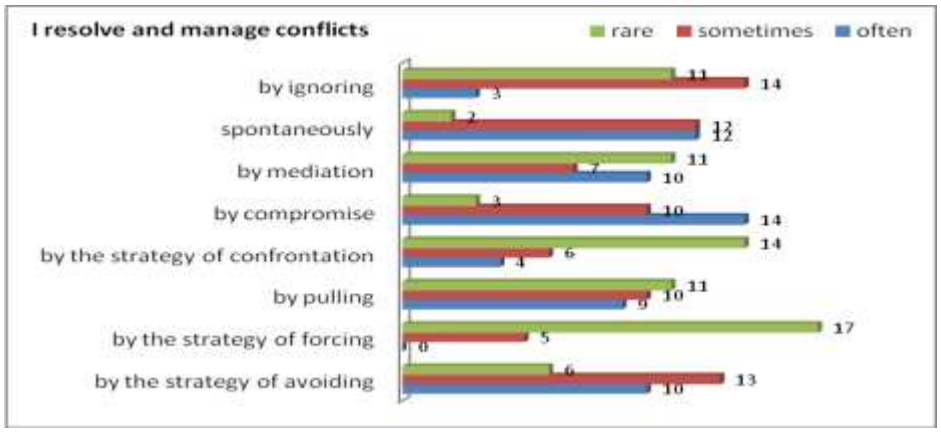

Figure 4 Conflict resolution

Compromise as the most common form of conflict resolution is represented in most of those employed in public and private health centers with a university degree. Employees with a high school degree in public health centers rather resort to ignorance and avoidance, as well as to methods of silencing conflict. The maximum deviation is noticeable in the method of mediation, which is almost totally avoided in public health centers, as opposed to private institutions, suggesting the existence of a relationship in which the focus is on the preservation of secure public position, without orientation towards resolving the conflict for the sake of development and achievement of goals. As a confirmation of this analysis, there is a deviation in terms of coercion. It is completely unacceptable in the private health centers, and appears as a method of public health centers under the auspices of tenure within the public health sector.

3.3.4. Respondents' Opinions on Conflict

Respondents were unified in their view that conflicts are not desirable in health care institutions. A significant difference is noted in the fact that respondents with high school education in a considerable number think that conflicts have negative effects and consequences on the health care institution, as opposed to the respondents with a university degree. The same difference in attitude is reflected in the fact that a number of respondents with university education considered conflicts sometimes as desirable for health institutions, while none of the respondents with a high school diploma declared in this option.

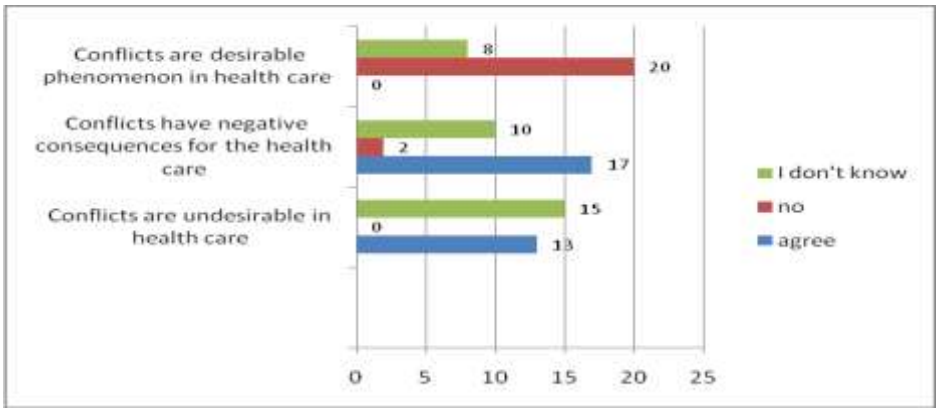

Figure 5 Respondents' Opinions on Conflict

4. CONCLUDING REMARKS AND RECOMMENDATIONS FOR FURTHER RESEARCH

Conflicts are irreversible state of personal and organizational systems and must be resolved and managed with great effort and difficulty. Identifying the nature and the event of conflict, the nature and the emergence and development of the conflict and selection of the best way of dismissal with respect to the least possible harm to people and organization are the key requirements placed before the participants in conflict.

The survey of conflict in personal and organizational levels still carry current task whose resolution can contribute to personal and organizational well-being. In order to achieve this, it is necessary to identify and categorize a clearer differentiation between the causes of the conflict, participants and their characteristics, frequency impressions, perceptions, consequences and ways to resolve and manage them. It is particularly important that employees in different levels of management are aware of all aspects in which conflicts are manifested, in order to manage them in the effective and purposeful manner, in particular in those cases where the conflicting parties are unable to accept ways to resolve them. The frequency of interpersonal and inter-group conflict requires a subtle analysis of personal and organizational values and recognition of cultural conditions of the system in which arises and develops personal, organizational and intergroup conflict.

Very often observed identical views of different management levels of the causes, consequences and indirect methods of conflict resolution indicate that employees of different levels of primary health care system are not in any way except by experience, educated for conflict management. For the realization of conflict resolution and management will be needed necessary research and systematization of their general and specific characteristics. Additional conditions that will examine updated and other issues related to various aspects of personal and organizational conflicts should be investigated. Until action or expression occurs, conflict is latent, lurking below the surface.

Looking at the developed countries as a reference case, a more team approach to health care and flexibility of resources is noticed. Since private health in Serbia begins with the application of these practices, it is clear that the change causes conflict in most cases. Negligence of employees as the cause of conflict in both groups necessarily results in conflicts. By adopting a different system of evaluation in health care institutions, employee sets new standards, both in the provision of health services, as well as in treatment of employees. Focusing on the process, not just the outcome one person desires, is key to productive conflict management. But above all, for several years now, health care experts have been issuing warnings about an impending disregard of government in expanding its role in primary health care. Health care reforms would increase government involvement in the Serbian health care system by enabling pre-employment and on-the-job training since healthcare workers need specialized skills, most of which require specific educational qualifications. Finally, by resolving financing problems in primary health care, the tensions between the opposing sides and conflict situations should be maintained at a moderate level in order that they function in harmony with one another.

REFERENCES

Deutsch M. (1983). "Conflict Resolution: Theory and Practice". Political Psychology. pp. 432–3. Retrieved June 13, 2012.

Krkeljić, Lj., Slobig, J., (2001). Kreativno rješavanje konflikata u učionici, Obrazovanje o miru i toleranciji, Ministarstvo prosvjete i nauke Republike Crne Gore i Program Ujedinjenih Nacija za djecu.

Lewin, K.; Lippitt, R.; White, R.K. (1939). "Patterns of aggressive behavior in experimentally created social climates". *Journal of Social Psychology* 10: 271–301.

Miller, G. R., M. Steinberg. (1975). Between people: A new analysis of interpersonal communication. Chicago: Science Research Association.

Ross, M. H. (1993). The management of conflict: Interpretations and interests in comparative perspective. New Haven: Yale University Press.

HUMAN RESOURCE MANAGEMENT

HR SHARED SERVICES CENTERS AS PART OF A NEW BUSINESS MODEL OF THE ORGANIZATIONS

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Abstract: *In the attempt to find an optimal business model, HR function can give the specific contribution to this aim by restructuring its activities and organization. In this sense, recognizable tendencies in the design of modern HR function are the foundation of HR SSCs. It is expected that this centers, through centralization of processes, activities and resource, will provide high quality of services and expertise in the field of HRM and effective cost control. Consequently, it is expected that this centers will give contribution to greater profitability of organizations. Bearing in mind the distinctive place that HR SSCs may have in the business models of modern organizations, the aim of this paper is to draw attention to their basic characteristics, factors which conditioned their appearance, the benefits that can be generated, as well as the possible negative aspects of their foundation.*

Keywords: *business model, HR SSCs, HR function, advantages, disadvantages.*

1. INTRODUCTION

Environment in which the most organizations today operate is very dynamic and turbulent. In such environment sudden and nonlinear changes often happen thanks to the activities undertaken by the competition or thanks to the changes in the requirements of the market. If organizations are to survive and continue development in such environment they must constantly monitor events in that market and create business models which will make the best connection between the market demands, on the one side, and the organizations' intention to gain the highest possible profit, on the other side. This leads to the proposition that once established business model must change and adapt as the major variables on which it was structured changed. The basic variables in every business models are: the value for the customer, profit formula, key resources and key processes (Johansen, Christensen, and Kagermann, 2008).

Aside from the fact that changes in business models affect the way in which organizations design their transactions to create the greatest possible value (Amit, Zott, 2001), these changes almost always have an impact on the employees. Business models' changes may require the need for employees to change their behavior and to accept some new changes in their daily work routine. Besides that, in the case of radical business models' changes they may become the surplus in the organization (Robinson, Reilly, Wolfe, 2006). Business models' changing also affects the design and activities of the HR function. This happens because of the fact that HR function has always been expected to provide systems and procedures which will be adequate support for current business. Consequently, any change in the business model and/or strategy inevitably requires that the HR function has to reassess the portfolio of its activities, as well as the adequacy of its internal design.

Having in mind that modern business conditions are very complex and that organizations often need to adapt existing or to create new business models, the goal of this paper is to show the position of the HR function in business models immanent to modern business conditions, in particular the importance that could have human resources shared service centers (HR SSCs.) These centers, because of the benefits that can generate become an almost indispensable element of the interior design of the modern HR function, especially in the large organizations.

2. HRM FUNCTION PLACE IN THE NEW BUSINESS MODEL

HR function, with its services and expertise, was always expected to be support for the current business needs. Since this function in the past was usually considered as the cost center, this support was primarily provided by activities and internal design which were cost-effective. In that line, employees are often seen as a resource which should be “obtained” at the lowest possible price and their competencies used in the most efficiency manner.

Today, in modern business conditions, product price is not usually the main source of the organizations’ competitiveness. Employees as differentia specifica of organizations have become the main source of their competitiveness. Consequently, this influenced the changes in the position and the role of the HR function which has become strategically important participant in the process of overall organizational competitiveness. Nowadays, this function is expected to contribute to the competitiveness of organizations in the several ways (Mercer, 2011):

- by being more strategically oriented, and contribute creating competitive advantage through human resources,
- by supporting analytical business information and metrics to adopt confident business decisions,
- effectively perform HR services to their customers (employees and management),
- be a support line managers in the daily activities of management employees, and
- be cost effective.

To make the HR function respond to all these demands, in many modern organizations are implementing changes in its interior design. One of the most effective HR function redesign model is created by the renowned theorist in the field of human resource management*, Dave Ulrich.* His model is based on the idea that the modern HR function can cope with the challenges it faces if its activities are grouped into three sections called "three legs of the stool." “Three legs of the stool”, i.e. three groups of activities in the *Dave Ulrich`s* model are (Ulrich, 1995):

- *HR Business Partner.* Within this group of activities HR professionals are expected to communicate directly with company’s leaders and propose solutions relating to human resources strategy. These experts are not involved in the transaction activities in the field of HRM, but perform activities of consultants and planners connecting business with adequate HR programs;
- *Centers of Excellence and Expertise.* The focus of this segment of the HR function is to create HR policies and programs which primarily serve to the line managers;
- *Shared service center.* This center performs daily activities in the field of HRM, such as payroll, benefits administration and other transactional activities with a focus on achieving the highest possible efficiency.

Dealing with the question of the interior design of modern HR functions, researchers from consulting firm *Mercer* also supports the *Dave Ulrich`s* model, but suggest that in the relationship between these segments should dominate HR SSCs (Figure 1). The researchers of this consulting company based their view on the fact that if a larger segment of transactional services held in these centers, HR professionals can devote greater extent for its expertise to the strategic needs of the business when it comes to human resources. In addition, developed HR SSCs will enable bringing the effective strategic decisions concerning employees because it always requires a large amount of analytical information, reports, measurements, etc. (Mercer, 2011), which also falls within the purview of these centers.

With this shift in the design of the HR function and this function it would receive much greater strategic importance for the successful implementation of business models and the overall competitiveness of the organization.

3. HR SHARED SERVICES CENTERS

Since the HR function in the modern business environment is faced with the imperative of making contribution to successful implementation of the chosen business model, in which significant place could have HR SSCs, in the following text we will analyze their main characteristics (concept, factors which influenced their appearance, structure, functioning, advantages, disadvantages, etc.). By knowing these facts the leadership of the organization could make grounded decision as they are an optimal solution to the design of the HR function in the intention to be adequate support for current business needs.

HR SSCs are commonly ***defined*** as places which integrate people, processes and technology in order to effectively deliver HR services to internal customer (Corporate Leadership Council, 2006). Their appearance is related to the late 90's, usually as part of a broader process of restructuring the HR function in large organizations. This is confirmed by the results of some studies that have shown that these centers are integral part of the design of the HR function in two thirds of the companies that employ more than 5,000 workers, and in companies that employ between 250 and 1,000 employees this percentage is around 17% (CIPID, 2007). Geographically, the data show that HR SSCs are most common in the U.S. and the UK, but they are becoming commonplace in Australia, Canada, the Netherlands and the Scandinavian countries, too. Also, the increase of HR SCCS is recorded in the Western European countries, such as Germany, Switzerland and Belgium, but also in developing countries where these centers are formed with the arrival of large foreign companies and banks (Mercer, 2008).

Due to the growing practice of forming HR SSCs some authors see them as a new point in a continuum that reflects the evolution of the design of this function (Figure 1).

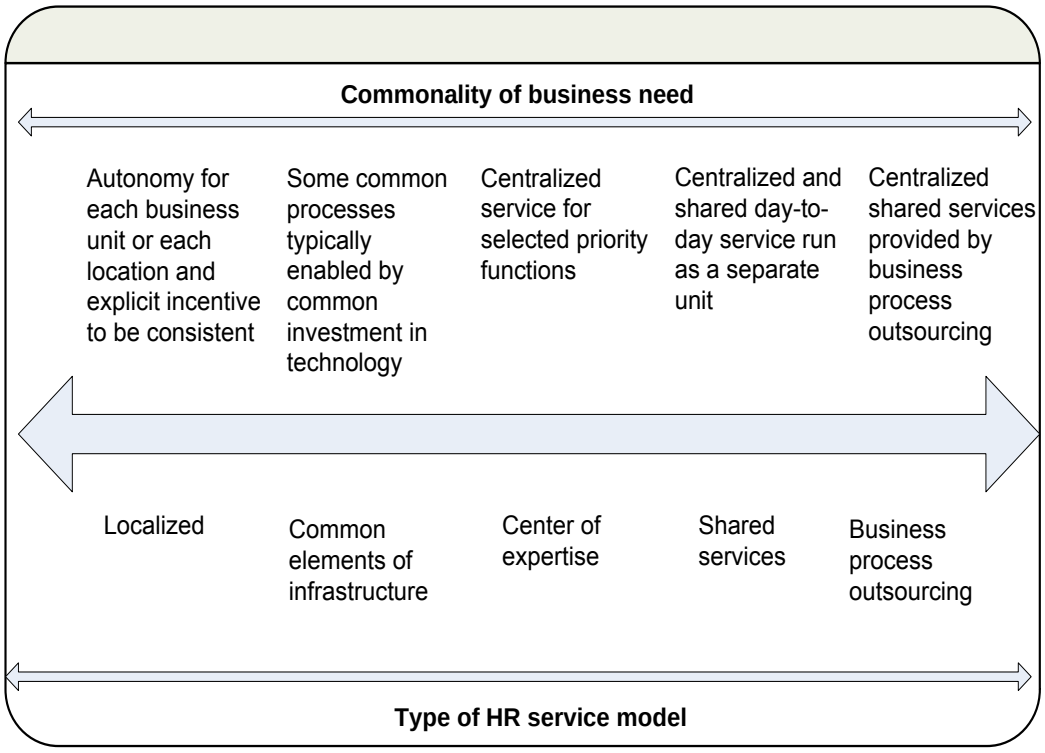

Figure 1: Continuum of HR services design

Source: Mercer, (2008). Finding your place on HR shared services continuum. Retrieved from http://www.mmc.com/knowledgecenter/Finding_your_place_on_HR_shared_services.pdf

Factors that caused the need for the HR function to make changes in direction of the formation of SSCs are, on the one hand the desire to meet the different needs of customers at the highest possible level, but on the other hand, to provide greater degree of standardization in service delivery. Proponents of this concept also believe that this is an effective way to provide greater consistency in the delivery of HR services and better

control costs. In this regard, there is an opinion that modern HR function has to be very agile and "very good at delivering differentiation when it is essential to business success, but ruthless at driving consistency when it is not essential" (Mercer, 2008, p. 2).

A factor that specially contributed to the appearance and the decision of many organizations to found them, is also a need to change the focus of this function where proportionally less time will be allocated to perform administrative activities, and more to its role as a strategic business partner. Consequently, the formation of HR SSC HR would provide professionals more space and time to deal with strategic issues which for the company have essential value. The other reasons for the formation of HR SSCs include the following (Reilly, 2000): increasing the customer satisfaction with services, the introduction of a single point of contact with customers, implementing the approach of an integrated "total solutions", providing greater cost transparency and consistency of information, achieving economies of scale for investment in technical and communication infrastructure and so on. Key reasons for the establishment of HR SSC in some companies are presented in Table 1.

Table 1: Primary drivers for creating shared services

Company	Key drivers
Bayer Group	• Increase quality • Improve speed of delivery • Reduce costs
Philips International	• Simplify HR service delivery for managers, employees, and HR business partners by standardizing processes • Leverage advanced technology to create "one-stop-shop" through HR portal • Enable strategic support to business through HR business partners • Increase cost agility
Siemens	• Increase consistency in support of "One Siemens" culture • Reduce costs and improve efficiency • Improve global metrics • Allow HT business partners to provide strategic support to business

Source: adapted according to Aon Hewitt's study (2011). Trends in Global HR Shared Services. Retrieved from http://www.aon.com/attachments/thought-leadership/Trends_Global_HR_Shared_Services.pdf

Positioning HR SSC in organizations can have different solutions depending on the assessment of the leadership of the manner in which these centers can contribute to the highest possible quality of service and efficient control of operating costs. Practice shows that in this respect are possible following ways (Corporate Leadership Council, 2006):

- *HR SSCs are located within a larger shared services function.* This solution is often in larger organizations. In this case of SSCs are usually grouped into shared services function with finance, information technology, security, etc.
- *Free-Standing HR Shared Services.* This solution means that organization create a shared services function focused solely on HR-related transaction.
- *Outsourcing HR Shared Services.* To provide better control of costs and to create a single point of contact for HR services, some organizations decide to outsource lower-level HR services. In this case HR personnel may focus on more complex HR issues, such as formulating HR

strategy, solve complex cases and manage vendor relationship. The vendor relationships usually assumes that group of HR personal contact the super vendor which then directs employees to the appropriate vendor with oversight of the relevant topic area, such as pension management or life insurance.[1]

Functioning of HR of SSCs in practice is usually multilayered, and usually consists of four levels. The first level is called *self-service* and implies that employees by using technology alone come up with the necessary information or the same change (e.g. personal data). Ideally, 60-70 % of such inquiries or requests should be realized in this way. The second level is called administrative service and assumes that representatives from SSCs take calls from the employees and by using online knowledge bases and by direct accessing to information about employees responds to their queries. The share of these requires is typically between 25 % and 30 %. The third level is called *subject expert* and means that experts in the particular field of expertise respond to users` questions or requests. These activities typically make up 10-15 % of all service requests. Finally, the fourth level is called *policy expert* and assumes that experts respond to users about highly specialized issues, for example in the field of labor law and the like. It is usual that such requests make up 5 -10 % of all service requests (Corporate Leadership Council, 2006).

Since HR SSCs already have enough long tradition, especially in the U.S., to some extent the practice of measuring their effectiveness is stabilized. The effectiveness of these centers is usually measured in three segments: financial aspect of their introduction, procedures and customer satisfaction services. Table 2 shows the most common indicators that are determining in order to monitor and evaluate the effectiveness of these centers.

Table 2: HR shared services metrics by category

Financial	Procedural	Customer feedback-based
• Cost broken down by offerings and utilization of offerings • Cost per full-time employees • Shared services cost growth relative to corporate revenue growth and/or corporate expenditures	• Number of unsolved customers' requests • Metrics for specific tasks (e.g., time to fill recruiting duties) • Six sigma • Users' time on hold • Utilization rates by phone, e-mail, fax, or Web	• Periodic surveys of internal customer population • Reviews of past calls for customer service quality • Surveys targeting specific user groups

Source: Corporate Leadership Council (2006). HR Shared Services: Determining the Scope, Scale, and Structure. Retrieved from http://www.spa.ga.gov/pdfs/CLCHRSharedServicesDeterminingtheScopeScaleandStructure.pdf

4. ADVANTAGES AND DISADVANTAGES OF SSCs IN THE HR FUNCTION

The implementation of the concept of SSCs in the design of HR function has numerous advantages but also the potential risks. The benefits expected from the establishment of HR SSCs can be systematized into three groups (Schwarz, 2007):

- *Cost advantages.* Numerous studies have shown that the implementation of the concept of SSCs in the design HR function can reduce costs by an average of 25 % to 40 %. One part of costs saving resulting from the reengineering process and the effects of economies of scale, while a portion of the

[1] As a specific example of outsourcing HR services can be mentioned an example of Adecco Group, precisely the branch of the group which is located in Belgium and employs 700 workers. This branch for the Belgian labor market performs a number of HR services such as recruitment, selection, temporary employment, etc. At the same time the services that are provided by Adecco Belgium are specialized for various industry sectors. The companies that are their major clients are XPE Engineering & ICT Finance & Accounting XPE, XPE Pharma & Science, Glotel, Modis, 3W and Lee Hecht Harrison. Adecco has over 120 offices in Belgium, where some are located at the clients' places. The head office and shared service center for HR, Finance and ICT is located in Brussels (http://www.citrix.com/customers/adecco_belgium_en.print.html). This suggests that SSCs in the HR group activities today are not only seen as a concentration of activities within large global companies, but are also formed as a joint services for several companies. In this case they are usually located where the best conditions for performing are.

savings resulting from the savings in labor costs due to the elimination of those HR activities that would be otherwise duplicated, and from introduction of modern technology. In addition, many MNCs decide to form their SSCs in countries where labor is cheaper which also leads to savings in labor costs. Consequently, we can identify trends in these centers as moving from highly cost urban areas to rural areas with low labor costs. In this regard, practice shows that companies in the EU are increasingly opting to aggregate common services in countries with lower labor costs, such as Eastern Europe (Aon Hewitt, 2011).

- *Service advantages*. Standardization of activities as well as the effective delivery of HR services ultimately contribute to the quality of services improvement by standardizing on a certain level. In addition, improvement in human resource management and improvement in communication between the HR function and other business units enables better and faster transfer of knowledge and the improvement of overall organizational performances.
- *Strategic advantages*. Establishment of HR SSCs allows the HR function to focus on strategic issues. By improving its structural flexibility and release from routine tasks this function can focus on strategic corporate objectives. Therefore, this function can become a true strategic partner in achieving company goals.

On the other hand, the establishment of HR SSCs, as we have pointed out, is not without challenges. Some studies have shown that the formation of HR SSCs caused dissatisfaction of line managers because of the increased workload within HR administration. On the other hand, there were also complaints from HR professionals who claimed that these centers have limited their opportunities for career development. Other deficiencies of formation of HR SSCs ranged from reduced quality of HR services, to the fact that the formation of these centers was very expensive investment. Briefly, the potential risks of introducing HR SSCs can be systematized into the following three groups (Schwarz, 2007):

- *Financial risk.* Financial risk stems from the fact that the project of forming HR SSCs can be more expensive than it was originally planned. The increase in costs may be due to the fact that their establishment may take longer period of time due to different resistances or organizational weaknesses. Also, the establishment of HR SSCs usually requires significant investment in IT.
- *Process risk.* This type of risk is related to the potential risk of reducing flexibility in meeting the needs of service users because one of the principles underlying the operation of these centers is that wherever is possible procedural differences for internal users should be eliminated. Consequently, the formation of HR SSCs “by default “significantly reduce flexibility. Specific needs should be satisfied only when the HR SSCs are prepared for that and when it is justifiably[2]. In the case of such HR SSCs is provided high level of operational excellence, and high level of personalized solutions.
- *Employee risk.* Employee risk is associated with the fact that the employees could form resistance to changes that are planned to be implemented. It is a well-known fact that when organizations implement changes, the employees may demonstrate less or more resistance to them since every change means abandoning the previous well known pattern of behavior. This type of risk can even strengthen financial and procedural risk.

5. EXAMPLES FROM PRACTICE

The next few examples illustrate the process of formation, as well as the benefits generated by establishing HR SSCs that could serve as examples of good practice if the companies think about redesigning the HR function in this direction. However, this does not mean that establishing HR SSCs in each company you will automatically result in positive effects. The following examples show the starting circumstances from which listed companies launched in the formation of these centers and what practical solutions resulted from these

[2] In order that HR SSCs cope with the new challenges it is suggested that within them should be formed a suitable base of knowledge that will be combined with the best practices in this area, as well as the technique of case management. More in Hird, M., Marsh, C., Sparrow, P. (2009), "HR Delivery Systems: Re-engineered or Over Engineered?" CPHR White Paper 09/05.

circumstances. As every company has specific characteristics, these examples should be used only for critical analysis and identification of specific causal relationships.

Bayer Group. Bayer Group is a global company that is recognized worldwide in the areas of health care, nutrition and high-tech materials. It employs over a hundred thousand people in more than 300 subsidiaries worldwide. In this company HR SSCs were introduced with the objective to increase the quality of the HR services, the speed in their realization, and to reduce operating costs. Over time the company has achieved all these goals, but the focus remained on the quality of HR services.

Bayer HR SSCs operate on several levels: global, regional and country level. Global HR SSC is located in Germany, the regional center for Europe also in Germany, and there is the regional center for North America located in Pittsburgh. This company established several HR SSCs at the level of the state too, such as centers in Argentina, Mexico, Brazil and Japan.
Since the precondition for successful functioning of HR SSCs is the standardization of HR programs and activities, this company during the formation of these centers considerable attention dedicated to ensure standardization and consistency of the process. Besides that, this company tied to offer the best possible services in a given area (best-in-class solution). The process of standardization of HR services and processes in Bayer began in 2005. First, all HR processes and activities were identified, and then grouped into 28 different clusters. Through this analysis, Bayer has identified three types of processes:

- *Global processes.* These are processes that are implemented in the same manner at each location. This company has identified six global processes, including performance management, short-term incentives and merit increases.
- *Global-at-core processes.* These processes are with a consistent foundation, but some variations at the local level; these include recruitment and training.
- *C processes.* These are processes that are significantly different across countries and include payroll.

Bayer aggregated the administrative aspects of these cluster in its SSCs. In this way, all six global processes are administered in a consistent manner for all employees within this global company. Other processes that require local adaptation are administered through regional HR SSCs or centers that are located in different countries. In order to monitor the effectiveness of these centers Bayer established practice of monthly reports on the performances that are achieved (Aon Hewitt, 2011).

Phillips International. Phillips International is world known company in the field of health care, lifestyle and lighting. It employs over 100 000 employees in more than 60 countries. A key reason for the formation of HR SSCs was a simplification of HR services. This effort was part of a broader mission of Phillips which stresses operational excellence and consistency across all businesses. In order to simplify HR services, Phillips formed global SSC with the single point of contact for all leaders, managers and employees. In this way, experts within the field of human resources (HR Business Partner) are freed up to provide more time to deal with strategic aspects of employment and to be support to managers. With these changes, Phillips recorded increased productivity and reduced costs, although these were not the primary objective of HR function restructuring.

The process of simplification of HR activities in Philips successful illustrates the fact that when it comes to recruitment they removed e 15 "touch points" from HR business partners and eight form managers. In this way, HR professionals are freed up from administrative duties and a recruitment process was significantly simplified. A similar situation was with the other activities in the field of HRM (Aon Hewitt's study, 2011).

Nestle. Nestle is an example of a company that literally applies the Dave Ulrich's model since in this the company HR function is composed of three segments: business partners, centers of expertise and HR SSCs. Such organization of the HRM function is implemented in its three global zones in which this company operates: Africa, Oceania and Asia (AOA), American zones - North and South America and the European zone - Central and Eastern Europe. In addition, within 84 countries where the company operates, a three-part model also has been implemented. In other words, within a global three-part model of HR functions operate three-part model of the functions in each country where the company has operations.

The basic principles which the HR function in this company implements in its functioning are as follows (Hird, Marsh, Sparrow, 2009):

- Provide consistency and ease of HR activities when you cannot achieve a competitive advantage through diversities and complexities,
- Provide as much information at the lowest level in the company,
- Local HR strategy should be aligned with corporate strategy,
- HR SSC and HR centers of expertise are centralized and provide service to all segments of business unless it is important that certain practices are localized.

Although presented examples are those in which the formation of HR SSCs generated positive effects, the implementation the SSCs concept in the design of the HR function was not without problems. This is illustrated with the slogan of Bayer's HR transformation group: "Let's make it happen." Repeating this slogan enabled them to successfully face many problems that arose in the implementation of this project in order to realize it fully.

6. CONCLUSION

HR SSCs should be considered as part of the evolution of the HR function design that best integrate the advantages of modern technology and standardization, with the idea that the needs of the employees and management should be satisfied in the best way. At the same time, this enable freeing up HR professionals enough time and energy to devote to strategic needs organization in terms of human resources.

Previously examples in the paper points out that HR SSCs can have a significant role in the business model of modern organization especially as their focus of HR SSCs is to create the greatest possible value for the users of their services at affordable costs. Positive impact on overall organizational performance such designed HR function can generate due to the fact that only high-quality, professional, motivated and satisfied workforce can be a generator of business success. All this issues are depending greatly on the quality of the services that provide HR SSCs. Howevere, in this paper is also stressed the fact that there are some potential risks of introducing these centers, such as financial risk, process risk and employee risk. Knowledge of the potential risks of establishing HR SSCs should enable the organization's leadership not to implement them without previously critical access as well as to prepare appropriate organizational responses to them in advance.

In this regard, the example of Bayer tells us that implementation of the SSCs concept in the design of the HR function requires patience and progressively overcoming obstacles. Also, this example shows that it is very important that once established HR SSCs should be the subject of ongoing analysis of the effects that are generated so that corrective measures can be taken. Therefore, some authors point out that the concept of shared services is still evolving, and that is going on specific "shared services journey" (Schwarz, 2007). This means that concept of HR SSCs have potential to generate many positive effects, but there are also some weaknesses that should be overcome. The main downsides that should be taken in account are huge investment in technology, reduced flexibility for individual and business units need, perception that HR function has been depersonalized, resistance to changes, etc.

REFERENCES

Amit, R., Zott, C. (2001). Value creation in e-business. Strategic Management Journal, 22, 493-520. doi: 10.1002/smj.187

Aon Hewitt's study (2011). Trends in Global HR Shared Services. Retrieved form http://www.aon.com/attachments/thought-leadership/Trends_Global_HR_Shared_Services.pdf

Corporate Leadership Council (2006). HR Shared Services: Determining the Scope, Scale, and Structure. Retrieved from http://www.spa.ga.gov/pdfs/CLCHRSharedServicesDeterminingtheScopeScaleandStructure.pdf

CIPD (2007). The Changing HR Function: Transforming HR. London, United Kingdom: Chartered Institute of Personnel and Development.

Hird, M., Marsh, C., Sparrow, P. (2009). HR Delivery Systems: Re-engineered or Over Engineered? CPHR White Paper 09/05. Lancaster, United Kingdom: Centre for Performance-led HR.
Johansen, M. W., Christensen, C. C., Kagermann, H. (2008). Reinventing your business model. Harvard Business Review, 86, 55-59.
Mercer, (2008). Finding your place on HR shared services continuum. Retrieved form http://www.mmc.com/knowledgecenter/Finding_your_place_on_HR_shared_services.pdf
Mercer (2011). It's time for the Next Generation HR Service Delivery Model. Retrieved from http://www.mercersignatureevents.com/Iachr_2011/resources/It's%20Time%20for%20the%20Next%20Generation.pdf
Reilly, P. (2000). HR Shared Services and the Realignment of HR. Sussex, United Kingdom: Institute of Employment Studies.
Robinson, D., Reilly, P., Wolfe, H. (2006). Business Models and HR Logic or Fashion. Brighton, United Kingdom: Institute for Employment Studies,
Schwarz, G. (2007). Shared Service Center. Retrieved from http://www.inst-informatica.pt/servicos/informacao-e-documentacao/biblioteca-digital/gestao-e-organizacao/servicos-partillhados/shared-service-center-2007
Ulrich, D. (1995). Shared Services: From Vogue to Value, Human resource planning, 18(3), 12-23.

E-SKILLS FOR PUBLIC SECTOR EMPLOYEES

IN THE PROCESS OF E-GOVERNMENT DEVELOPMENT

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Abstract: *Public sector effectiveness depends largely on the skills of employees in public administration who face specific challenges due to the nature of their work. Modernization of public sector initiated by introduction of information and communication technologies (ICTs) has led to new demands regarding skills required for public sector employees emphasising the need for achieving digital literacy among them. This paper seeks to address a broad range of challenges faced by developing countries at the beginning of the process of e-government implementation, primarily referring to low level of ICT literacy and e-skills of public administration employees. The aim of the paper is to discover the variables with the highest influence on the process of e-government development in these counties, especially focusing on identifying the appropriate mix of specific skills (with particular emphasis on e-skills) required by public sector professionals (especially non-IT workers) involved in the process of e-government development and implementation. Conclusion of the paper is that a user-centric approach for acquiring e-skills in the public sector should be used in the process of e-government development and recommendations of various channels that may be used for acquiring of these skills are offered. This paper may present value to relevant bodies and institutions in developing countries intending to develop and implement the concept of e-government. The findings can also serve as guidelines for development of a possible curriculum for training and education of public administration employees in these countries.*

Keywords*: e-government, e-skills, human resources, public sector, public administration employees, leadership skills*

1. INTRODUCTION

Rapid transformation of society from industrial to informational, from bureaucratic to citizen-cantered, from service economy to knowledge-based one has influenced the development of human resources skills, making them much more pervasive and encompassing than ever before. The main initiator of these changes has been the introduction of information and communication technologies (ICTs).

Information age, associated with the digital revolution, has emphasized the need for digital literacy, or widespread use of basic IT skills (so-called electronic or e-skills) especially within the public sector. It has highlighted the critical role of e-skills for creation of effective and proactive policies aimed at sustaining investments in ICTs and protection of e-skills from becoming a bottleneck.

E-skills are becoming increasingly important in a knowledge-centric concept such as e-government. The main task of the public sector is to provide a substantial supply of high-quality services for the community in order to achieve efficiency and effectiveness in its performance (which is related to the purpose of citizen-cantered orientation). E-government refers to the achievement of this objective within the field of public administration through the use of ICTs (UN 2003).

2. THE CONCEPT OF E-GOVERNMENT

A commonly used narrow definition of e-government refers to service delivery on the Internet (West 2001). However, during the time definitions extended the scope of e-government from “the use of ICTs” towards “reforms in public administration”, stating that e-government “is not just automation of existing processes…but creation of new processes and new relationships” (InfoDev and CDT 2002, p. 5) between administrative institutions and bodies. So, e-government “has become an indispensable tool in reforming state administration and the work of local government, it is increasing the satisfaction of citizens regarding services, and creating a more flexible, transparent, public administration” (Molnár, 2006, p. 5).

E-government users include citizens, businesses, governments and public administration employees. According to World Bank (2005) e-government may build one of three possible relationships with its users: government-to-citizen (G2C), government-to-business (G2B) or and government-to-government (G2G). The

fourth and final relationship is the one between the government and its employees (government-to-employees or G2E), where the government is expected to provide e-learning and facilitate knowledge sharing among its employees using Intranet.

Regarding the implementation of ICT concept in government OECD (2003) and UN (2005) point out that successful e-government requires two main categories of human resources: well-balanced human resources in the public sector comprised of professional engineers in charge of system development, management and maintenance on one hand, and users (clients and public sector employees) equipped with IT knowledge on the other hand. Similarly, López-Bassols (2002, p. 3) notes that ICTs "offer the promise of new business and employment opportunities along with higher productivity gains, but also make new demands on skills…and adequate training programmes for various categories of workers''.

3. HUMAN RESOURCES AND THEIR SKILLS AS ONE OF THE MOST IMPORTANT FACTORS FOR E-GOVERNMENT DEVELOPMENT

Many studies attempted to identify the most important factors for development of successful e-government which lead to achievement of higher efficiency, effectiveness, transparency and accountability of government day-to-day administration. Numerous variables have been found to have impact on the implementation of e-government in developing countries, such as: changes in work processes, technical/human resources, organizational culture/values, vision/strategy/internal leadership, external/financial support, and laws/regulations/policies, with "technical/human resources" being one of the most important factors (Shin et al., 2008).

Human resources represent a set of individuals who make up the workforce of an organization, a company or an institution in any sector: private, public, NGO, etc. Human resources possess different skills, abilities, knowledge and qualifications needed for performing particular jobs. A skill may be defined as: (1) a learned ability to use one's knowledge, practice, and aptitude; (2) an ability to perform a task with pre-determined results within a provided amount of time and/or energy; (3) a special competence in performance. According to Skills Investment Strategy (2003) there are two types of skills- essential and occupational. Essential skills are enabling skills that help people perform the tasks required by their occupation as well as other activities of their everyday life. These skills provide a foundation for acquiring other skills and enhance individual's ability to adapt to changes in the workplace. Essential skills include reading, writing, analytical skills, verbal communication skills, computer skills and thinking skills, among others. Occupational skills refer to job-specific technical skills that are required in order to perform specific tasks for a particular job.

Skills may be acquired through a variety of channels (OECD, 2001; López-Bassols, 2002)- through natural abilities, formal education, work experience, training (on-the-job or external) and other (e.g. self-training, non-formal training). On-the-job learning is often considered as one of the most effective ways for gaining necessary knowledge and acquiring tacit skills (Barrett, 2001; Lucking, 2003; Ma, 2004; Tessema et al., 2007). Methods of skills development or training programs in organizations can be either formal or informal. The latter is done through on-the-job training and is less expensive, whereas the former is more structured and takes place in a classroom or e-learning setting and is more expensive. For example, an informal method can be used for acquiring basic IT skills, both in public and private sector. Experts suggest that formal training methods can be used for acquisition of Internet skills and technical e-skills either in classroom setting, e-learning, or by outsourcing to local and international institutes. Additionally, public sector may facilitate the process of acquiring IT skills through enhancing access of their employees to ICTs by providing low-cost PC programs (including the Internet).

3.1. SKILLS OF PUBLIC ADMINISTRATION EMPLOYEES

Well-balanced human resources in the public sector and provision of a variety of training programs aimed at developing users' knowledge and capacities are often considered as necessary prerequisite for maximizing the benefits of e-government (OECD, 2003; UN, 2005). Public sector effectiveness depends largely on the skills of employees in public administration who face specific challenges due to the nature of their work. However, it is not easy to fill the skills gaps in order to increase the ability to deliver excellent service to the community. Since skills cannot be easily measured, different proxies may be used for capturing observable employee characteristics, such as education (on the supply side) and occupations (on the demand side). These issues become even more challenging when ICTs are being introduced in work processes in public administration. Having this in mind it is necessary to identify the skills required for public sector employees in order to enable successful development and implementation of e-government.

In the past public administration employees were mainly required to possess only hard skills in order to be considered for a particular job-the emphasis was on technical competencies and functional expertise as

crucial determinants for successful performance. However, during the time the importance of soft skills has increased. Soft skills refer to the ability of an individual to communicate and interact with other employees in a positive manner. These skills are usually seen as a combination of communication and interpersonal skills, emotional intelligence, leadership qualities, negotiation skills and team skills (Deepa and Seth, 2013) as well as social skills - skills needed for working (collaborating) with people in order to achieve mutual goals (e.g. social perceptiveness, coordination and negotiation skills, persuasion and instruction skills, and team working skills) (Ben-ner and Urtasun, 2013).

Nalbandian and Nalbandian (2003) summarize skills necessary for public sector professionals as follows: administrative skills, political and policy skills, skills related to public service values education, and emotional and personal attributes. Administrative skills usually refer to achievement of collaboration and cooperation among departments, creation of opportunities for adoption of best practice as well as orientation of other employees toward accomplishment of organizational goals. Public sector employees need to possess political skills (Ferriset al., 2005; Ferris et al., 2007) which include networking ability, social astuteness, interpersonal influence and apparent sincerity (Ferris et al., 2005); they are expected to work on creating a climate which promotes and emphasizes issues related to loyalty, trust and commitment. They are also required to be committed to expressing public sector values, to educate others on those values, and to encourage the development of organizational values consistent with the values of the community (Nalbandian and Nalbandian, 2003). Another valuable skill for public sector employees refers to emotional intelligence- an understanding of feelings and emotions on one hand, and rational intelligence or reasoning on the other (Vigoda-Gadot and Meisler, 2010).These skills may lead to better performance in delivering service to customers, as well as higher work outcomes of public sector organizations (Rubin et al., 2005; Coté and Miners, 2006; Elfenbein et al., 2007; Vigoda-Gadot and Meisler, 2010). Special attention has to be paid to the significance of leadership skills for effectiveness of public service employees -public sector needs to identify and train employees in leadership skills in order to ensure responsibility. These skills mainly refer to the ability to communicate, motivate, coach, reward, involve and support others, as well as the ability to promote teamwork and collaboration among employees (Basheer and Sulphey, 2012).

Modernization of the public sector and introduction of new technologies has led to new demands regarding skills required for public sector employees. ICTs are affecting skills required and the nature and organization of work even for non-IT workers. Technological changes in the form of computer-based technologies entail an increase in skill content of jobs performed by skilled employees (Machin, 2001). By its nature IT work requires individuals to master codified and tacit knowledge as well as technical and abstract concepts, which are acquired through various formal (e.g. education) and non-formal channels (e.g. work experience).

3.2. E-SKILLS IN PUBLIC ADMINISTRATION

New information society and new concept of e-government require public administration employees to possess (beside essential and occupational skills) also cross-disciplinary, cognitive and problem-solving skills, understanding of the fundamentals of business and communication skills (including competence in foreign languages) as well as ICT-related skills (i.e. e-skills). Specific e-skills are needed for successful development of e-government which entails innovation of on-line services.

ICT skills (or computer technology skills) can be defined as:(a) the ability to learn, communicate effectively, collaborate, and solve problems regarding computer-technology-related tasks and projects; (b) the ability to use technology to support individual's work with people/things/data/information (e.g. use of technology in an engineering lab, design studio or research program; use of technology for development of print and on-line materials; or use of technology for organizing and presenting information or for creating and maintaining databases); and/or (c) the ability to support others in the use of technology (e.g. setting up computer work stations for people, teaching computer skills, troubleshooting technology-related issues, and maintaining and repairing computers and related equipment).

E-skills usually refer to a broad set of skills necessary in the modern workplace. Commission of the European Communities (2007) extended this definition stating that e-skills represent a set of skills, knowledge, and concepts that are needed for effective consumption in terms of access, locating, operating, managing, understanding, and evaluating e-services provided in different stages of e-government. There are five levels of e-skills necessary for public sector employees - non-IT workers (i.e. workers without formal ICT education, such as minimum bachelor degree in informatics as a background for occupational skills) (López-Bassols, 2002; European e-Skills Forum, 2004; OECD, 2005):

1. *Basic level of e-skills* which is close to ICT user skills. These skills generally refer to "digital literacy" and include skills required for confident and critical use of ICTs for work purposes, leisure, learning and

communication. Employees who possess these e-skills can use generic tools (such as Word, Excel, Outlook and PowerPoint) and have the ability to use ICTs for basic tasks and as a tool for working.

2. *Middle ("advanced") level of e-skills*. Employees who possess these e-skills are practitioners because these skills enable them to use advanced and sector-specific software tools. They have the ability to apply simple IT tools in general workplace settings and also have capabilities required for researching, developing, designing, strategic planning, managing, producing, consulting, marketing, selling, integrating, installing, administering, maintaining, supporting and servicing ICT systems.

3. *ICT specialist*. Employees with these e-skills possess professional skills in ICTs - they have the ability to use advanced IT tools to develop, operate, repair, maintain and create ICT systems.

4. *E-leadership skills*. Employees with these e-skills have the capabilities needed for exploiting opportunities provided by ICTs (notably the Internet). They are expected to ensure more efficient and effective performance of different types of organizations as well as to explore the possibilities for new ways of conducting administrative and organizational processes. They have T-shaped portfolio of skills, representing expertise both in using ICT and developing organizations, which means that a leader is expected to possess the following skills:

- Expertise or "deep knowledge" in a specific area (e.g. engineering) - a vertical set of skills;
- "Transversal skills" that enable collaboration across a variety of boundaries (e.g. negotiation skills; critical thinking; design and systems thinking, business and entrepreneurship etc.) - a horizontal set of skills;

Both vertical and horizontal sets of skills require a basic level of ICT user skills, as defined by the European e-Skills Forum (2004).

5. *ICT professionalism skills* represent the highest level of e-skills. Employees with these e-skills possess a comprehensive and up-to-date knowledge, accommodating a common ICT body of knowledge, as well as pertinent specialist knowledge and skills. They are able to demonstrate an on-going commitment to professional development via an appropriate combination of qualifications, certifications, work experience and non-formal/informal learning, as well as to deliver high-quality products and services and adhere to applicable regulatory practices and/or a code of ethics/conduct.

4. ACQUIRING E-SKILLS IN DEVELOPING COUNTRIES

Human resources in the public sector represent one of the fields which need a lot of investments within the process of e-government implementation. Developing countries are still at the nascent stage of e-government development. Even though they require sophisticated and up-to-date e-skills in the public sector, these countries are usually characterized by a low level of digital literacy. One of the reasons for this is inappropriate formal education system in these countries which is not adapted to existing needs for e-government development and does not provide programs aimed at acquiring of e-skills for non-IT workers in public administration. As a result, most employees in the public sector in developing countries with a lot of work experience possess high level of essential and occupational skills but lack e-skills. Beside this category of public sector employees, there is another category which consists of employees who possess basic e-skills (beside essential and occupation skills). These employees usually build up their e-skills through self-training or non-formal learning. Even though they are in better position comparing to the employees without e-skills, they still belong to the first ("basic") level of e-skills. Most of employees in the public sector belong to this category. These is only a small number of public sector employees in developing countries who possess "advanced" level of e-skills; they usually do not have formal education in ICT field but have acquired these skills through self-training, previous work experience and on-the-job training. Even less employees may be found at "ICT specialist" level; this level of e-skills is reserved for employees who acquired their professional skills in ICTs through the process of formal education and later upgraded through work experience and training programs (both on-the-job training as well as external trainings). The forth and the fifth level of e-skills is rarely found in the public administration of developing countries. It is a complex one and not so easily achieved especially at the beginning of e-government implementation process.

Training programs aimed at acquiring of e-skills in the public sector in developing countries should not be defined universally for all public sector employees; they must be well defined and goal-directed in order to satisfy the needs of each particular job position. Khan et al. (2010) propose e-skills acquisition methods for public sector employees: formal training methods (e.g. on-the-job training); informal training methods; PC and Internet access in the offices; public private partnership (PPP - joint training programs by government and private sector which are supposed to enhance e-learning through a government extranet where public and private sector employees can share knowledge and experience); e-learning (short term and long term programs); outsourcing e-skills training and development or inviting foreign experts to provide trainings in e-

skills; defining minimum requirements regarding IT skills for each position (for instance, ECDL - European Computer Driving License and/or MOUS - Microsoft Office User Specialist certificate); ICT training through media (radio, television, newspapers); periodic internships in IT departments/organizations; providing ICT training in collaboration with universities or institutes; socialization and capacity building through FAQ, providing manual book/guidance, and through help desk centre; stimulating and motivating employees for acquiring IT skills; make IT skill acquisition as one of the requirements of promotion in the public service; encourage life-long learning programs in the public service etc.

So, there is a necessity for long-term strategy related to e-skills development at the national level in developing countries. A common objective of ICT policies in developing countries refers to providing a minimum level of ICT knowledge for individuals and organizations, offering help to understand information technology and its cross-disciplinary effects, as well as providing a possibility of access to citizens and offering trainings in ICTs. There is also a need for deep scanning of current situation and existing skills in public administration as well as determining which e-skills are required for each position related to e-government and on-line service delivery. Special attention has to be paid to positions which require e-leadership skills. The results of this analysis should be used as a foundation for creation of long-term strategy for building up e-skills in the public sector. From a long-term perspective, there is also a need for some of the e-skills to be embedded in the formal higher education process in developing countries, in order to enable future generation of public sector employees to enter the public administration/government with basic or even advanced level of e-skills developed.

5. CONCLUSION

Continuous and fast development of ICTs on one hand, and changes in e-skills requirements on the other hand, have provided a complex target for policy makers whose job is to create educational and professional training systems at the national level, facing the challenge of delivering the skills needed for e-government. Despite their efforts, they still find it difficult to cope with the existing situation, and lifelong learning is still far from being a reality (Commission of the European Communities, 2007).

E-government facilitates the process of transition from a consolidated model of centralized, hierarchical, bureaucratic and operating government, in which “silo” functioning is dominant, to a new model of “horizontally integrated systems…which facilitate customer orientation’’ and move towards “e-government solutions that are sustainable” (UN, 2012, p. 63). Introduction of computer-based technologies has led to changes in skills of human resources (Ben-ner and Urtasun, 2013). There are strong reasons to believe that basic IT skills are becoming a new category of “general” competencies, such as analytical or literacy skills. IT skills do not only increase earning potential of IT workers, but they are also becoming necessary for a broad range of activities in the public sector.

However, at the very beginning of introduction of ICTs in the public sector, public administration employees are expected to show readiness and willingness (as well as basic digital literacy) to understand and participate in implementation of new technologies necessary for innovation and advancement of services provided by this sector. The next phase (implementation of e-government concept) requires even more specific, additional skills (e-skills) from public administration employees, especially non-IT workers, in order to be able to engage in a wide variety of uses within e-government. Different forms of formal and non-formal channels of education may be used for solving this problem - a user-centric approach for acquiring e-skills in the public sector should be used in the process. E-skills framework system should be used as a diagnostic tool to assist employers in public administration in determining more precisely and systematically the skills content of current jobs and new skills requirements. IT skills and competencies must be considered as one of the requirements for recruitment of new staff or promotion of existing staff in civil and public service. Developing countries need to create strategies and policy frameworks aimed at strengthening educational systems and facilitating workforce up e-skills in order to set up efficient and effective e-government. Finally, IT skills should become integrated into the concept of lifelong learning of public sector employees as one of necessary conditions to maximize the benefits of e-government, which is expected to facilitate the rapid diffusion of basic IT skills in developing countries.

REFERENCES

Barrett, R. (2001). Labouring under an illusion? The labour process of software development in the Australian information industry. New Technology, Work and Employment, 16 (1), 18–34. doi: 10.1111/1468-005X.00074

Basheer, A.& Sulphey, M.(2012).Leadership effectiveness in implementing change and driving innovation: A study among public sector employees. Asia Pacific Journal of Research in Business Management, 3 (9), 1.

Ben-ner, A.&Urtasun, A.(2013). Computerization and skill bifurcation: The role of task complexity in creating skill gains and losses. Industrial & Labor Relations Review, 66 (1), 225-267.

Commission of the European Communities (2007). Communication from the Commission to the Council. The European Parliament, The European Economic and Social Committee and the Committee of the Regions. E-skills for the 21st Century: Fostering Competitiveness, Growth and Jobs, Brussels. Retrieved from http://eur-lex.europa.eu/legal-content/EN/NOT/?uri=CELEX:52007DC0496

Coté, S.&Miners, C.(2006). Emotional intelligence, cognitive intelligence and job performance. Administrative Science Quarterly, 51 (1), 1–28.doi: 10.2189/asqu.51.1.1

Deepa, S.& Seth, M.(2013). Do soft skills matter? – Implications for educators based on recruiters' perspective. IUP Journal of Soft Skills, 7 (1), 7-20.

Elfenbein, H.A., Foo, M.D., White, J., Tan, H.H. & Aik, V.C. (2007). Reading your counterpart: The benefit of emotion recognition accuracy in negotiation. Journal of Nonverbal Behavior, 31(4): 205–223.doi: 10.1007/s10919-007-0033-7

European e-Skills Forum (2004). E-Skills for Europe: Towards 2010 and beyond. European Commission Enterprise and Industry Directorate-General Unit D4: E-business, ICT industries and services, Brussels. Retrieved from http://europa.eu.int/comm/enterprise/ict/policy/ict-skills.htm

Ferris, G.R., Treadway, D.C., Kolodinsky, R.W., Hochwarter, W.A., Kacmar, C.J., Douglas, C. & Frink, D.D. (2005). Development and validation of the political skill inventory. Journal of Management 31(1):126–152.

Ferris, G.R., Treadway, D.C., Perrewé, P.L., Brouer, R.L., Douglas, C. & Lux, S. (2007). Political skill in organizations. Journal of Management 33(3), 290–320.doi: 10.1177/0149206307300813

Khan,G.F., Moon, J., Rhee, C.& Rho, J.J. (2010). E-government skills identification and development: Toward a staged-based user-centric approach for developing countries. Asia Pacific Journal of Information Systems, 20 (1), 1-31.

InfoDev and CDT - Center for Democracy and Technology (2002). The e-government handbook for developing countries. A project of InfoDev and the Center for democracy &technology, Washington DC. Retrieved from http://www.infodev.org/en/Document.16.pdf

López-Bassols, V. (2002). ICT skills and employment. OECD Science, Technology and Industry Working Papers, OECD Publishing. doi: 10.1787/110542373678

Lucking, R.(2003). Lessons on best practice in the approach to effective civil service training: A comparative study of selected countries from Central and Eastern Europe and the Former Soviet Union 1989 to 2003. UNDP, New York. Retrieved from http://unpan1.un.org/intradoc/groups/public/documents/UNTC/UNPAN012894.pdf

Ma, S.K. (2004). Introduction: Civil service training. International Journal of Public Administration 27 (3–4), 147–149.

Machin, S. (2001). The changing nature of labour demand in the new economy and skill-biased technological change. Oxford Bulletin of Economics and Statistics, 63 (s1), 753–776. doi: 10.1111/1468-0084.63.spe1.8

Molnár, S. (2006). eGovernment in the European Union. Network for Teaching Information Society, NETIS.

Nalbandian, J.& Nalbandian, C.(2003). Meeting today's challenges: Competencies for the contemporary local government professional. Public Management (00333611), 85 (4), 11-15.

OECD (2001), Education Policy Analysis 2001.OECD Publishing, Paris. doi:10.1787/epa-2001-en

OECD - Organisation for Economic Co-operation and Development (2003). The e-government imperative. OECD Publishing, Paris.doi:10.1787/9789264101197-en

OECD - Organisation for Economic Co-operation and Development (2005).E-government for better government. OECD Publishing, Paris. doi:10.1787/9789264018341-en

Rubin, R.S., Munz, D.C.& Bommer, W.H.(2005). Learning from within: The effects of emotion recognition and personality on transformational leadership behaviour. Academy of Management Journal 48(5), 845–858. doi: 10.5465/AMJ.2005.18803926

Shin, S., Song, H. & Kang, M. (2008). Implementing e-government in developing countries: Its unique and common success factors. Paper presented at the APSA 2008 Annual Meeting, Hynes Convention Center, Boston, Massachusetts. Retrieved from http://www.allacademic.com/meta/p280176_index.html

Skills Investment Strategy (2003). Supporting the Development of a Skilled Workforce in Alberta. Alberta Human Resources and Employment Labor Force Partnerships and Skills Policy Branch Alberta, USA. Retrieved from http://www.gov.ab.ca/hre

Tessema, M.T., Soeters, J.L., De Groot, G. & Tesfaselassie, M.F. (2007). Managing civil service training institutions: What lessons can countries learn from Singapore? International Journal of Human Resources Development and Management, 7(3), 300–318. doi:10.1504/IJHRDM.2007.017136

UN - United Nations (2003). Global E-government Survey. Retrieved from http://www.unpan.org

UN - United Nations (2005). Global E-government Readiness Report 2005 - From e-government to e-inclusion. Retrieved from http://www.unpan.org

UN - United Nations (2012). Global E-Government Survey 2012 - E-Government for the People. Retrieved from http://www.unpan.org

Vigoda-Gadot, E.& Meisler, G.(2010). Emotions in management and the management of emotions: The impact of emotional intelligence and organizational politics on public sector employees. Public Administration Review, 70 (1), 72-86.doi: 10.1111/j.1540-6210.2009.02112.x

West, D.M. (2001). WMRS global e-government. Taubman Centre for Public Policy, Brown University, Providence, Rhode Island, USA. Retrieved from http://www.InsidePolitics.org

World Bank (2005). Definition of e-government. Retrieved from http://www1.worldbank.org/publicsector/egov/definition.htm

INTERNATIONAL PERFORMANCE MANAGEMENT – ISSUES AND CHALLENGES

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Abstract: *Having in mind that human resources are considered the most valuable resource for a company, monitoring and assessing performance of individual employees represents a task of great interest for every organization. However, these issues become much more complex in international environment. International performance management represents one of crucial functions of international human resource management (IHRM). The aim of this paper is to provide a more comprehensive perspective of the process of performance appraisal (as a central part of performance management) of employees in multinational companies (MNCs) - expatriates and host-country nationals. The paper seeks to address the issues related to the way of conducting this process in international settings; it explores and analyses common problems and challenges faced by multinational companies regarding this IHRM process in order to identify certain elements for improvement of international performance appraisal. Conclusion of the paper includes recommendations for best practice of performance appraisal in international context, mostly focusing on: formulation of well understood, valid and reliable goals and performance criteria, providing training for the raters, providing regular feedback, use of multi-rater system, etc. This paper may present value to multinational companies which need to manage various categories of employees intending to improve performance appraisal of their international employees in their foreign subsidiaries. Having in mind that there is limited research (both theortical and empirical) regarding performance appraisal in MNCs, this paper is expected to partially fill the existing gaps in the literature.*

Keywords*: performance management, performance appraisal, multinational company, human resource management, expatriate, host-country national*

1. INTRODUCTION

Globalization has created many challenges for Human Resource Management (HRM). Today organizations are paying much more attention to employee performance than ever before. International performance management represents one of crucial functions of international human resource management, attracting considerable interest of both academics and practitioners. Effective performance management is necessary to ensure that employees perform their jobs effectively in all units of a multinational company disseminated throughout the world. However, unlike other aspects of international HRM (such as staffing, training or compensation), there is limited research regarding performance management in international context (Shen 2004). The literature in this field is based more on empirical research than on theoretical concepts (Claus and Briscoe 2009). Most studies refer to domestic operations, while the results usually may not be applied in MNCs. Lack of research conducted in international performance management suggests that issues regarding this HRM function that have been identified in domestic context will be exaggerated in international context (Harvey, Novicevic and Speier 2002).

2. INTERNATIONAL PERFORMANCE MANAGEMENT

The term performance management appeared during the late 1980s (Lindholm 1999). It refers to identification, measuring, managing, and developing performance of human resources in an organization. It evaluates the achievement of pre-determined goals and targets. Dowling et al. (1999) define international performance management as strategic HRM process which enables a MNC to assess and continuously improve performance of individual employees, performance of foreign subsidiaries, as well as performance of the whole company according to clearly predefined goals directly related to MNC international strategy. Although this aspect of performance management is not often emphasised, it also represents a part of control system of a MNC, which, among other control mechanisms, enables a MNC to achieve coordination and consistency of desired behaviour and outcomes expected both in MNC headquarters and its foreign subsidiaries (Dowling and Welch 2006).

Performance management is often considered as an extension of performance appraisal. It is claimed that individual performance management includes goal setting, performance appraisal and providing feedback (Dowling and Welch 2006). Performance appraisal represents one of central parts of performance management (Tahvanainen 1998; Suutari and Tahvanainen 2002), representing a practice used for evaluation of past performance of an individual employee. So, it can be defined as an ongoing process in which employee performance is being reviewed and evaluated. However, performance management also includes other important components beside performance appraisal, such as: strategic planning, communication of organizational strategy through individual objective setting, job analysis and design (aimed at identification of performance requirements in a particular job), feedback and monitoring, training and development, motivating employees, employee relations and compensation (Vance and Paik 2006). So, it may be claimed that performance management includes a systematic analysis and assessment of employee performance, as well as communication of that assessment to the employee aimed at improving performance over time.

3. PERFORMANCE APPRAISAL OF INTERNATIONAL EMPLOYEES

It is necessary to measure individual performance on a job, regarding employee's behaviour or outcome during a specific period of time (Tahvanainen 1998). Performance appraisal is often viewed as one of HRM topics most widely debated and studied (Wright 2002). Performance appraisal represents an evaluation of the output of an individual measured periodically against specific expectations. Performance appraisals can be a critical part of organization's success because they allow the company to retain and reward high performers (Smith and Rupp 2003).

Having in mind that performance appraisal done in a domestic context is already a very complex process, conducting performance appraisal is even more challenging in the global environment - managing employees originating from different countries and cultures makes it difficult. International performance appraisal mainly focuses on two categories of employees: host-country nationals and expatriates; although the majority of research within the area of international performance appraisal is focused on performance appraisal of expatriates. The nature and the way of conducting of performance appraisal in MNC subsidiaries are considered to be influenced by HRM strategy and structure in the company (Maley and Kramar 2007).

Performance appraisal enables a multinational company to observe, monitor and evaluate individual performance of its employees in the workplace in relation to pre-defined standards, as well as their contribution to the success of the company. Performance can be defined by following key elements: goals, measures, assessment and feedback to employees at all levels. Appropriate implementation of this process is expected to reduce the inconsistencies in information between MNC headquarters and its host-country subsidiaries. Good performance appraisal is supposed to enable efficient control of MNC subsidiaries and to emphasize orientation at organizational goals at all hierarchical levels (Schlegel and Britzelmaier 2011), as well as to provide a realistic evaluation of international operations in order to motivate the subsidiaries to improve their performance in the future (Schmid and Kretschmer 2010).

It is often claimed that performance appraisal is used for two main purposes: to help managers to make administrative decisions (particularly referring to compensation packages and promotions - including expatriation) and to accomplish developmental objectives (regarding training and development of employees) (Brumback 1988). However, many other purposes of performance appraisal have been defined in the literature, such as assessing employee efficiency in the workplace, recognition of individual performance, improving employee performance, as well as providing information for managers' decisions regarding rises in salary, promotions, training and development opportunities, selection of employees (especially regarding selection of expatriates), retention and termination decisions. From the perspective of an individual employee the uses of performance appraisal include the following: identification of individual strengths and weaknesses, identification of individual training needs, making decisions regarding determining transfers (to international assignment) etc. In practice performance appraisals often influences other HRM systems in an organization - HR planning, determining organizational training needs, evaluating achievement of goals or identifying organizational development needs.

4. CHALLENGES OF CONDUCTING INTERNATIONAL PERFORMANCE APPRAISAL

Although performance appraisal systems represent such an important part of human resource management system they are still not completely understood and appreciated (Abu-Doleh and Weir 2007) in multinational companies.

There are various problems related to the process of conducting performance appraisal in international settings. The literature has identified main failures in this field, mainly focusing on the following. There is usually a lack of formal and universal performance appraisal system for evaluating performance of expatriates (Bonache et al. 2001) and lack of agreement among researchers regarding the most effective and objective criteria for evaluating performance and what constitutes effective (or satisfactory) evaluation (Maley and Kramar 2007). Competences and bias of the rater are often considered as a challenging issue in international performance appraisal (Woods 2003).

It is also difficult to isolate only job-related factors in conducting performance appraisal in international settings (Dowling et al. 1994; Gregersen et al. 1996). Numerous studies attempted to discover key attributes which should be possessed by an individual in international assignment in order to complete it successfully; although, researchers still have not agreed on universally accepted answers to these questions (Schmid and Kretschmer 2010). This has resulted in MNCs measuring some attributes and behaviours of international employees which are inappropriate which may lead to dissatisfaction of international employees regarding their appraisals.

It is often claimed that multinational companies tend to assess the abilities of their employees in terms of technical competencies. However, it has been often noticed that technical competences may not be considered as sufficient criteria for success in international operations of MNCs (Dowling and Welch 2006). Research suggests that the use of certain qualitative criteria may be better methods for assessing effectiveness of performance appraisal in international context (Milliman, Taylor and Czaplewski 2000). These criteria may refer to evaluation of individual attributes of international employees, such as: personal attitude, cultural awareness, global (geocentric) perspective, cross-cultural skills (communication skills, learning skills, adaptability, tolerance) (Harvey i Moeller 2009).

One of the common challenges of international performance appraisal refers to the existence of a gap between the evaluations of the rater and the rate. Performance appraisal in multinational companies represents a very complex process, as there is no best way to evaluate performance of a geographically distant employee performing a job in environment not fully understood by the rater (Shen 2004) - geographic distance between the rater and rate often makes performance appraisal process difficult. Other factors which can increase the complexity of an international performance appraisal include: differences in socioeconomic and legal environment, different norms and policies, cultural differences, language barriers, time zone differences, gender or social status (Appelbaum et al. 2011). These factors can sometimes increase the gap between the rater and the ratee, which may result in unfair performance appraisal process from the perspective of the rate in the foreign subsidiary - whether expatriate or local employee (Piggot-Irvine 2003).

Research has demonstrated that employee perceptions regarding the fairness of their performance appraisals are useful determinants of success of performance appraisal systems (Erdogan et al. 2001). These perceptions often influence employee attitudes and behaviours (Narcisse and Harcourt 2008) and may result in employee resentment or unhappiness (Abu-Doleh and Weir 2007). Literature lists three categories of employee perceptions of fairness - distributive, procedural and interactional (Erdogan et al. 2001). Narcisse and Harcourt (2008) explain that distributive fairness of performance appraisal refers to relation between perceived justice of outcomes of the appraisal (ratings) and actual work performed; procedural fairness focuses on the perceived justice of performance appraisal procedures used; while interactional fairness refers to the perceived fairness of the interpersonal treatment of employees during the performance appraisal process.

5. RECOMMENDATIONS FOR IMPROVEMENT OF INTERNATIONAL PERFORMANCE APRAISAL

Researchers have agreed upon the importance of international performance appraisal process, but there seems to be a lack of agreement on the best practices to conduct this process in international context (Appelbaum et al. 2011). Designing and implementation of performance appraisal system (or improvement of an existing process) is never a simple and easy task. Various issues concerning implementation of this system might arise, such as: aspects of performance which are being assessed; way of defining or describing employee performance; criteria used for performance appraisal; type of scales used for evaluation; raters who conducts the appraisal; as well as the frequency of conducting performance appraisal (Abu-Doleh and Weir 2007).

It has been noted that satisfaction with the performance appraisal system by employees in international settings is more likely to be higher in the following situations: when the appraisal has a clearly defined purpose in the company (Lindholm 1999), when employees perceive performance appraisal to be fair (Bradley and Ashkanasy 2001), when there is regular communication and positive relationship between the

rate and the rater (Milliman et al. 2002) and when there is timely and accurate feedback (Sully De Luque and Sommer 2007).

Having in mind that performance appraisal is often considered to have a direct influence on job satisfaction and motivation of workers (Rusli and Nur Azman 2004), in order to achieve effective performance appraisal it is necessary to create an environment full of trust and open relationships between raters and ratees (supervisors and employees). Face-to-face communication between the rater and rate is often considered necessary for building the mutual trust; in order to enable this regular contacts between the rater and the ratee should be arranged (whether through regular visits of the rater to the foreign subsidiary where the rate is located or through the use of information communication technologies).

Performance appraisal needs to be based on valid and reliable criteria (Harvey and Moeller 2009). These criteria should be easy to access and understand and they should be motivating for all international employees regardless of their nationality (Shen 2004). Performance appraisal system has to be fair and to ensure equal treatment for different international employees within the same company (Woods 2003). Both employees whose performance is assessed and the supervisor (the rater) need to understand the purpose of conducting performance appraisal in the company. It is necessary that MNC provides competent raters in order to decrease the possibility for bias in conducting the appraisal. However, formulating objective performance measures that are both valid and reliable can be problematic.

The performance appraisal measures and the way of conducting this process are supposed to be well understood across the organization. It is crucial that the expatriate's and HCN's expectations are consistent with the expectations of the MNC. Employees (both expatriates and host-country nationals) need to know what they are expected to do in a particular assignment. Effectiveness of performance appraisal increases when goals are formal and written (Claus and Briscoe 2009). Employees should be included in the process of setting the goals. Regarding performance appraisal of expatriates, this process should be done during the international assignment (and not after repatriation).

Appelbaum et al. (2011) recommend that performance appraisal in a global environment should be done by 360 degree or multi-rater system, which allows the rater (manager) to receive feedback on ratee's (employee's) performance from various sources. In order to ensure appropriate use of performance appraisal and to decrease the possibility for errors regular trainings need to be provided for the raters in the following fields: setting goals and performance standards, coaching, counselling, conflict resolution, providing employee feedback. It is also important to emphasize the necessity for the manager (the rater) to take into account cultural differences between MNC home and host country when evaluating performance of a particular employee.

Feedback has been found to be a crucial part of a successful international performance appraisal. Regular provision of performance feedback is especially important in international context, where ratee (employee) and rater (manager or supervisor) are not located in the same country (Milliman et al. 2002; Sully De Luque and Sommer 2007). It is considered to be a key determinant for achieving talent development of diverse employees in MNCs (Sully De Luque and Sommer 2007). In case when employees receive feedback more frequently, they usually expected to perceive performance appraisal process to be more precise and timely. However, in practice international employees often do not receive performance feedback and might feel a lack of opportunity to discuss various problems (such as their career or personal needs) with their raters.

6. CONCLUSION

Literature review suggests that various issues may be related with inappropriate conducting of performance appraisal process in multinational companies. These issues and challenges mainly appear due to complexity of performance appraisal of international employees. However, elements for improvement of performance appraisal systems in MNCs have been identified in the paper. A performance appraisal system designed in suggested manner (in order to implement the proposed changes) may be successful and effective and lead to increased employee motivation and satisfaction, trust and commitment to work.

REFERENCES

Abu-Doleh, J. & Weir, D. (2007). Dimensions of performance appraisal systems in Jordanian private and public organizations. International Journal of Human Resource Management, 18(1), 75-84. doi:10.1080/09585190601068334

Appelbaum, S.H., Roy, M. & Gilliland, T. (2011). Globalization of performance appraisals: theory and applications. Management Decision, 49(4), 570-585. doi:10.1108/00251741111126495

Bonache, J., Brewster, C. & Suutari, V. (2001). Expatriation: A Developing Research Agenda. Thunderbird International Business Review, 43(1), 3–20. doi:10.1002/1520-6874(200101/02)43:1<3::AID-TIE2>3.0.CO;2-4

Bradley, L. & Ashkanasy, N. (2001). Formal performance appraisal interviews: Can they really be objective, and are they useful anyway? Asian Pacific Journal of Human Resources, 39(2), 83-97. doi:10.1177/103841110103900206

Brumback, G. (1988). Some Ideas, Issues and Predictions about Performance Management. Public Personnel Management 17(4), 387–402.

Claus, L. & Briscoe, D. (2009). Employee Performance Management Across Borders: A Review of Relevant Academic Literature. International Journal of Management Reviews, 11(2), 175–196. doi:10.1111/j.1468-2370.2008.00237.x

Dowling, P.J., Schuler, R.S. & Welch, D. (1994). International Dimensions of Human Resources Management (2nd ed.). New York: Wadsworth.

Dowling, P.J. & Welch, D.E. (2006). International Human Resource Management: Managing People in a Multinational Context (4th ed.). London: Thomson.

Dowling, P.J., Welch, D.E. & Schuler, R.S. (1999). International Human Resource Management: Managing People in a Multinational Context (3rd ed.). Cincinnati: South–Western College Publication.

Erdogan, B., Kraimer, M.L. & Liden, R.C. (2001). Procedural Justice as a Two-Dimensional Construct: An Examination in the Performance Appraisal Context. The Journal of Applied Behavioral Science, 37(2), 205–222. doi:10.1177/0021886301372004

Gregersen, H.B., Hite, J.M. & Black, J.S. (1996). Expatriate Performance Appraisal in U.S. Multinational Firms. Journal of International Business Studies, 27(4), 711–738. doi:10.1057/palgrave.jibs.8490150

Harvey, M. & Moeller, M. (2009). Expatriate Managers: A Historical Review. International Journal of Management Reviews, 11(3), 275–296. doi:10.1111/j.1468-2370.2009.00261.x

Harvey, M., Speier, C. & Novicevic, M. (2002). The Evolution of Strategic Human Resource Systems and their Application in a Foreign Subsidiary Context. Asian Pacific Journal of Human Resources, 40(3), 284-300. doi:10.1177/1038411102040003254

Lindholm, N. (1999). National culture and performance management in MNC. International Studies of Management and Organizations, 29(4), 45-66.

Maley, J. & Kramar, R. (2007). International Performance Appraisal: Policies, Practices and Processes in Australian Subsidiaries of Healthcare MNCs, Research and Practice in Human Resource Management, 15(2), 21-40. doi:10.1108/17574321111116388

Milliman, J., Taylor, S., & Czaplewski, A. (2000). Performance feedback in MNC: opportunities for organizational learning. Human Resource Planning, 25(3), 29-44.

Milliman, J., Nason, S., Zhu, C., & De Cieri, H. (2002). An Exploratory Assessment of the Purposes of Performance Appraisals in North and Central America and the Pacific Rim. Asia Pacific Journal of Human Resources, 40(1), 87-107. doi:10.1177/1038411102401007

Narcisse, S. & Harcourt, M. (2008). Employee fairness perceptions of performance appraisal: a Saint Lucian case study. International Journal of Human Resource Management, 19(6), 1152-1169. doi:10.1080/09585190802051451

Piggot-Irvine, E. (2003). Appraisal training focused on what really matters. The International Journal of Educational Management, 17(6), 254-261. doi:10.1108/09513540310487587

Rusli, A. & Nur Azman, A. (2004). Performance Appraisal Decision in Malaysian Public Service. International Journal of Public Sector Management, 17(1), 48–64. doi:10.1108/09513550410515565

Schlegel, D. & Britzelmaier, B. (2011). Business Strategy as a Situational Factor of Subsidiary Performance Management. International Journal of Management Cases, 13(3), 217–226.

Schmid, S. & Kretschmer, K. (2010). Performance Evaluation of Foreign Subsidiaries: A Review of the Literature and a Contingency Framework. International Journal of Management Reviews, 12(3), 219–258. doi:10.1111/j.1468-2370.2009.00259.x.

Shen, J. (2004). International Performance Appraisals: Policies, Practices and Determinants in the Case of Chinese Multinational Companies. International Journal of Manpower, 25(6), 547–564. doi:10.1108/01437720410560442

Smith, A. and Rupp, W. (2003). Knowledge Workers: Exploring the Link among Performance Rating, Pay and Motivational Aspects. Journal of Knowledge Management, 7(1), 107–124. doi:10.1108/13673270310463662

Sully De Luque, M.F. & Sommer, S. (2007). The impact of culture on feedback seeking behavior: an integrated model and propositions. Academy of Management Review. 25(4), 829-849. doi:10.5465/AMR.2000.3707736

Suutari, V. & Tahvanainen, M. (2002). The antecedents of performance management among Finnish expatriates. International Journal of Human Resource Management, 13(1), 1-21. doi:10.1080/09585190110092794

Tahvanainen, M. (1998). Expatriate Performance Management. Helsinki: Helsinki School of Economics Press.

Vance, C.M. & Paik, Y. (2006). Managing a global workforce: Challenges and Opportunities in International Human Resource Management. Armonk, NY: M.E.Sharpe.
Wright, R. (2002). Perceptual Dimensions of Performance Appraisal Management Systems in the Eyes of Different Sample Categories. International Journal of Management, 19(2), 184–193.
Woods, P. (2003). Performance Management of Australian and Singaporean Expatriates. International Journal of Manpower, 24(5), 517–534. doi:10.1108/01437720310491062

THE PRACTICE OF PERFORMANCE BASED PAY IN CENTRAL AND EASTERN EUROPE

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Abstract: *Employee's pay is one of the most mentioned factors of organizational motivational system. In contemporary business pay usually includes variable and fixed component. Fixed component is an element of the total reward, which usually is not influenced by employees' performances, and it is based on the organization's pay philosophy and structure. Variable parts of the reward are monetary or non-monetary elements such as bonuses, incentives, benefits, financial participation or some other non-monetary value for employees (work autonomy, training and development possibilities, work quality improvements, recognition). For the purpose of this study the practice of variable pay, based on data from CRANET research, was explored. The main goal of this research was to present the trend in performance based pay in countries in Central and Eastern Europe. The subject of the research was variable pay, consisting of financial participation and performance based pay, where authors decided to analyse four elements of performance based pay: bonus based on individual goals, bonus based on team goals, pay for performance and flexible benefits (as relatively new way of rewarding employees). The methodology and data used in the research was based on the CRANET project, where authors used existing data about HRM activities in organizations all over the world. For the purpose of the analysis author used data for 1147 organizations from 8 countries of the Central and Eastern Europe, Bulgaria, Czech Republic, Slovakia, Slovenia, Serbia, Hungary, Estonia, and Lithuania. Descriptive statistics and chi square were used to analyse performance based pay in specific sample of counties.*

Keywords*: performance based pay, variable pay, bonus, incentives, Cranet, Central and Eastern Europe*

1. INTRODUCTION

Employees' compensation, especially performance based pay, has always been a subject of many researches and debates in the world (Chiu et al., 2002; Weibel et al., 2010; Larkin et al., 2012; Bryson et al., 2012; Kalmi et al., 2012; Gupta and Shaw, 2014) and in domestic scientific and professional literature (Malinić, 2007; Bogićević-Milikić, 2007; Štangl-Šušnjar and Leković, 2009; Štangl-Šušnjar and Slavić, 2012; Berber, 2013; Janićijević, 2013). Connecting rewarding activities like human resource management and performance of employees, their satisfaction and organizational commitment indicates the importance of compensation and all other related activities for employees. Many authors state that the employees' compensation affects attraction of young talented employees and retaining existing staff in the organization.

The purpose of this paper was to explore the practice of performance based pay in organizations in several countries of Central and Eastern Europe. The subject of the research was variable pay, consisting of financial participation and performance based pay, where four elements of performance based pay: bonus based on individual goals, bonus based on team goals, pay for performance and flexible benefits (as relatively new way of rewarding employees) were explored and analysed. The methodology and data used in the research was based on the CRANET project, where authors used existing data about HRM activities in organizations all over the world. For the purpose of this analysis, there have been used data for 1147 organizations from 8 countries of the Central and Eastern Europe: Bulgaria, Czech Republic, Slovakia, Slovenia, Serbia, Hungary, Estonia, and Lithuania. Descriptive statistics, t-test and chi square were used to analyse performance based pay in specific sample of counties.

The paper was composed from three parts. In the first part of the research there have been made a research of available theoretical literature on incentive pay, where special attention was dedicated to the performance based pay. In the second part of the research there have been presented methodology and data used in the analysis, while the third part was consisted from the results and discussion.

2. THEORETICAL BACKGROUND

Variable salary may be understood as a reward paid to an employee for a partial or complete achievement of predetermined work assignment. This part of the overall compensation is variable in the sense that it varies in relation to the objectives and standards - organizational, group or individual goals. This type of reward points to the importance and correlation between effort and performance, on the one hand, and the rewards, on the other. Incentives are very important for any organization because they are the primary way to encourage desired behaviour among members of the organization (Jensen et al., 2009, p. 59). The goal of any incentive payment is to increase productivity and performance levels of employees, and to sure that one system of incentives is effective, it is necessary to be based on the following assumptions:

- Individual workers differ from work teams in terms of contribution to the organization, in terms of what they do and how they perform work activities.
- Overall organizational performance largely depends on the individual and group performance.
- In order to attract, retain and motivate those employees who achieve high levels of performance and achieve fairness against all employees, there is a need to reward employees based on their performance (Martochioo, 2009, p. 129).

Performance-based pay can be considered from different aspects. It can be a pay based on individual performance, team performance and organizational unit or the company. Pays are determined on the basis of realized production volume, cost saving, satisfied standard quality, as well as the result - profit increase (Štangl-Šušnjar and Leković, 2009, p. 1). Gittleman and Pierce in their study analysed pay based on performance as production bonuses and non-production bonuses, where production bonuses are commissions and piece rates, and non-production bonuses are employment incentive bonuses, performance based awards, recognition awards, and union-related bonuses (2013, p. 35).

Table1: Forms of pay for performance plans

	Individual	Collective
Fixed	Merit pay	
	Skill- or competency-based pay	
	Promotion	
Variable	Payment by results	Performance-related pay
	Piece-rate pay	Financial participation
	Commissions	Gain-, goal- and profit sharing
	Bonuses	Ownership
	Individual incentives	Group incentives

Source: Salimaki and Heneman, 2008, str. 159.

From table 1 it is obvious that pay for performance, or performance based pay, takes several forms, but the most important are individual incentives and bonuses, while in collective those are performance based pay and financial participation.

During researches in the past there has been found many differences in these plans. The number of such differences is crucial to the success of performance-related pay. The authors in this area identified several dimensions on which differences may arise in this part of the variable salary:

- ~~I~~s pay based on organizational, group, or individual performance?
- Is pay based on objective measures such as piece-rate or subjective measures such as supervisory ratings?
- What proportion of pay is variable?
- How big are performance-based pay differences between good and bad employees?
- Are pay criteria clearly specified to employees in advance?
- Is there a policy of pay secrecy?
- In group-level performance-based pay plans, is pay distributed to group members equitably or equally?
- Is performance-based pay supplemented with other rewards?" (Gupta and Shaw, 2014, p. 3).

Gerhart and Fang classified pay for performance programs on three dimensions: ~~t~~he emphasis on results-oriented (physical production output, sales, profits, total shareholder return) or behaviour-oriented performance (supervisor or customer ratings of specific behaviours) measures, the emphasis on performance measured at the individual employee or aggregate (group, unit, organization) level, and the degree of incentive intensity. According mentioned authors, all private sector organizations in the United States and in many other countries usually use multiple pay for performance plans with the design based on

factors such as job level, type of occupation, the way the work is organized, and the organization's strategy" (2014, p. 41).

Since the most common classification of variable pay is on short-term and long term incentives, authors described these two categories.
Namely, short term incentives are remuneration linked to short-term goals of the organization – usually annual, monthly or quartile financial performance of the organization. The most common example, both in theory and in practice, is bonus. Bonus is a reward usually paid to individuals for above-average performance; it can be a fixed amount or a percentage of a basic salary. It is always paid once, and it is related exclusively to the efforts made and the results obtained. Each new bonus is necessary to earn, this kind of reward involves continuous monitoring and measurement of employee performance. In practice, companies differ in the short-term bonuses in the way of payment, but all boil down to the same fact that these are rewards associated with specific effects, which are paid once, and as a percentage of the basic salary. In addition, bonuses may be paid based on individual and team performance, which is especially interesting for this research. Namely, in the past research related to the team or individual bonuses, the variable pay was preferable if it comes to be incentives for performance of the individual, rather than collective (team) and organizational performance. Employees are more optimistic about the probability of obtaining incentives if the variable pay is based on the performance of individuals (Kuhn and Yockey, 2003, p. 323).

Long-term incentives are related to the payments for achieving long-term goals of the organization, and include those payments that are related to economic value, profitability, market share, etc. The most common categories of employees who were awarded these types of incentives are managers. Long-term incentives commonly include financial participation in the ownership of the organization. Providing capital means involving employees in the capital structure of the organization, through stocks. Specifically, when an employee owns shares of companies, in which he is employed, it comes to the development of employee ownership culture, and to the better alignment of organizational and personal goals. Share based plans, stock options and profit-sharing are the most common forms of long-term incentives (Štangl-Šušnjar and Berber, 2014).

2.1. The Practice of Performance Related Pay in Europe

In the study of incentive pay in the world, authors Bryson, Freeman, Lucifora, Pellizzari and Perotin indicated that the variable pay is used in about 10-15 per cent of organizations in some Mediterranean countries (Portugal and Greece), Continental Europe (Belgium and Germany) and Anglo-Saxon countries (UK and Ireland), 30% and over 40% in the Nordic countries (Sweden and Finland) (2012, p. 3). These data are referred to the period of the 2000th to 2006th year.

On the other hand, researchers from Hungary and CEE countries (from the Cranet research period from 2004-2005) found that variable pay related to the specific level of performances is given far more often to all staff categories than financial participation, where profit sharing was mostly used (Karoliny et al., 2009). In the case of managerial compensation, European authors have demonstrated a strong impact of the regulatory environment on share-based compensation plans in the region, where state shareholding has a major impact on the existence of such schemes in Polish public corporations, which could be considered as evidence of the rigid, direct regulation of executive pay in contrast to the Czech and Hungarian practice (Festing and Sahakiants, 2011).

Berber and Štangl-Šušnjar (2013) performed a research on the compensation for professional workers, based on the Cranet data from 2008/2010, and found that performance related pay is used more often than financial participation in the case of professionals' rewards in the companies from the CEE region, similar to the results of Karoliny, Farkas and Poór from 2009 but instead of performance based pay, bonuses based on team goals are the most common form of professionals' rewards in the area of variable pay.

Performance based pay has been explained as a selection device and a response to heterogeneous worker preferences. Authors from UK explored the relation between the size of organization and performance based pay. Using a large Portuguese data panel in the analysis mentioned authors found that large firms are more likely to use performance related pay and pay higher wages (Coelho et al., 2011). Authors from Europe found that there are significant differences in the distribution of incentive pay schemes by firm size. Incentive pay is more common in large organizations, usually for professional workers (Bryson et al., 2012, p. 7).

After a brief overview of the most important attitudes related to the payment based on performance, it is analysed the current practice of rewarding in the world. Specifically, the research team of CRANET in the period 2003/2005 explored the level of use of the performance based pay in organizations that were involved

in the project. According Brewster, Sparrow and Vernon (2007, p. 133-135) there have been observed the following phenomena associated with the use of rewards based on performance:

- Usage of the incentives for individual performance for manual workers was the highest in Slovakia and Switzerland, over 35 % of organizations. Countries such as Canada and Sweden used this approach less than 10 %, while countries such as Turkey, Australia and the United States less than 15 %.
- Usage of the incentives for individual performance for administrative workers was the largest in Italy, almost 50%, followed by Greece, Switzerland, Slovakia, Germany, France and Austria, more than 35%. Countries like Sweden used this approach only in 10% of organizations.
- In Finland, a country with a strong unions and collective bargaining, there are a significant proportion of payments based on performance and in manual and in administrative staff.
- Similarly, for team performance for manual workers - the largest share of this approach had Slovakia and Italy, followed by Finland, while the rest of the surveyed countries used this form in less than 15 - 17%.

3. METHODOLOGY, DATA AND HYPOTHESES

Based on the previously discussed researches related to the incentive compensation, and in accordance with the available data and variables, two hypotheses were proposed.

> *H0: Organizations from the CEE region use performance related pay based on individual level more than incentives based on team level.*
>
> *H1: Larger organizations from the CEE region use performance related pay more than smaller organizations.*

The present comparative analysis of compensation was based on the worldwide data of the Cranet international network of business schools. This international organization organizes comparative researches on the policies and practices of human resource management, using a standardized questionnaire. The survey is undertaken approximately every four years with the purpose to provide high quality data for academics, public and private sector organizations, as well as HRM students, and to create new knowledge about human resource management practice in different countries of the world. The questionnaires are filled out by the HRM executives of companies with more than 50 employees. The Cranet questionnaire is divided into six sections (Parry et al. 2013, p. 4). Section IV on Compensation and benefits contains questions about the level of basic pay and bonus schemes, as well as on schemes in excess of statutory requirements. The research data were processed using SPSS software and MS Office EXCEL programme, using descriptive statistics and chi square test.

The objectives of this paper were to find out the level of usage of different variable elements of pay in compensation packages for managers, professionals, clericals and manuals in countries of CEE. The subject of the research was variable pay, consisting of financial participation and performance based pay, where authors decided to analyse four elements of performance based pay: bonus based on individual goals, bonus based on team goals, pay for performance and flexible benefits (as relatively new way of rewarding employees). Respondents were asked to give answers whether they use (yes) or not (no) four elements of performance related pay.

The Cranet 2008/2011 dataset was collected in 32 countries. In this paper the authors used data from 8 CEE countries (Bulgaria, Czech Republic, Estonia, Lithuania, Hungary, Slovakia, Serbia and Slovenia) to perform a deeper analysis of incentive compensation, with a total of 1147 organizations. In Serbia this research was done in 50 companies from the whole country, with 17,064 employees. Table 1 presents the sample.

Table 2: The sample structure

	Frequency	Percentage	Cumulative Percentage
Bulgaria	267	23,3	23,3
Czech Republic	54	4,7	28,0
Estonia	74	6,5	34,4
Hungary	139	12,1	46,6
Lithuania	119	10,4	56,9
Slovakia	225	19,6	76,5
Slovenia	219	19,1	95,6
Serbia	50	4,4	100,0
Total	**1147**	**100,0**	

Source: Authors analysis based on CRANET data

4. RESULTS OF THE ANALYSIS

To explore the usage of the variable pay elements related to performance based pay authors used crosstabs technique. The results are given in following tables.

Table 3: Performance based pay for managers and professionals in CEE region

Countries	Managers				Professionals			
	Flexible benefits	Performance based pay	Team bonus	Individual bonus	Flexible benefits	Performance based pay	Team bonus	Individual bonus
Bulgaria	28.6	49.0	44.1	53.6	23.9	53.7	41.4	50.2
Czech Republic	42.6	37.0	38.9	53.7	40.7	35.2	44.4	48.1
Estonia	63.6	65.2	49.2	66.1	59.1	71.6	48.3	72.6
Hungary	49.6	41.0	29.5	56.8	48.2	43.2	34.5	49.6
Lithuania	31.1	42.9	41.2	48.7	26.9	52.1	42.0	56.3
Slovakia	24.7	53.2	43.5	54.9	19.0	56.9	40.3	53.6
Slovenia	61.7	76.4	42.0	77.5	54.1	75.5	44.6	78.8
Serbia	18.8	80.5	43.8	43.8	16.1	76.7	37.5	46.9
Total	**37.9**	**53.7**	**42.1**	**58.2**	**32.3**	**55.1**	**43.0**	**57.7**

Source: Authors analysis based on CRANET data

Table 4: Performance based pay for clericals and manuals in CEE region

Countries	Clericals				Manuals			
	Flexible benefits	Performanc e based pay	Team bonus	Individual bonus	Flexible benefits	Performance based pay	Team bonus	Individual bonus
Bulgaria	22.1	47.2	30.7	40.8	18.8	49.8	32.3	44.8
Czech Republic	38.9	27.8	37.0	37.0	33.3	44.4	35.2	24.1
Estonia	47.3	61.4	45.5	59.3	47.3	49.1	33.3	58.3
Hungary	43.9	33.1	24.5	37.4	36.7	41.0	25.9	33.1
Lithuania	24.4	31.1	27.7	46.2	16.0	35.3	32.8	39.5
Slovakia	17.2	49.8	36.9	44.2	13.6	56.8	31.8	35.8
Slovenia	48.0	70.5	36.2	71.6	44.2	72.3	40.7	71.5
Serbia	13.8	70.7	22.6	34.4	7.1	71.1	20.0	31.3
Total	**28.5**	**48.3**	**34.4**	**46.4**	**25.0**	**50.2**	**33.5**	**44.1**

Source: Authors analysis based on CRANET data

From tables 3 and 4 it is obvious that incentives based on individual goals are more used than bonuses based on team performances. Namely, in table 3 there were analysed four elements of performance based pay for managers and professionals, while in table 4 those were clericals and manuals. More organizations use individual bonuses (for managers 58.2%, professionals 57.7%, clericals 46.4% and manuals 44.1% of organizations) than team based bonuses (for managers 42.1%, professionals 43.0%, clericals 34.4% and manuals 33.5% of organizations) in their compensation policy. Also, from these tables it can be concluded that flexible benefits are used less than other elements of incentive pay, which was expected, since those are relatively new elements of rewards, especially in compensation systems of transition and post-transition countries in CEE region. Performance related payments in terms of incentives are used more for professionals and manuals (55.1% and 50.2%, respectively) than for managers and clericals (53.7% and 48.3%, respectively). From tables 3 and 4 it is also evident that there is diversity among countries when the performance related pay is in question. In case of flexible benefits, organizations from Estonia, Slovenia, Czech Republic and Hungary experienced greater usage of these benefits in comparison with Bulgaria, Lithuania, Slovakia and Serbia. Also, this diversity is evident in case of all other three elements of performance related pay, but in some smaller degree than in case of flexible benefits. In addition, from table it is evident that the greatest usage of performance related pay is for the category of managers, then for professionals and clericals, while the lowest level of the usage of these elements is for manual workers.

For the purpose of testing first hypothesis (H1) authors used chi square test. Variables used in test were elements of performance based pay and size of organization (based on the number of employees). Results of the chi square test are given in table 5. The results pointed to the conclusion that, in case of the observed organizations, larger organizations use flexible benefits, performance based pay, team and individual bonuses in greater extent (percentage) than medium or small organizations. More detailed, in case of flexible benefits for all categories of workers chi square test showed that there are significant differences between large, medium and small organizations regarding the percentage of organizations that use flexible benefits (X^2 value and *p* value). If the p value is lower than 0.05, there is a significant association between size of companies and the usage of the performance related pay. Phi value shows that there are weak but positive correlation between the size and the level of the usage of performance related pay in CEE region. In case of incentives for performances (second element of PfP) there were found no significant association between size and PfP.

Table 5: Difference between the usages of performance related pay in CEE region regarding the size of organizations

	Flexible benefits for management		Chi square	Flexible benefits for professional		Chi square	Flexible benefits for clerical		Chi square	Flexible benefits for manual		Chi square
	No	Yes		No	Yes		No	Yes		No	Yes	
1-50	70,1%	**29,9%**	**X^2=34,362**	71,7%	**28,3%**	**X^2=26,033**	77,1%	**22,9%**	**X^2=32,879**	77,5%	**22,5%**	**X^2=25,313**
51-250	68,8%	**31,2%**		74,4%	**25,6%**		78,3%	**21,7%**		81,2%	**18,8%**	
251-1000	56,3%	**43,8%**		62,3%	**37,7%**	**Phi=0,162**	66,1%	**33,9%**		71,6%	**28,4%**	**Phi=0,166**
1000+	44,2%	**55,8%**	**Phi=0,185**	53,2%	**46,8%**		55,1%	**44,9%**	**Phi=0,182**	59,7%	**40,3%**	
	62,3%	**37,7%**	**p=0,000**	67,9%	**32,1%**	**p=0,000**	71,7%	**28,3%**	**p=0,000**	75,2%	**24,8%**	**p=0,000**
	Performance related pay for management		Chi square	Performance related pay for professional		Chi square	Performance related pay for clerical		Chi square	Performance related pay for manual		Chi square
	No	Yes		No	Yes		No	Yes		No	Yes	
1-50	56,1%	43,9%	X^2=7,46	50,3%	49,7%	X^2=3,741	64,1%	35,9%	**X^2=12,083**	54,5%	45,5%	X^2=3,919
51-250	43,2%	56,8%		41,9%	58,1%		47,6%	52,4%		46,9%	53,1%	
251-1000	46,1%	53,9%		46,4%	53,6%	Phi=0,060	51,5%	48,5%		49,6%	50,4%	Phi=0,064
1000+	46,9%	53,1%	Phi=0,085	45,5%	54,5%		52,3%	47,7%	**Phi=0,108**	54,8%	45,2%	
	46,3%	53,7%	p=0,058	44,9%	55,1%	p=0,291	51,7%	48,3%	**p=0,007**	49,8%	50,2%	p=0,270
	Bonus based on individual goals for management		Chi square	Bonus based on individual goals for professional		Chi square	Bonus based on individual goals for clerical		Chi square	Bonus based on individual goals for manual		Chi square
	No	Yes		No	Yes		No	Yes		No	Yes	
1-50	58,2%	**41,8%**	**X^2=27,223**	57,7%	**42,3%**	**X^2=21,195**	71,3%	**28,7%**	**X^2=29,252**	63,8%	36,2%	X^2=5,266
51-250	43,4%	**56,6%**		42,5%	**57,5%**		54,1%	**45,9%**		53,8%	46,2%	
251-1000	36,3%	**63,7%**		38,5%	**61,5%**	**Phi=0,144**	49,8%	**50,2%**		57,2%	42,8%	Phi=0,075
1000+	30,5%	**69,5%**	**Phi=0,163**	32,6%	**67,4%**		40,8%	**59,2%**	**Phi=0,170**	52,0%	48,0%	
	41,8%	**58,2%**	**p=0,000**	42,4%	**57,6%**	**p=0,000**	53,7%	**46,3%**	**p=0,000**	56,0%	44,0%	p=0,153
	Bonus based on team goals for management		Chi square	Bonus based on team goals for professional		Chi square	Bonus based on team goals for clerical		Chi square	Bonus based on team goals for manual		Chi square
	No	Yes		No	Yes		No	Yes		No	Yes	
1-50	71,0%	**29,0%**	**X^2=21,092**	72,2%	**27,8%**	**X^2=23,099**	80,7%	**19,3%**	**X^2=21,750**	77,4%	**22,6%**	**X^2=16,576**
51-250	60,6%	**39,4%**		58,7%	**41,3%**		66,6%	**33,4%**		68,9%	**31,1%**	
251-1000	51,8%	**48,2%**		51,4%	**48,6%**	**Phi=0,152**	61,7%	**38,3%**		62,3%	**37,7%**	**Phi=0,134**
1000+	48,1%	**51,9%**	**Phi=0,145**	46,9%	**53,1%**		55,2%	**44,8%**	**Phi=0,152**	55,8%	**44,2%**	
	58,0%	**42,0%**	**p=0,000**	57,1%	**42,9%**	**p=0,000**	65,7%	**34,3%**	**p=0,000**	66,6%	**33,4%**	**p=0,001**

Source: Authors analysis based on CRANET data

5. CONCLUSION

Incentive pay represents one of the most important elements of each compensation system. Based on several researches around the world, EU, CEE region, and empirical data from CRANET project, authors of this paper made several conclusions.

In CEE region organizations use individual bonuses more than bonuses based on team performances – a confirmation of the zero hypothesis (H0) of the research. Namely, organizations in CEE region use individual bonuses usually more for each category of employees, which is in the line with the findings of Kuhn and Yockey (2003) who found that employees respect more incentives based on individual performance. Also, flexible benefits are used less than all other elements of incentive pay, which was expected, since those are relatively new elements of rewards, especially in compensation systems of transition and post-transition countries of the CEE region. Performance related payments in terms of incentives are used more for professionals and manuals than for managers and clericals. This can be expected that monthly incentives are usually given to those workers that are directly connected to the working tasks – in this case those are exactly professional and manual employees.

For the purpose of testing second hypothesis there have been used a chi square test. The results pointed to the conclusion that, in case of the observed organizations, larger organizations use flexible benefits, performance based pay, team and individual bonuses in greater extent (percentage) than medium or small organizations. These findings are in the line with some past researches of performance related pay (Coelho et al., 2011; Bryson et al., 2012). This was a confirmation of the first hypothesis (H1). In the case of flexible benefits and bonuses based on team and individual performances for all categories of workers chi square test showed that there are significant differences between large, medium and small organizations regarding the percentage of organizations that use flexible benefits. In case of performance related pay there were found no significant association between size of organization and these incentives.

Regarding performance related pay, in the CEE region there is also evident a diversity among countries. In case of flexible benefits, organizations from Estonia, Slovenia, Czech Republic and Hungary experienced greater usage of these benefits in comparison with Bulgaria, Lithuania, Slovakia and Serbia. Also, this diversity is evident in case of all other three elements of performance related pay, but in some smaller degree than in case of flexible benefits.

All findings are interesting especially for Serbia, as a country that until 2008 has never participated in some similar global research related to the area of HRM. Comparing its own practice of performance related pay with organizations abroad, in the CEE region, EU or world, organizations from Serbia can gain knowledge and information about trends and contemporary HRM practices. Based on the results of the researches and comparisons, domestic organization can plan and prepare improvements in this area, which is in Serbia still underdeveloped and based on some nonflexible system. Organizations from Serbia should pay more attention to compensation practice when rewarding and motivating their employees, especially incentives, with focus on individual bonuses (since those elements of performance related pay were used mostly in the CEE region). Also, it is important to bear in mind that each compensation plan should be based on the preferences of employees, and aligned with the possibilities of organizations.

REFERENCES

Berber, N. (2013). The influence of culture on human resource management: Compensations and benefits. Anali Ekonomskog fakulteta u Subotici, (29), 105-117.

Bogićević-Milikić, B. (2007). Role of the reward system in managing changes of organizational culture. Ekonomski anali, 52(174-175), 9-27.

Brewster, C., Sparrow, P., & Vernon, G. (2007). International Human Resource Management. London: Chartered Institute of Personnel and Development.

Bryson, A., Freeman, R., Lucifora, C., Pellizzari, M., & Perotin, V. (2012). CEP Discussion Paper No 1112 January 2012 Paying For Performance: Incentive Pay Schemes and Employees' Financial Participation. London: London School of Economics and Political Studies.

Chiu, R. K., Luk, V. W. M., & Tang, T. L. P. (2002). Retaining and motivating employees: Compensation preferences in Hong Kong and China. Personnel Review, 31(4), 402-431. doi: 10.1108/00483480210430346

Coelho, M., de Meza, D., & Rienzo, C. (2011) Performance related-compensation, firm size and absenteeism: evidence from Portugal. UK: London School of Economics.

Festing, M., & Sahakiants, I. (2011). Determinants of share-based compensation plans in Central and Eastern European public companies: An institutional analysis. Journal for East European Management Studies, 16(4), 338-357. doi: http://dx.doi.org/10.1016/j.emj.2013.01.005

Gerhart, B., & Fang, M. (2014). Pay for (individual) performance: Issues, claims, evidence and the role of sorting effects. Human Resource Management Review, 24(1), 41-52. http://dx.doi.org/10.1016/j.hrmr.2013.08.010

Gittleman, M., & Pierce, B. (2013). Pay for Performance and Compensation Inequality: Evidence from the ECEC (No. 465). USA: U.S. Department of Labor and U.S. Bureau of Labor Statistics.

Gupta, N., & Shaw, J. D. (2014). Employee compensation: The neglected area of HRM research. Human Resource Management Review, 24(1), 1-4. http://dx.doi.org/10.1016/j.hrmr.2013.08.007

Janićijević, N. (2013). Matching compensation system with the type of organizational culture. Ekonomika preduzeća, 61(5-6), 309-324.

Jansen, E. P., Merchant, K. A., & Van der Stede, W. A. (2009). National differences in incentive compensation practices: The differing roles of financial performance measurement in the United States and the Netherlands. Accounting, Organizations and Society, 34(1), 58-84. http://dx.doi.org/10.1016/j.aos.2008.05.002

Kalmi, P., Pendleton, A., & Poutsma, E. (2012). Bargaining regimes, variable pay and financial participation: some survey evidence on pay determination. The International Journal of Human Resource Management, 23(8), 1643-1659. doi:10.1080/09585192.2012.661993

Karoliny, Z., Farkas, F., & Poór, J. (2009). In focus, Hungarian and Central Eastern European characteristics of human resource management–An international comparative survey. Journal for East European Management Studies, 14(1), 9-47.

Kuhn, K. M., & Yockey, M. D. (2003). Variable pay as a risky choice: Determinants of the relative attractiveness of incentive plans. Organizational Behavior and Human Decision Processes, 90(2), 323-341. doi: http://dx.doi.org/10.1016/S0749-5978(02)00526-5

Larkin, I., Pierce, L., & Gino, F. (2012). The psychological costs of pay-for-performance: Implications for the strategic compensation of employees. Strategic Management Journal, 33(10), 1194-1214. doi: 10.1002/smj.1974

Malinić, D. (2007). Podsticajni planovi u funkciji podizanja efikasnosti korporativnog upravljanja. Ekonomika preduzeća, 55(5-6), 189-203.

Martochioo, J.J. (2009). Strategic compensation: A Human Resource Management Approach. New Jersey: Pearson Education International.

Parry, E., Stavrou, E., & Lazarova, M. (2013). Global trends in human resource management. UK: Palgrave Macmillan.

Salimaki, A., & Heneman, R. (2008). Pay for Performance for Global Employees. In: Gomez – Mejia, L.R., & Werner, S. (2008). Global Compensation: Foundations and Perspectives. Oxford: Taylor & Francis.

Štangl-Šusnjar, G., & Leković, B. (2009). Performance-based pay in human resources development. Strategic Management, 14(3), 1-14.

Štangl-Šušnjar, G., & Berber, N. (2014). Incentive pay and performances of organizations: Research on the basis of the Cranet data in Europe. XIX International Scientific Conference SM 2014, 16 May 2014, Subotica: Faculty of Economics.

Štangl-Šušnjar, G., & Slavić, A. (2012). Changes in the human resource compensation systems of European companies: Based on the CRANET research result analysis. Strategic Management, 17(4), 32-40.

Weibel, A., Rost, K., & Osterloh, M. (2010). Pay for performance in the public sector—Benefits and (hidden) costs. Journal of Public Administration Research and Theory, 20(2), 387-412. doi: 10.1093/jopart/mup009

COMPETENCIES ASSESSMENT OF THE EXPERTS - PARTICIPANTS IN GROUP DECISION-MAKING ON SELECTION OF THE METHODS FOR ASSESSING THE QUALITY OF MILITARY DRIVERS

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Abstract: *Deciding on the group level means of group decision-making, which requires knowledge on the specific techniques of group decision making. Quality of the expert group members, e.i. their competence, is crucial for the success of the decisions made.*

In the scientific literature, different approaches to group decision-making as well as to evaluation of the competence of the expert group members can be found. This paper presents an approach to assessment of the competence of the experts - participants of the "Analytic Hierarchy Process" group decision making on the selection of methods for assessing the quality of military drivers.

Keywords: *Assessment, Experts Competency, Group Decision Making, Work Quality, Military Drivers*

1. INTRODUCTION

The emergence of expert assessment is linked to the emergence of the first formally described and studied technologies of expert assessment in the 50s and 60s of the last century. At that time the first articles on group decision-making, expert decision aggregation in the process of multi-criteria decision-making, determining of the results of the collective expertise by Delphi methods and scenarios and about the experiences of their application were created.

Interest in the expert assessment increased with the increase of the level of the development and the complexity of the decision-making process in the narrow sense, and with the development of science and technology in general sense. During recent years, the use of expert assessment has become frequent as it became clear that the effective solutions can be obtained by use of the experience, knowledge and intuition of specialists-experts.

Unlike individual decision-making, in which there is no need for any special decision-making techniques since the decision-maker decides by him/herself, for group decision-making process knowledge regarding group decision-making techniques is essential. Group decision-making also involves a smaller or larger number of people, members of the group, which have to be organized, directed and led.

The composition of the expert group depends on the particular problem which should be addressed, on the expertise organizer's ability to hire (engage) highly qualified specialists as well as on ability of experts to participate in the work of the expert group. People, whose opinion would be of the best assistance in making of the appropriate decisions, should be used as experts *(Milicevic 2010).*

Proper selection of specialists for work in the expert group is very important because the quality of expert assessment mainly depends on the quality of the expert group. The quality of the expert group depends on the quality and number of experts. Most of the existing methods of expert's quality assessment can be divided into five groups *(Denisova & Zaitsev, 2002):*

- *Heuristic* assessment is given by a man and is based on the assumption that, through self-evaluation and mutual evaluation between experts, high quality of evaluation of the experts could be provided;
- *Statistical* assessment obtained by expert opinion of expertise objects;
- *The test* assessment obtained by special examination of experts;
- *Documented assessments* based on an analysis of the documentary data on experts;
- *The combined assessments* obtained by a combination of several methods.

This paper presents an approach to assessment of the competence of the experts who participated in the "Analytical Hierarchy Process" (AHP) group decision-making in the selection of the methods for assessing the quality of military drivers *(Lukovac 2010).* The Group of Experts (GEX), consisted of twenty officers of the Traffic Service of the Serbian Army, to whom the assessment of the quality of work of the direct perpetrators i.e. drivers, was one of the obligations, arising from the functional duty they perform. To assess their competency the model recommended for the assessment of competence of experts in the field of transport support *(Djorovic 2003),* which is a combination of methods based on heuristic (argumentation evaluation and self-assessment) and documented assessment (objective assessment based on documented facts) of the quality of the experts, was used.

2. ASSESSMENT OF COMPETENCE OF EXPERTS

According to the model which is recommended for the assessment of competence of the experts in the field of transport support, the coefficient of competence(K), includes three aspects of assessment *(Djorovic 2003):*

(1) objective assessment (K_d);
(2) assessment of the source of argument (K_a);
(3) subjective judgment of experts (K_s);

Coefficient of competence is calculated according to following formula:

$$K = q_1K_d + q_2K_a + q_3K_s \qquad (1)$$

For weight that determines relative importance of the partial coefficient the following values are proposed*(Đorović 2003):* $q_1 = 0.6$, $q_2 = 0.25$ i $q_3 = 0.15$.

The coefficient of objective assessment(K_d)represents contribution of individual traitsof expert to his/hers competence. As the dominant individualtraits following are recommended *(Djorovic 2003):*

- K_1–level of education;
- K_2–total length of service;
- K_3–current duty;
- K_4 –length of service in the current duty;
- K_5–published scientific and professional papers;
- K_6–participation in projects;
- K_7–professional activity outside the post;
- K_8–work quality evaluation;
- K_9–the awards;

Integral component of individual traitsand their level of importance (in a scale 1-10) are shown in Tables 1 to 9 *(Djorovic 2003).*

Table 1: Level of education

K_1 – EDUCATION LEVEL		
Number of component	Component	The proposed level
K_{11}	Postgraduate level PhDs	10
K_{12}	Postgraduate level magistarture(master)	8
K_{13}	Postgraduate level specialization	7
K_{14}	University degree	5
K_{15}	College	4
K_{16}	High school	1

Table 2: Total years of service

K_2 – PERIOD OF PRACTICE		
Number of components	Component	The proposed level
K_{21}	Over 20 years	10

K_{22}	15–20 years	8
K_{23}	10–15 years	6
K_{24}	5–10 years	4
K_{25}	Less than 5 years	2

Table 3: Current duty

K_3 – CURRENT DUTY		
Number of components	Component	The proposed level
K_{31}	Faculty Professor	10
K_{32}	Chairman of the Steering Board	9
K_{33}	Member of the Steering Board	8
K_{34}	Manager of the production facility in the enterprise	7
K_{35}	Leader of the production department in the enterprise	5
K_{36}	Other post	2

Table 4: Length of service in the current duty

K_4 – LENGTH OF SERVICE IN THE CURRENT DUTY		
Number of components	Component	The proposed level
K_{41}	Over 10 years	7
K_{42}	8–10 years	6
K_{43}	6–8 years	5
K_{44}	4–6 years	4
K_{45}	2–4 years	3
K_{46}	Less than 2 years	1

Table 5: Published scientific and professional papers

K_5 – PUBLISHED SCIENTIFIC AND PROFESSIONAL PAPERS		
Number of components	Component	The proposed level
K_{51}	Books, monographs	10
K_{52}	Over 20 articles	9
K_{53}	10 - 20 articles	8
K_{54}	5-10 articles	6
K_{55}	Less than 5 articles	4
K_{56}	No published papers	0

Table 6: Participation in projects

K_6 – PARTICIPATION IN THE PROJECT		
Number of components	Component	The proposed level
K_{61}	Project Manager	10
K_{62}	Member of the Project management team	10
K_{63}	Participation in projects at faculties	8
K_{64}	Participation in the enterprise management projects	6
K_{65}	No participation in projects	0

Table 7: Professional activity outside the post

K_7 – PROFESSIONAL ACTIVITY OUTSIDE THE POST		
Number of components	Component	The proposed level
K_{71}	Additional features in their profession	4
K_{72}	Member of scientific and technical councils	8
K_{73}	Member of the editorial board of the journal	5
K_{74}	Activity in the scientific - technical associations	7
K_{75}	Papers for scientific professional conferences	6

K_{76}	The right to perform duty of the expertwitness	3
K_{77}	Completed foreign language courses	1

Table 8: Work quality assessment

K_8 – WORK QUALITY ASSESSMENT		
Number of components	Component	The proposed level
K_{81}	Over 4.50	5
K_{82}	3.50–4.50	4
K_{83}	2.50–3.50	3
K_{84}	2.00–2.50	2

Table 9: Awards

K_9 – AWARDS		
Number of components	Component	The proposed level
K_{91}	State awards	10
K_{92}	Awards by universities and faculties	8
K_{93}	Awards by enterprises	6
K_{94}	Other prizes	5

The coefficient of objective assessment (K_d) is calculated as:

$$K_{di} = \frac{1}{10} \times \frac{\sum_{i=1}^{n} p_i t_i}{\sum_{i=1}^{n} t_i} \qquad (2)$$

Wherein:

- p_i – the level of importance of i^{th}trait expert;
- t_i – weight that determines the relative importance of i^{th} trait of expert $t_i \in (0–1)$ (for specific problem recommended value is$t_i = 0.5$ for the trait "Published scientific and professional papers" and " Professional activity outside the post", and for other traits $t_i = 1$);
- n – number of traits;

The coefficient of argument (K_a), in whose assessment expert determines the degree of influence (high, medium or low) of certain source tohis/hers opinion, is calculated according to the following formula:

$$K_a = \sum_{i=1}^{m} \sum_{j=1}^{3} l_{ij} \qquad (3)$$

Wherein:

- i – source index;
- j – source influence index;
- m – number of sources;
- l_{ij} – coefficient of the source of the argument (which is determined by the expert);

Table 10 shows the degree of influence (by levels) of certain sources on expert opinion.

Table 10: Sources of argumentation *(Djorovic 2003)*

No.	SOURCES OF ARGUMENTATION	Degree of influence		
		1 – high	2 – medium	3 – low

1	Theoretical knowledge	0.3	0.2	0.1
2.	Experience	0.5	0.4	0.2
3	Papers from the literature	0.2	0.1	0.05
4	Proposer consultations	0.1	0.05	0.025
5.	Intuition	0.1	0.05	0.025
6.	Other	0.1	0.05	0.025

Based on the previously mentioned, the coefficient of argument (K_a), is calculated according to the following formula:

$$K_a = \sum_{i=1}^{6} \sum_{j=1}^{3} I_{ij} \qquad (4)$$

Table 11: Ratios of competence of the expert group *(Lukovac 2010)*

EXPERTS	ASPECTS OF COMPETENCE ASSESSMENT			COMPETENCE COEFFICIENT
	K_d	K_a	K_s	$(q_1K_d + q_2K_a + q_3K_s)$
1.	0.43125	0.925	0.7	0.595
2.	0.59375	0.95	0.9	0.72875
3.	0.6	1	0.9	0.745
4.	0.5	0.925	0.8	0.65125
5.	0.38125	0.9	0.5	0.52875
6.	0.75	0.95	1	0.8375
7.	0.4875	0.9	0.7	0.6225
8.	0.5625	1.075	1	0.75625
9.	0.7375	0.9	0.9	0.8025
10.	0.3625	0.8	0.5	0.4925
11.	0.5125	0.9	0.8	0.6525
12.	0.7375	0.975	1	0.83625
13.	0.66875	0.825	0.9	0.7425
14.	0.45625	0.875	0.6	0.5825
15.	0.5625	1.025	0.9	0.72875
16.	0.5875	0.85	0,8	0.685
17.	0.74375	1	1	0.84625
18.	0.3625	0.975	0.5	0.53625
19.	0.5375	0.9	0.8	0.6675
20.	0.38125	0.9	0.5	0.52875
COMPETENCE COEFFICIENT OF THE GROUP OF EXPERTS				**0.6783125**

The last partial element of the total competence coefficient represents experts' subjective assessment of the degree of knowledge on the specific problem (on a scale of 1 to 10), which is multiplied by 0.1 and, as such, is the coefficient of the subjective assessment (K_s).

When the competence coefficient (K) is determined for each expert,competencies coefficient GEX is calculated as their arithmetic mean *(Djorovic 2003).* Table11 shows the individual competence coefficients of expert participants in this study, as well as determined competence coefficient GEX.

Competence coefficient GEX is considered acceptable if its value is greater than 0.5 *(Djorovic 2003).* Since calculated competence coefficient GEX is 0.6783125 (Table 11), it can be concluded that members of the GEX are competent to participate in group AHP decision making on the selection of methods for assessing the quality of military driver (K> 0.5).

3. CONCLUSION

A number of authors in scientific works, and becoming more practitioners - the real decision makers, indicate that the decision making based just on personal considerations or intuitionispractically impossible. In recent times, when there are opportunities, choice is to make decisions within the group, through so-called group sessions during which opinions are exchanged and knowledge of individual participants is enhanced, participants' experiences is exploited, the way for consensus is made and an important psychological effect of common interest in the success of the decision made is achieved.

Proper selection of specialists to work within the expert group is very important because their competence is essential for making successful decisions. One of the parameters by which the quality of the experts, and thus the quality of the expert group's is assessed, is rating of competence. In the scientific literature there are different approaches to assessing the competence of experts. For the assessment of the competence of the experts in the field of transport support a model which is a combination of methods based on heuristic (argumentation evaluation and self-assessment) and documented assessment (objective assessment based on documented facts) of the quality of the experts is recommended.

REFERENCES

Denisova, A. L., & Zaitsev E.V. (2002).Teoril and practice zkspertnoi rated products and services, Uchebnoeposobie, Izdatelvstvo TGTU, Tambov.

Djorovic, B. (2003). Research design the organizational structure of organs transportation service, dissertation, Military Technical Academy, Belgrade.

Lukovac, V. (2010).A model for assessing the quality of military drivers, thesis, Faculty of Traffic Engineering, Belgrade.

Milicevic, M.(2010). The development of a methodology for eliminating the interest of experts in the expert evaluation, Ph.D. Thesis, Military Academy, Belgrade.

APPLICATION OF THE PROCESS FUNCTIONS METHOD FOR ASSESSING THE ORGANIZATION LEVEL OF WORK POST

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Abstract: *A method of process functions is one of the well-known analytical methods for assessing the level of organization and it is very suitable instrument for obtaining overview of existing organizing modes and diagnosing what needs to be changed or improved. By using the method of process functions organization of professional functions, organizational units, work areas, operational elements, work posts etc. can be evaluated. This paper presents a mathematical model for the analysis of organizational structure of administrative bodies. The organizational structure of administrative bodies of the Serbian Army (SA) has been analyzed in order to analyze the situation and optimize the existing organizational structure. Analysis of the state of organization is aimed at creating a picture of the current mode of organization and, on the basis of that, removing identified deficiencies. This model has been applied for the analysis of process functions and tasks of the administrative bodies of the organizational structure taking into account the fact that administrative bodies should be designed and sized so that they can meet the basic goals and tasks of their existence. Each task set before the administrative bodies should be completed in a quality and reliable way in all environmental conditions.*

Keywords: *process functions, assessment, organisational structure*

1. INTRODUCTION

The organizational structure of business systems is necessary to be designed and sized to meet the basic corporate goals and objectives. Almost every task set before the system management should be completed in a quality and reliable way in different environmental conditions.

One of the possible approaches to analyzing the degree of coordination and effectiveness of organizational structure is based on the division of the organization according to business and process functions and on their evaluation. Organizational or business functions relate to a group of different activities that are centered on a single task. This way, organizational and business functions are differentiated by type.

Process functions relate to particular phases of activity taking place within each organizational function and within each of the subdivisions of organizational functions, or work areas of organizational functions. The nature and number of business and process functions is not specified or definite. Some analysts, for example, believe that management and leadership does not make a business function, but that these activities belong to the administrative functions in accordance with the criteria that some of the authors of the science of organization mention (Fayol, 1947). Urwick (1964) believes that business and administrative functions at the same level of itemization should be the same or nearly the same importance and complexity. However, business and process functions formally the same rank differ by “difficulty” and complexity. This approach was also used when creating a model for assessing the infrastructure business functions *(Vešović & Bojovic, 2002).*

Several methods for assessing the organization can be found in the literature, but this paper presents the model for the analysis of the organizational structure of administrative bodies of the SA.

2. APPLICATION OF THE METHOD OF PROCESSFUNCTIONS

The term “process functions” includes the activities which are required to successfully complete the entire task at all levels of work posts in the organization *(Eric, 2000).* In the working process there are nine main stages - the processing function, Table 1.

Table 1: Overview of process functions with signs and meanings *(Đorović & Pamučar, 2008)*

Process functions	MARK	Meaning
Recording	Ev	Inclusion of all work events in the organization.
Informing	Ob	Submission of data and information to all work post in the organization.
Monitoring	Kt	Comparison of the performed activities with pre-set criteria, standards and guidelines
Analysis	An	Disassembly, comparison and conclusion on the causes of deviations.
Decision making	Odl	Re-intervention on the developments in the existing processes and the design of future processes.
Planning	Pl	Providing of the elements necessary for the implementation of decisions.
Harmonization	Us	Combining and directing individual efforts into the overall effort.
Organization	Org	Search and design of the appropriate organizational procedures and task execution.
Performance	Izv	Particular execution of tasks at all positions in the organization.

Tasks, prescribed by organizational order for the work of that institution, performed by the commander of the transport platoon in one of the institutions of SA is analyzed in this paper, Table 2.

Table 2: Overview of tasks with marks *(Lukovac 2000)*

MARK	TASK
01	Cooperation with the transport officer
02	Referring to the manager
03	Duty hours
04	Holding meetings at the level of the platoon.
05	Making orders.
06	Preparation of transport planning documents.
07	Document processing for issuing assignments to drivers.
08	Making reports.
09	Development of vacations plan for people in the platoon.
10	Implementation of additional training, retraining and conditioning of the driver.
11	Collecting data on the improprieties "material and technical resources" (MTS).
12	Cooperation with the technic officer in order to address the defects of the MTS.
13	Supplying of transportation means with necessary tools and equipment.
14	The organization and implementation of activities in the field of basic maintenance of MTS.
15	Sending transport means to the civil workshops.
16	Initiation of proceedings for compensation for damages to the MTS for which platoon is responsible.
17	Proposing expenses
18	Cooperation with the platoon maintenance commander in terms of eliminating defects in MTS.
19	The work organization of duty officer in the technical resources park.
20	Organization of control-pass station.
21	Determining the causes of traffic violations and accidents.
22	Implementation of activities to increase road safety.
23	Sending driver to systematic medical examinations.
24	Monitoring and evaluation of the quality of work of persons in the platoon.
25	The organization and implementation of fire safety measures.

Since each work post, does not have to contain all process functions, it is necessary to determine their relationship. Connections of tasks with process functions is determined by the table "tasks - processing functions" (Table 3), for a task that contains some of the process functions characters “+” is put in, where the summation of “+” signs represents the

sum frequency (F). If the task does not contain any of the process functions character "-" is put in the table .

Table 3: Overview of functional interdependence of tasks and process functions *(Lukovac 2000)*

PROCESS FUNCTIONS / TASKS	Ev	Ob	Kt	An	Odl	Pl	Us	Org	Izv	F
01	+	-	+	+	+	+	+	+	+	8
02	+	+	+	+	+	+	+	+	+	9
03	+	+	+	+	+	+	+	+	+	9
04	+	+	+	+	+	+	+	+	+	9
05	+	-	+	+	+	+	+	+	+	8
06	+	+	+	+	+	+	+	+	+	9
07	+	-	+	+	+	+	+	+	+	8
08	+	-	-	+	-	+	+	+	+	6
09	+	+	+	+	-	+	+	+	+	8
10	+	+	+	+	+	+	+	+	+	9
11	+	+	+	+	+	+	+	+	+	9
12	+	+	+	+	+	+	+	+	+	9
13	+	+	+	+	+	+	+	+	+	9
14	+	+	+	+	+	+	+	+	+	9
15	+	+	+	+	+	+	+	+	+	9
16	+	-	+	+	+	+	+	+	+	8
17	+	+	+	+	-	+	+	+	+	8
18	+	+	+	+	+	+	+	+	+	9
19	+	+	+	+	+	+	+	+	+	9
20	+	+	+	+	+	+	+	+	+	9
21	+	+	+	+	+	+	+	+	+	9
22	+	+	+	+	+	+	+	+	+	9
23	+	+	+	+	+	+	+	+	+	9
24	+	-	+	+	+	+	+	+	+	8
25	+	+	+	+	+	+	+	+	+	9
F	25	19	24	25	22	25	25	25	25	215

Since all tasks do not have the same importance, i.e. some are more, and others less important, it is necessary to perform their weighting. The weighting is performed by selecting one of the weights on a scale of 0 to 5, according to the criteria shown in Table 4.

Table 4. Criteria for the selection of weights of tasks *(Đorović & Pamučar, 2008)*

WEIGHTS	CRITERIA
5	A task performing is necessary, business would not be possible.
4	A task performing affects the entire business in great deal
3	A task performing affect economic efficiency of business
2	Failure to perform tasks causes deficiency in the business, but the business is yet possible
1	A task performing affects the integrity of the business
0	A task performing is not necessary

According to the same criteria, process functions are weighted as well because they all do not have equal importance for the business. Selected weights for certain tasks, as well as weights for the selected process functions, are result of a poll conducted with the person who performs the task which is subject to this analysis. Weighting of tasks and process functions is performed by the multiplying selected tasks weights with selected process functions weights. Obtained results are theoretical weights of tasks by process functions, i.e. for process functions by tasks, Table 5.

Table 5: Theoretical weights of tasks by process functions *(Lukovac 2000)*

Process functions / TASKS		Ev	Ob	Kt	An	Odl	Pl	Us	Org	Izv	Σ
		WEIGHT									
MARK	WEIGHT	1	2	3	3	5	5	4	4	2	
01	5	5	–	15	15	25	25	20	20	10	135
02	5	5	10	15	15	25	25	20	20	10	145
03	4	4	8	12	12	20	20	16	16	8	116
04	3	3	6	9	9	15	15	12	12	6	87
05	4	4	–	12	12	20	20	16	16	8	108
06	5	5	10	15	15	25	25	20	20	10	145
07	5	5	–	15	15	25	25	20	20	10	135
08	4	4	–	–	12	–	20	16	16	8	76
09	3	3	6	9	9	–	15	12	12	6	72
10	5	5	10	15	15	25	25	20	20	10	145
11	5	5	10	15	15	25	25	20	20	10	145
12	5	5	10	15	15	25	25	20	20	10	145
13	5	5	10	15	15	25	25	20	20	10	145
14	5	5	10	15	15	25	25	20	20	10	145
15	5	5	10	15	15	25	25	20	20	10	145
16	3	3	–	9	9	15	15	12	12	6	81
17	3	3	6	9	9	–	15	12	12	6	72
18	5	5	10	15	15	25	25	20	20	10	145
19	5	5	10	15	15	25	25	20	20	10	145
20	5	5	10	15	15	25	25	20	20	10	145
21	4	4	8	12	12	20	20	16	16	8	116
22	5	5	10	15	15	25	25	20	20	10	145
23	4	4	8	12	12	20	20	16	16	8	116
24	4	4	–	12	12	20	20	16	16	8	108
25	4	4	8	12	12	20	20	16	16	8	116
Σ		110	170	318	330	500	550	440	440	220	3078

The next step is the rating of tasks by process functions on a scale of 1 to 5, according to the rate determining criteria based on perceived organizational stand on observed work post, shown in table 6.

Table 6: Rate determining criteria *(Đorović & Pamučar, 2008)*

RATE	RATINGS DETERMINING CRITERIA
1	Tasks are not performed.
2	Tasks are carried out periodically.
3	Tasks are carried out on its own initiative, but upon agreement
4	Tasks are carried out according to the instructions of superiors.
5	Tasks are carried out according to organizational requirements.

Rates of tasks by process functions are shown in Table 7, and are also the result of a poll conducted with the person who performs tasks that are the subject of this analysis.

Table 7: Assessment tasks for process functions *(Lukovac 2000)*

PROCESS FUNCTIONS / TASK	Ev	Ob	Kt	An	Odl	Pl	Us	Org	Izv
01	5	–	4	4	4	4	4	4	4
02	5	3	4	4	4	4	4	4	4
03	4	4	5	5	5	5	5	4	5

PROCESS FUNCTIONS / TASK	Ev	Ob	Kt	An	Odl	Pl	Us	Org	Izv
04	2	3	2	2	3	2	2	3	2
05	5	–	5	4	4	4	4	5	4
06	5	4	3	3	3	4	3	5	5
07	5	–	5	4	5	5	5	5	5
08	5	–	–	3	–	5	5	5	4
09	2	3	4	3	–	4	3	4	4
10	5	5	3	3	4	5	5	5	5
11	3	3	3	4	3	5	5	5	5
12	4	3	3	2	3	3	3	2	2
13	5	3	3	2	3	3	2	2	2
14	3	3	3	3	3	3	3	3	3
15	5	3	3	2	3	3	3	2	2
16	5	–	5	3	3	5	5	5	2
17	2	2	3	4	–	3	4	4	4
18	3	3	2	2	4	3	3	3	3
19	5	5	2	2	3	5	5	5	5
20	3	5	3	2	3	3	5	5	5
21	5	5	4	4	5	5	5	5	5
22	4	5	4	4	4	3	5	3	5
23	3	2	2	2	3	3	5	3	2
24	5	–	5	3	2	2	4	4	3
25	3	5	2	3	3	5	4	3	2

After rating the tasks by process functions the calculation of the actual task weights (P_s) is conducted by using following formula :

$$P_s = \frac{P_p \times O}{S_o} \quad (1)$$

where:

P_p - Required (theoretical) the weight of work,

O - Assessment of tasks by process functions,

S_o - Score scale (5).

The actual weights of tasks are shown in Table 8.

The next phases in the application of this method is calculating the average rate of tasks and process functions and, based on these ratings, ranging of tasks and process functions. Average ratings of tasks ($\bar{O}$) are calculated by using following formula:

$$\overline{O} = \frac{\sum P_s}{\sum P_p} \times S_o \quad (2)$$

Rang of the tasks based on their average rate is shown in Table 9.

Table 8: Actual tasks weights *(Lukovac 2000)*

PROCESS FUNCTIONS / TASKS	Ev	Ob	Kt	An	Odl	Pl	Us	Org	Izv	Σ
01	5	–	12	12	20	20	16	16	8	109
02	5	6	12	12	20	20	16	16	8	115

PROCESS FUNCTIONS / TASKS	Ev	Ob	Kt	An	Odl	Pl	Us	Org	Izv	Σ
03	3.2	6.4	12	12	20	20	16	12.8	8	110.4
04	1.2	3.6	3.6	3.6	9	6	4.8	7.2	2.4	41.4
05	4	–	12	9.6	16	16	12.8	16	6.4	92.8
06	5	8	9	9	15	20	12	20	10	108
07	5	–	15	12	25	25	20	20	10	132
08	4	–	–	7.2	–	20	16	16	6.4	69.6
09	1.2	3.6	7.2	5.4	–	12	7.2	9.6	4.8	51
10	5	10	9	9	20	25	20	20	10	128
11	3	6	9	12	15	25	20	20	10	120
12	4	6	9	6	15	15	12	8	4	79
13	5	6	9	6	15	15	8	8	4	76
14	3	6	9	9	15	15	12	12	6	87
15	5	6	9	6	15	15	12	8	4	80
16	3	–	9	5.4	9	15	12	12	2.4	67.8
17	1.2	2.4	5.4	7.2	–	9	9.6	9.6	4.8	49.2
18	3	6	6	6	20	15	12	12	6	86
19	5	10	6	6	15	25	20	20	10	117
20	3	10	9	6	15	15	20	20	10	108
21	4	8	9.6	9.6	20	20	16	16	8	111.2
22	4	0	12	12	20	15	20	12	10	105
23	2.4	3.2	4.8	4.8	12	12	16	9.6	3.2	68
24	4	–	12	7.2	8	8	12.8	12.8	4.8	69.6
25	2.4	8	4.8	7.2	12	20	12.8	9.6	3.2	80
Σ	90.6	8	139.8	202.2	122	423	356	343.2	164.4	2261

Average rates of process functions (O_{pf}) are calculated using the weight given in tables 5 and 8, and according to following formula:

$$O_{pf} = \frac{\sum P_s}{\sum P_p} \times S_o \qquad (3)$$

where :

P_s - Actual weights of process functions,

P_p - Required ponder of processing functions,

S_o - Scale of rates (5).

Table 9: Rang of the tasks (Lukovac 2000)

RANG	TASK	ΣP_s	ΣP_p	$\overline{O}$	WEIGHT
1.	07	132	135	4.89	5
2.	21	111.2	116	4.79	4
3.	03	110.4	116	4.76	4
4.	08	69.6	76	4.58	4
5.	10	128	145	4.41	5
6.	15	92.8	108	4.3	4
7.	16	67.8	81	4.19	3
8.	11	120	145	4.14	5

RANG	TASK	ΣP_s	ΣP_p	$\overline{O}$	WEIGHT
9.	01	109	135	4.04	5
10.	19	117	145	4.03	5
11.	02	115	145	3.97	5
12.	06	108	145	3.72	5
13.	20	108	145	3.72	5
14.	22	105	145	3.62	5
15.	09	51	72	3.54	3
16.	25	80	116	3.45	4
17.	17	49.2	72	3.42	3
18.	24	69.6	108	3.22	4
19.	14	87	145	3.00	5
20.	18	86	145	2.97	5
21.	23	68	116	2.93	4
22.	15	80	145	2.76	5
23.	12	79	145	2.72	5
24.	13	76	145	2.62	5
25.	04	41.4	87	2.38	3
	Σ	2261	3078	3.67	

Rang of process functions based on their average rate is shown in table 10

Table 10: Rang of process functions *(Lukovac 2000)*

RANG	Process functions	$\sum P_s$	$\sum P_p$	O_{pf}	PONDER
1	Recording	90.6	110	4.12	1
2.	Harmonization	356	440	4.05	4
3	Organization	343.2	440	3.90	4
4	Planning	423	550	3.85	5
5.	Performance	164.4	220	3.74	2
6.	Decision making	351	500	3.51	5
7.	Monitoring	215.4	318	3.39	3
8.	Informing	115.2	170	3.39	2
9.	Analysis	202.2	330	3.06	3
	Σ	2261	3078	3.67	

Law average ratings point out those tasks that are neglected in the organizational structure. All average ratings with a value below 3.67 indicate the tasks and functions that are critical points in the organization.

Average ratings of process functions indicate the importance that they have in the overall functioning of the organizational structure. If these ratings are very different, it points to the unadjusted leadership and management. In addition, average rating of business functions is the evaluation of the organizational level of the organizational structure. Average task ratings indicate the importance they have in the overall functioning of administrative bodies. As these ratings are very different ranging from 2.38 to 3.72, this means that the cause was the unadjusted task management.
Strengths and weaknesses of the existing organization and functioning of the organizational structure show the ranking of process functions. The ranking shows what process functions should be given more attention; this applies especially to those process functions that have high weights, and low average ratings. Average ratings of process functions indicate those process functions which have to be significantly changed and improved. This applies particularly to those process functions that are rated below average (Decision making, Monitoring, Informing and Analysis).

CONCLUSION

Average rate represents the level of organization of the particular workpost. Having in mind its numerical value of 3.67, it can be concluded that this is a level of organization that is characterized by the execution of the tasks based not on organizational rules, but on officers own initiative or instructions of superiors. This primarily applies to tasks that are rated with lower rates than the average rate, and in this case these are tasks that are ranked from 15th to 25th place (tasks marked with "09", "25", "17", "24", "14", "18", "23", "15", "12", "13" and "04"). Average rate of the process functions provides overview what process functions should be to significantly changed or improved. This primarily applies to those process functions that are rated below average rate (3.67), and in this case are "Decision making" (3.58), "Monitoring" (3.39) "Informing" (3:39) and "Analysis" (3.06).

Advantages and disadvantages of the organization level are shown by the rate of process functions and activities as well. This rate shows which process functions and tasks more need attention, and this applies primarily to those process functions and tasks which are assigned with high weights and have low average rate. From this point of view, in this particular case interesting tasks are marked with "14", "18", "15", "12" and "13", i.e. process functions "planning" and "decision making".

The results of this analysis should be viewed critically, because for detailed analysis the opinion of a number of persons who are familiar with concrete problem (or a group of experts in the field of transport support) should be should taken into account.

REFERENCES

Đorović, B., & Pamučar, D.(2008). Practicum in work organization in the traffic and transportation, the Military Academy, Belgrade.

Eric, D. (2000). Introduction to Management, Cigoja press, Belgrade.

Lukovac, V.(2000). The organization of the workplace medical platoon commander cars military medical center for emergency and home treatment garrison of Belgrade, thesis, Military Technical Academy of the Army of Yugoslavia, Belgrade.

Vešović, V., & Bojovic, N.(2002). Organization of transport companies, the second revised edition, Traffic Engineering, Belgrade.

EDUCATIONAL ACHIEVEMENTS AS A DETERMINANT OF AN INDIVIDUAL'S FORMAL POWER

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Abstract: *The scope of this study was to define how educational achievements of individuals in Slovenia define their "formal power" in organizations where they work. The study was based on theoretical definitions of the concepts of formal power and education. A total of 509 people from Slovenia over 30 years of age participated in the study. We recognized a certain influence of educational achievement on the formal position in the organizational hierarchy. The main predictor of an individual's formal power in an organization is the individual's last achieved level of formal education. The average grade for the final achieved level of formal education and the initiative regarding the search for additional education has much less of an impact on power than the last level of education obtained. One of the most important practical implications is that education is one of the basic predispositions to having formal power but not necessarily always and not in every case.*

Keywords*: education, formal power, work, employees, HRM*

1. INTRODUCTION

The basic definition of power would be: "Power is the ability to implement one's will." The study of power in organization has been interesting topic for many researchers. Power is consider by many as one of the most important factors in an organization. Some authors suggest that power lies in the potential, and others suggest that power is only present in its use. There is also an ongoing debate what makes individual powerful (Marič & Ferjan, 2011).

Despite the importance of an individual's formal and informal power in an organization, there is very little research on what gives power, formal or informal combined, to an individual in an organization. In this article, we will explore the effect of an individual's education on one's formal power in an organization. We suppose that the education one receives leads to principal differences in one's power later on in an organization that one is working in. We could also say that the duration of schooling determines one's formal power in an organization. Those who have higher education usually gain more formal power and amenities depending on their working positions in some cases even regardless of their abilities.

In his book "Organization, Power and Change" (1995) Borum Finn states that there is reason to believe that the narrow connection between educational and professional competence and pyramidal location plays an important role. It creates the impression that there is a connection between the length of education and the ability to make decisions also in relation to non-professional issues. The inflexibility of the educational system widens the individual pyramidal strata and thus reinforces the authoritarian nature of the system. Education is one of the identified factors that contribute to one's personal power (Rees, 1999). One could argue that the shift from a capital-based to a knowledge-based economy represents a fundamental shift in power dynamics (Lynn, 2000).

2. AN INDIVIDUAL'S EDUCATION

The educational process offers individuals knowledge, skills and habits. Some describe it as the last level of education that one has achieved so far in their life (FAQ | Ministry of Higher Education, Science and Technology, 8.6.2009). It could also be important how many years of education one has and what was their average grade during the last level of their education. Knowledge is the capacity to act on information… it implies learning (Lynn, 2000). We could say that education is one of the predispositions to having knowledge, but not in everyone's case. Being included in the educational process does not necessarily mean that the individual has really gained that knowledge. Organizations are employing the most educated workforce in the history of the world (Burke & Ng, 2006) because they do not need more people willing to blindly follow orders or to do repetitive work; they need people of courage and initiative (Pinchot, 1992).

Different styles of upbringing have their effect on children's will and capacity to learn, and on their adaptability to the requirements of the school (Ferjan & Jereb, 2008). Bowles and Gintis (2002) found that

parental economic status is passed on to children in part by means of unequal opportunity, but that the economic advantages of the offspring of higher status families go considerably beyond the superior education they receive. Educational transformation also influences the social justice and the social status of the people (Unterhalter & Dutt, 2001). There are also various factors that influence the study progress (Jereb et al., 2009).

By the day more and more importance is given to lifelong learning (European Commission - Education & Training - lifelong learning programme - A single umbrella for education and training programmes, 2009) in which the formal education is in a way perceived a foundation for further lifelong work and education. It could easily be said that the higher level of formal education one has, the more involved in lifelong learning one has to have to keep up with everyday requirements of one's work (Ferjan & Jereb, 2005).

Lifelong learning (European Commission - Education & Training - lifelong learning programme - A single umbrella for education and training programmes, 2009) is sort of defined by additional learning per year, search for appropriate forms of additional education and of course not to forget, the training that is required by the employers or the organization in which one works. The learning process accompanies individuals in every phase of their life. The levels of education in the EU are also increasing with the following generations (The levels of education in the EU are increasing with the following generations: Evropa.gov.si, 8.6.2009).

3. AN INDIVIDUAL'S FORMAL POWER

Power is part of our lives, both private and organizational. Power is basically the ability to influence the desired outcomes. Power can be broadly defined as the ability to influence different outcomes, by pooling resources (human and material) to achieve the realization of certain things within the network of relationships (Rees, 1999) and at the same time to resist unwanted influence from others (Wagner & Hollenbeck, 2010). Individuals' who have power in the organizational environment often also have power even in their private lives and vice versa.

An individual's power in organizations can be best assessed with observations (Finn, 1995). However, on the other hand that is a long process, sometimes even subjective and would take a lot of man-hours to implement on a larger sample. That is why the power evaluating process takes part only on smaller samples at a time; for instance one company or one branch of a company at a time. Robbins (quoted in: Senior, 2002) argues: "Power has been described as the last dirty word... People who have it deny it, people who want it try not to appear to be seeking it, and those who are good at getting it are secretive about how they got it."

An individual's power is also very relative; one could have it one day and lose it on another (Mintzberg, 1983). Or one could have power in one group, and have none in another group of people simultaneously. Power is difficult to measure, since it can only be perceived (Marič & Ferjan, 2011).Power is difficult to measure, since it can only be perceived. From the social-psychological perspective, a person's behaviour is affected by his or her behavioural intentions, which are in turn influenced by an attitude and set of perceptions. Behavioural intention is regarded as a key antecedent in determining one's future behaviour (Wu et al., 2008). We could say that power concerns the capacity of individuals to exert their will over others.

In a company or in an organization there are basically two kinds of power: formal and informal power (Mintzberg, 1983). While formal power is defined, the informal power that is in many cases even more important is not so well defined. Here we will focus on individual's formal power within organizations.

Formal power comes from one's place in the hierarchy, one's duties and their position and is well defined. Hierarchical levels are adjusted to convey the relative authority of employees (Rosenbaum, 1980). Power resides in the position no matter who has it (Moorhead & Griffin, 2010) so it is similar to authority. When constructing a position in an organization the power of this position is determined. The person in this position has all the power and all the limitations that the position holds. Formal power on an individual's level consists of: legitimate power, reward power, coercive power and information power (George & Jones, 2008). Formal power basically comes from placement in the organizational hierarchy.

4. RESEARCH QUESTIONS

Below we will explore the influence of one's formal level of education with respect to an individual's formal power in an organization. Higher level of formal education is considered as a way of getting everything that one wants in life (often climbing the hierarchical ladder) and the thing that many consider as the cover of it all is power. There are several ways to gain power, and one of the most commonly perceived ways is education. For instance when one introduces himself as PhD, the all, at least the vast majority of people

around him think that he knows everything. Hogan (2005) claims that people respect someone who has a higher position (M.D. vs. orderly), more extensive education (Ph.D. vs. high school), and more experience (20 years of work experience vs. just out of school). That brings us to our research questions.

- *R1: What kind of effect does individual's higher level of formal education have on individual's formal power in the organization?*

- *R2: What kind of positions do individuals' achieve in the hierarchy of an organization compared to their achieved level of formal education?*

5. METHODOLOGY

Participants in this study were selected randomly. The sample consisted of 232 men and 277 women (N=509). The age range of the respondents was between 30 and 61 years. The average age of the respondents was 41.35 years, the average level of education was 5.26 (a little above completed high school), and the average place in the organization's hierarchy was 3.50 (middle administrative staff).

The questionnaire contained closed questions referring to: (i) general data (age, gender), (ii) education, (iii) an individual's formal power within an organization. An individual's formal power was measured through their place in the hierarchy of the organization. Individuals were asked about their place in the hierarchy of the organization that they are working in. We have developed and used the following hierarchical scale: (1) manual worker, (2) head of the shift, (3) routine administrative staff, (4) non-routine administrative staff, (5) expert, (6) lower management, (7) middle management, (8) top management.

The final "hierarchical" structure of the sample is shown in Table 1. We have developed a concept to classify the placements in the hierarchy ourselves and created eight degrees of hierarchical placement of individuals in the organization's hierarchy which relates to their formal power.

Table 1: Placement in the Organization's Hierarchy (n=509)

Hierarchical Position	*1. Manual Worker*	*2. Head of Shift*	*3. Routine Admin. Staff*	*4. Non-Routine Admin. Staff*	*5.Expert*	*6. Lower Management*	*7. Middle Management*	*8. Top Management*	*Total*
N	*164*	*43*	*76*	*38*	*84*	*32*	*38*	*34*	*509*
%	*32,2*	*8,4*	*14,9*	*7,5*	*16,5*	*6,3*	*7,5*	*6,7*	*100*

Mean = 3.50; Median = 3.00; Std. Deviation = 2.303;

The individual's *final level of formal education* was measured through the achieved degree of education. The following scale was used: (1) did not finish basic school, (2) finished basic school (8 years), (3) secondary school (2 years), (4) secondary school (3 years), (5) secondary school (4 years), (6) two year study, (7) higher education, and (8) master's degree, doctorate degree. The final formal educational structure of the sample is shown in Table 2. In Slovenia, the education classification from 1980 is used and has eight degrees (Ferjan & Jereb, 2008).

Table 2: Formal educational structure (n=509)

Education degree	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*Total*
N	*6*	*41*	*20*	*74*	*159*	*60*	*112*	*37*	*509*
%	*1,2*	*8,1*	*3,9*	*14,5*	*31,2*	*11,8*	*22,0*	*7,3*	*100*

Mean = 5.26; Median = 5.00; Std. Deviation = 1.67;

- The *educational success at the last level of formal education* was measured on a grading scale from 6 to 10, where: (6) sufficient, (7) good, (8) very good, (9) almost excellent and (10) excellent which is in use by Slovenian universities. Primary and secondary schools in Slovenia use a grades scale from 1 to 5; because of which the grades from 1 to 5 were converted into grades ranging from 1 to 10 as follows: 1 converted into 5; 2 converted into 6; 3 converted into 7; 4 - 4,5 converted into 8; 4,5 - 4,75 converted into 9; 4,75 – 5 converted into 10.

Table 3: Average Grade at the Last Educational Level (n=509)

Average grade	6 – Sufficient (6,00-6,99)	7 – Good (7,00-7,99)	8 – Very Good (8,00-8,99)	9 – Almost Excellent (9,00-9,49)	10 – Excellent (9,50-10,00)	*Total*
Frequency	*48*	*199*	*181*	*53*	*28*	*509*
Percent	*9,43*	*39,10*	*35,56*	*10,41*	*5,50*	*100*

Mean = 7.7055; Median = 8.00; Std. Deviation = 0.96477;

Self-initiative regarding the search for additional training was measured through surveying the respondents about how often they search for appropriate additional forms of education and training. A grading scale from 1 to 5 was used, where: (1) never, (2) very rarely, (3) occasionally, (4) often and (5) permanently.

Table 4: Self-initiative Regarding the Search of Appropriate Education or Training Contents (n=509)

Self-initiative Regarding Education	*1 - Never*	*2 - Very Rarely*	*3 - Occasionally*	*4 - Often*	*5 - Permanently*	*Total*
Frequency	*126*	*130*	*149*	*76*	*28*	*509*
Percent	*24,8*	*25,5*	*29,3*	*14,9*	*5,5*	*100*

Mean = 2.51; Median = 2.00; Std. Deviation = 1.173;

6. RESULTS AND DISCUSSION

We can see that there are positive correlations between all of the variables. All the variables were measured on an increasing scale. As seen in the table above there is a positive correlation between the achieved level of education and all of the place in the hierarchical structure which we used as a measure of formal power in an organization are above 0,304 and are all statistically significant. Table 5 gives the correlation coefficients between the previously described variables.

Table 5: Pearson R Correlation Coefficients (n=509)

	Achieved level of education	*Average grade at the last level of education*	*Self-initiative regarding the search for additional education or training*
Average grade at the last level of education	*0,332**		
Self-initiative regarding the search for additional education or training	*0,488**	*0,235**	
Place in the hierarchical structure	*0,628**	*0,304**	*0,469**

** Correlation is significant at the 0.01 level (2-tailed).*

To continue, a regression analysis between the independent variables (*Achieved level of formal education, Average grade at the last level of formal education and Self-initiative regarding the search for additional education or training*) and the dependent variable (*Place in the hierarchical structure*) has been made and is shown below in Table 6.

Table 6: Regression Analysis for the Dependent Variable "Place in the Hierarchical Structure" (n=509)

Predicators	*Unstandardized Coefficients*		*Standardized Coefficients*	*t*	*Sig.*
	B	*Std. Error*	*Beta*		
(Constant)	-2,790	,621		-4,495	,000
Achieved Level of Education	,684	,054	,498	12,564	,000
Average Grade at the Last Level of Education	,218	,085	,091	2,567	,011
Self-Initiative Regarding Education	,402	,075	,205	5,323	,000

Dependent Variable: Place in the Hierarchical Structure

With the predictors *"Achieved Level of Formal Education", "Average Grade at the Final Level of Formal Education", "Self-initiative Regarding the Search for Additional Education and Training"* 43.3% variance of "*Place in the hierarchical structure"* is explained. The achieved level of formal education (β=0.498) has the most influence. Individuals educated differently have different abilities of reaching higher positions in the hierarchical structure which answers *R1*.

The answer to *R2* lies in Table 7 where we can see that not even one individual who has not completed primary school achieved a position in the hierarchy higher than the position of *manual worker*. On the other hand 35.15% of the individuals who achieved the highest level of formal education also achieved the top management positions in organizations and 94.6% of the achieved positions in the hierarchy that are at the level of experts or management (r=0.628 at p=0.01).

Table 7: An Individual's Position in the Hierarchy Compared to an Individual's Achieved Level of Formal Education (n=509)

		Position in the Hierarchy								*Total*
		Manual Worker	*Head of Shift*	*Routine Admin. Staff*	*Non-routine Admin. Staff*	*Expert*	*Lower Manag.*	*Middle Manag.*	*Top Manag.*	
Achieved Level of Education	*1*	100,0%								100.0%
	2	85,4%	2,4%	2,4%		7,4%			2,4%	100.0%
	3	75,0%	15,0%	5,0%	5,0%					100.0%
	4	62,2%	16,1%	4,1%	10,8%	4,1%	1,4%		1,4%	100.0%
	5	28,3%	13,8%	27,0%	10,2%	8,8%	5,0%	3,1%	3,8%	100.0%
	6	20,0%	3,3%	16,7%	6,7%	25,0%	15,0%	10,0%	3,3%	100.0%
	7	4,5%	2,7%	14,3%	8,0%	32,1%	10,7%	17,9%	9,8%	100.0%
	8			5,4%		35,15%	5,4%	18,9%	35,15%	100.0%
Total		32,2%	8,4%	14,9%	7,5%	16,5%	6,3%	7,5%	6,7%	100,0%

1 - did not finish primary school. 2 - finished primary school. 3 - secondary school (2 years). 4 - secondary school (3 years). 5 - secondary school (4 years). 6- two year study. 7 - higher education. 8 - master's degree. doctorate degree

Of course, characteristics do not fit every single individual but we still think that people who have achieved higher levels of formal education also have higher tendencies toward the top of the hierarchical structure and also have better possibilities of achieving higher positions.

7. CONCLUSION

An individual's power is an always important factor in one's personal as well as business life. Education is a factor in one's power yet the mere presence of formal education will not give you power as many believe. This study provides basic insights into the connection between one's formal education and power and it can be summarized as follows: an individual's formal education is one of many things that compose into individual's formal power. However, it does not explain the whole concept of power because there is an infinite number of variables that influence one's power and we can only explain them in parts.

Several limitations of this study need to be considered before interpretations of the results can be explored. First; the discussed findings and implications were obtained from a single study; generalizing the results should be done with caution. Second; the whole research was focused mostly on how an individual's education affects one's formal power. We have had that in mind already in the beginning when we were defining the goal of the study so that it is relatively simple with a concept that is influenced by many other variables that are not included in this study.

We can all agree that there is a lot more to power that just these variables that we used in our study to determine it but still even this simple study shows that there are some basic predispositions to having formal power and that one of them is formal education. Maybe in a way the findings are area specific because formal education is so emphasized in this study. However, it is still an interesting way for simplistically evaluating one's potential power depending on formal education.

One of the factors that influence an individual's power could also be the power of their parents and their social position. A similar study regarding the influence of social class position as a determinant of educational achievements has already been done (Ferjan & Jereb, 2008) and the results could also be used to determine power and its sources.

According to the findings, the perceptions and the "size" of an individual's formal power in an organization depends on one's level of formal education. One man once said that all people are divided into two groups; the leaders and the followers. Most people are simple followers but those who want to be leaders need power to achieve that someone will follow them. Leadership facilitates quality relationships and balances power (Pinchot, 1992).

REFERENCES

Bowles, S., & Gintis, H. (2002). Schooling in Capitalist America Revisited. *Sociology of Education,* 75(1), 1-18.

Burke, R. J., & Ng, E. (2006). The changing nature of work and organizations: Implications for human resource management. *Human Resource Management Review,* 16, 86–94.

European Commission – Education & Training – lifelong learning programme – A single umbrella for education and training programmes. Found on June 8th 2009 on web address http://ec.europa.eu/education/lifelong-learning-programme/doc78_en.htm (8.6.2009)

Ferjan, M., & Jereb, E. (2008). Social Class Position as a Determinant of Educational Achievement. *Društvena Istraživanja,* 17(4-5), 869-886. doi: 316.342.2(497.4):37

Jereb, E., Ferjan, M., & Jesenko, J. (2009). Conceptual Model of Study Progress in Higher Education. *Didactica Slovenica – Pedagoška obzorja,* 24(1), 168-184. doi: 37.091.212.7

Finn, B. (1995). *Organization. Power and Change.* Handelshøjskolens Forlag, Copenhagen, ISBN 9788716132482.

George, J. M., & Jones, G. R. (2008). *Understanding and managing organizational behavior. (5th ed.).* Upper Saddle River: Pearson Education, Inc.

Hogan, K. (2005). *The science of influence: how to get anyone to say »yes« in 8 minutes or less!* Hoboken, New Jersey, John Wiley & Sons. Inc.

Lynn, I. (2000). Knowledge, Labour and Education. *Compare,* 30(3), 275-282.

Marič, M., & Ferjan, M. (2011). Managing with power in the organisation to achieve common progress. T. Kern & V. Rajkovič (eds), *People and sustainable organization*, Frankfurt am Main, Peter Lang, ISBN 978-3-631-62113-4.

Mintzberg, H. (1983). *Power in and Around Organizations*. Englewood Cliffs, Prentice Hall.

Moorhead, G., & Griffin, R. W. (2010). *Organizational Behavior: Managing People and Organizations. (9th ed.).* South-Western: Cengage Learning.

Pinchot, E. S. (1992). Balance the Power. *Executive Excellence,* 9(9), 3-5.

Rees, R. (1999). Power: an example of its changing nature. *The Canadian Journal of Higher Education,* 29(1), 27-46.

Rosenbaum, J. E. (1980). Hierarchical and Individual Effects on Earnings. *Industrial Relations,* 19(1), 1-14.

Senior, B. (2002). Organisational change, Harlow, Prentice Hall.

Unterhalter, E., & Dutt, S. (2001). Gender, Education and Women's Power: Indian state and civil society intersections in DPEP (District Primary Education Programme) and Mahila Samakhya. *Compare,* 31(1), 57-73.

Wagner, J. A. III, & Hollenbeck, J. R. (2010). *Organizational Behavior: securing competitive advantage.* Routhledge, New York, ISBN 0-203-87353-X.

Wu, W., Chang, H. P., & Guo, C. J. (2008). An Empirical Assessment of Science Teachers' Intentions toward Technology Integration. *The Journal of Computers in Mathematics and Science Teaching,* 27(4), 499-520.

ICT AND MANAGEMENT

USE OF TEMPORAL CONCEPTS IN TRANSACTIONAL DATABASES

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Abstract: *The last quarter-century, a number of researchers and experts are engaged in the study of temporal concepts in databases. Justification of a large number of research papers is that conventional DBMS are not able to respond to some of the tasks imposed by the modern business environment. These tasks are related to tracking the state in real system on one hand, while on the other hand they are related to tracking the state of database itself. Furthermore, the study of information systems, as one of its goals, is to make better description of the real system and the problems that need to be addressed. The consequence of this is to enrich the semantic data models with brand new or older and expanded concepts and represent real system in better way. This paper aims to present a brief overview of temporal concepts and to show their application in one of the proprietary transaction DBMS, IBM DB2 10.5.*

Keywords: *Temporal databases, SQL:2011 standard, transactional databases*

1. INTRODUCTION

History of the temporal concepts in databases is long, complicated and with a lot of controversy. In short, there are two main periods. The first period is 1986-2011 and is called SQL/Temporal. Significant research works in this period are: (Snodgrass, 1986), (Snodgrass et al., 1994), (Snodgrass, 1994), (Darwen & Date, 2006). The second period is 2008-2011 and it is characterized by the fact that temporal concepts become part of the SQL: 2011 standard. Temporal concepts in SQL: 2011 standard is largely based on the SQL/Temporal, but there are significant differences (Kulkarni & Michels, 2012).

The rest of this article is organized in the following way: Section 2 gives an overview of temporal concepts and focus on temporal features defined in SQL:2011. Section 3 provides examples of temporal concepts in transactional database in IBM DB2 10.5. The last section gives conclusions and discusses future work.

2. BASIC TEMPORAL CONCEPTS

The problem that occurs in conventional databases is that only current state is memorized. Therefore, they are referred as snapshot database. We insert new data, change or delete existing data, but state before change is not memorized. Thus, a conventional DBMS are memoryless systems (Patel, 2003).

The problem can be solved using temporal concepts. In practice there is need to implement them, but information system designers, programmers, database administrators, users in one word, ignore and simplify that fact, because of the complexity. Application were required to implement support for temporal concepts were developed for a long time with a lot of code and proved to be incomplete. As an example, IBM made research in which they compared the implementation of temporal concepts in three possible ways (Saracco et al., 2012). The first is to incorporate them directly into the database. The second is implementation by using stored procedures and triggers. The third realization consists of triggers and application logic written in Java programming language. Result of the research is that the built-in support for temporal concepts is the best solution that can reduce the size of the program code up to 45 times.

Time in temporal database is viewed as ordered sequence of points in granularity which is determined by application. For example, if we need to develop application for HR, which task is to track period of time in which employee has worked in department, minimal granularity should be one day. This means that employee in one day can do his job only in one department. In reality, every day is flow of time, not a point, because it consists of hours, minutes, seconds etc. Chronon is term in literature that is used to describe this minimal granularity of application. The consequence of defining minimal granularity, for example a day, is that events that take place in this day are simultaneous events, although in reality it does not have to be.

There are two types of temporal information (Elmasri & Navathe, 2010). First group are time series. In that situation, event is connected with one point in a time in some granularity. For example, stock value of some

company at August 15, 2013. was 50$. In practice, to process these types of information companies are using dedicated software systems – time series database server (TSDS). They are not subject of this paper.

Second group are duration events, or facts and they are referring to specific time period in database. For example, employee may have worked in financial department from August 18, 2012 until January 1, 2014. Time period is represented by its start and end time points, for example [2012-08-18, 2014-01-01]. This time period can be represented as the set of all time points from its start-time to end-time, in the specified granularity (Elmasri & Navathe, 2010). If the granularity is day, then the defined period is the sum of all days from August 18, 2012 to January 01, 2014.

Temporal concepts links time of event, or a fact with time point in database. If an event has occurred in the real world, or fact proved to be true or valid and has its conjunction with time in the database, then the time is referred to as the valid time. Transaction time is the time to indicate that the information is valid in the database, ie. in the system itself. If database has support to each of these time dimension, it is indicated as bitemporal database. These basic concepts are described, from point of SQL/Temporal. There is a slight difference in terminology between SQL/Temporal and SQL:2011 standard. It is shown in the table 1.

Table 1: SQL/Temporal vs SQL: 2011 difference in terminology

SQL/Temporal	SQL:2011
valid time	application time
transaction time	system time
validtime table	application time period table
transactiontime table	system-versioned table
bitemporal table	system-versioned application time period table

2.1. Application time period tables

Application time period table contains PERIOD clause, whereby the user can define the name of the period. These tables contain two columns: one to store the initial time of period, and the other to store the end time of period. The values in these columns are defined by user. Additional syntax is provided for users to specify primary key/unique constraints to ensure that no two rows with the same key value have overlapping periods. Application time period table stores valid time, and they suggest when a fact or event is valid in the real world. Because user defines values for initial and end time of period, changes in database can be applied before they come in real world. That is proactive update, and it reflects state of table in a future. In addition, there is a retroactive update, where changes are entered into the database after they have occurred in the real world.

This temporal concept can be used to solve the following business requirements (Saracco et al. 2012):

1. A client challenges an insurance agency's resolution of a claim involving a car accident. The agency needs to determine the policy's terms in effect when the accident occurred.
2. An online travel agency wants to detect inconsistencies in itineraries. For example, if someone books a hotel in Rome for eight days and reserves a car in New York for three of those days, the agency would like to flag the situation for review.
3. A retailer needs to ensure that no more than one discount is offered for a given product during any period of time.

2.2. System-versioned tables

In contrast to regular tables, system-versioned tables preserve old versions of rows as table is updated. Table contains two additional columns where start time and end time of period is stored. Values in these columns are set by system. Users are not allowed to supply values for these columns. These tables keep all changes of state of table, so user can logically returns on some state of database. Because of that database with this time can be referred as rollback database (it isn't related with rollback operation of transaction) (Elmasri & Navathe, 2010). System-versioned tables contain PERIOD clause, with predefined name of period SYSTEM_TIME, and specified WITH SYSTEM VERSIONING. Rows whose periods intersect the current time are called current system rows. All others are called historical system rows. Only current system rows can be updated or deleted. All constraints are enforced on current system rows only.

This temporal concept can be used to solve the following business requirements (Saracco et al., 2012):

1. An internal audit requires a financial institution to report on changes made to a client's records during the past five years.
2. A pending lawsuit prompts a hospital to reassess its knowledge of a patient's medical condition just before a new treatment was ordered.

2.3. System-versioned application time period table

If database should store application and system time at the same time, in that situation we use combined approach, system-versioned application time period table.

This temporal concept can be used to solve the following business requirements (Saracco et al., 2012):

1. A client inquiry reveals a data entry error involving the three-month introductory interest rate on a credit card. The bank needs to retroactively correct the error (and compute a new balance, if necessary).

3. TEMPORAL CONCEPTS EXAMPLES ON IBM DB2 10.5

IBM DB2 10.5 version implements all previous mentioned temporal concepts. It should be borne in mind that concepts that are described by SQL:2011 standard have different names in IBM DB2 terminology. The differences are shown in Table 2.

Table 2: terminology differences between SQL:2011 standard and IBM DB2 10.5

SQL:2011 Standard	IBM DB2 10.5
application time period tables	tables with business time
system-versioned tables	tables with system time
system-versioned application time period tables	bitemporal tables

Temporary concepts are going to be presented in following examples. That will be done using Product table. In one point of time, discount for only one product should be enabled.

3.1. Tables with business time

Creation of table with business time in IBM DB2 is done using following command:

```
CREATE TABLE Product(
id INT NOT NULL,
name VARCHAR(20),
price DECIMAL,
discount INT,
bus_start DATE NOT NULL,
bus_end DATE NOT NULL,
PERIOD BUSINESS_TIME(bus_start, bus_end),
PRIMARY KEY(id, BUSINESS_TIME WITHOUT OVERLAPS)
)
```

In IBM DB2 implementation of temporal concepts, user doesn't have the possibility to define the name of the period. It is predefined as BUSINESS_TIME. Bus_start and bus_end columns present start and end time. Optional command BUSINESS_TIME WITHOUT OVERLAPS is used for primary key limitation. That means that 2 versions of the same product, which are valid in one same point of time, cannot exist. Inserting rows into Product table is shown in the following example:

```
INSERT INTO Product
 VALUES(1, 'Black Shoes', 150, 10, '2012-12-25', '2013-01-10'),
       (1, 'Black Shoes', 150, 5, '2013-01-10', '2013-01-31'),
       (1, 'Black Shoes', 150, 0, '2013-01-31', '9999-12-30'),
       (2, 'Moccasin', 100, 5, '2012-09-01', '2013-04-01')
```

Table 3: table with business time after INSERT statement

id	name	price	discount	bus_start	bus_end
1	Black Shoes	150	10	2012-12-25	2013-01-10
1	Black Shoes	150	5	2013-01-10	2013-01-31
1	Black Shoes	150	0	2013-01-31	9999-12-30
2	Moccasin	100	5	2012-09-01	2013-03-01

If we tried to execute following SQL statement:

```
INSERT INTO Product VALUES (1, 'Black Shoes', 150, 10, '2013-06-06', '2013-07-07')
```

An error would occur because of defined limitation for Period temporal data. Syntax for UPDATE command is expanded with FOR PORTION clause that supports temporal data. This clause is used to specify a period of time for which update is going to be done.

The result of next UPDATE statement, used for Table 3, is shown in Table 4:

```
UPDATE Product
   FOR PORTION OF BUSINESS_TIME FROM '2013-06-01' TO '2013-09-01'
SET discount = 20
WHERE id = 1;
```

Table 4: table with business time after UPDATE FOR PORTION

id	name	price	discount	bus_start	bus_end
1	Black Shoes	150	10	2012-12-25	2013-01-10
1	Black Shoes	150	5	2013-01-10	2013-01-31
1	**Black Shoes**	**150**	**0**	**2013-01-31**	**2013-06-01**
1	**Black Shoes**	**150**	**20**	**2013-06-01**	**2013-09-01**
1	**Black Shoes**	**150**	**0**	**2013-09-01**	**9999-12-30**
2	Moccasin	100	5	2012-09-01	2013-04-01

Two rows are processed with UPDATE command for product 1. Each of 2 original rows will split into 2 rows, as shown, because the command includes a part of period inside these 2 rows in the table.

For removing data from table with business time, operation can be limited to specific part of the time, by specifying FOR PORTION OF BUSINESS TIME clause. If a row should be deleted, and data are not fully included in that part of time, DB2 would provide that row information is saved.

Result for the following command executed over Table 4:

```
DELETE FROM Product
 FOR PORTION OF BUSINESS_TIME FROM '2012-09-01' TO '2013-01-01'
WHERE id = 2
```

is shown in Table 5.

Table 5: table with business time after DELETE FOR PORTION

id	name	price	discount	bus_start	bus_end
1	Black Shoes	150	10	2012-12-25	2013-01-10
1	Black Shoes	150	5	2013-01-10	2013-01-31
1	Black Shoes	150	0	2013-01-31	2013-06-01
1	Black Shoes	150	20	2013-06-01	2013-09-01
1	Black Shoes	150	0	2013-09-01	9999-12-30
2	**Moccasin**	**100**	**5**	**2013-01-01**	**2013-04-01**

It is possible to make temporal and non-temporal queries over table with business time. Non-temporal queries are classic SELECT commands that are also written for DBMS that don't support temporal concepts. Following 3 temporal conditions can be included in temporal queries:

- FOR BUSINESS_TIME AS OF . . . – enable the execution of query over data in specific point of time
- FOR BUSINESS_TIME FROM . . . TO . . . – enable the execution of query with condition from start to end time defined. IBM DB2 uses inclusively-exclusive approach, so end time is not taken into count
- FOR BUSINESS_TIME BETWEEN . . . AND . . . – data are selected from specific to specific time. Condition is inclusively-inclusive, which means that start and end point are included in condition for selection.

If following query is used with Table 5:

```
SELECT discount
FROM Product FOR BUSINESS_TIME AS OF '2013-03-20'
WHERE id = 1
```

The operation result is 0.

If we want to list conditions for buying product 1 in period from 2013-03-01 to 2013-07-01, following query can be made. The result is shown in Table 6.

```
SELECT *
FROM Product FOR BUSINESS_TIME FROM '2013-03-01' TO '2013-07-01'
WHERE id = 1;
```

Table 6: result of SELECT statement with condition FOR BUSINESS_TIME

id	name	price	discount	bus_start	bus_end
1	Black Shoes	150	0	2013-01-31	2013-06-01
1	Black Shoes	150	20	2013-06-01	2013-09-01

3.2. Tables with system time

Creation of table with system time is going to be shown. In IBM DB2 database, old rows are kept in history table – table that is separated from table with current data, with the same structure (Saracco et al., 2012). For IBM DB2 database table creation is done in 3 steps:

1. Create the base table for current data – it contains 3 TIMESTAMP columns, 2 for start and end point of system time and one for transaction start time. (In DB2 this column is used to follow the first execution of data changing command). These three columns can be specified with GENERATE ALWAYS, so on INSERT, UPDATE or DELETE command new values will be generated in database. Optionally, you may define these columns as IMPLICITLY HIDDEN so they won't show up in SELECT * statements.
2. Create the history table - this table has structure identical to the table that contains current data. This is easy step with CREATE TABLE . . . LIKE statement.
3. Alter the current table to enable versioning and identify the history table.

Now we will see these 3 steps. First is to create base table. We can do it with command:

```
CREATE TABLE Product(
id INT PRIMARY KEY NOT NULL,
name VARCHAR(20),
price DECIMAL,
discount INT,
sys_start TIMESTAMP(12) GENERATED ALWAYS AS ROW BEGIN NOT NULL,
sys_end TIMESTAMP(12) GENERATED ALWAYS AS ROW END NOT NULL,
trans start TIMESTAMP(12) GENERATED ALWAYS AS TRANSACTION START ID IMPLICITLY HIDDEN,
PERIOD SYSTEM_TIME (sys_start, sys_end)
);
```

Now we will create related history table.

```
CREATE TABLE Product_history LIKE Product
```

The last step is to enable versioning:

```
ALTER TABLE Product ADD VERSIONING USE HISTORY TABLE Product_history;
```

Suppose now that the following command was executed on April 13, 2012. Results are displayed for current row is in table 7, and history rows in table 8.

```
INSERT INTO Product(id, name, price, discount)
VALUES (1, 'Black Shoes', 150.00, 10);
INSERT INTO Product(id, name, price, discount)
VALUES (2, 'Moccasin', 100.00, 5);
```

Table 7: Product table after INSERT statement

id	name	price	discount	sys_start	sys_end
1	**Black Shoes**	**150**	**10**	**2014-04-13 17:53:25**	**9999-12-30 00:00:00**
2	**Moccasin**	**100**	**5**	**2014-04-13 17:53:25**	**9999-12-30 00:00:00**

Table 8: Product_history table after INSERT statement - empty

id	name	price	discount	sys_start	sys_end

For each row in database TIMESTAMP VALUES are generated for system time, and transaction start time. Value in column SYS_END is set to December 30, 9999. This means that these rows are current.

If we run UPDATE command on current rows, old versions of rows will be memorized in history table. Suppose now that the following command was executed on April 15, 2014.

```
UPDATE Product
SET discount = 30
where id = 1;
```

Row that keeps current data is updated and copy of old row is moved to history table as shown in table 10.

Table 9: Product table after UPDATE statement

id	name	price	discount	sys_start	sys_end
1	**Black Shoes**	**150**	**30**	**2014-04-15 12:53:25**	**9999-12-30 00:00:00**
2	Moccasin	100	5	2014-04-13 17:53:25	9999-12-30 00:00:00

Table 10: Product_history table after UPDATE statement

id	name	price	discount	sys_start	sys_end
1	**Black Shoes**	**150**	**10**	**2014-04-13 17:53:25**	**2014-04-15 12:53:25**

If data is going to be deleted, they are moved to history table. END_TIME of deleted data is time of the transaction. Suppose the following command was executed on April 20, 2014.

```
DELETE FROM Product WHERE id = 2;
```

Tables that show current and history rows are shown in table 11 and table 12.

Table 11: Product table after DELETE statement

id	name	price	discount	sys_start	sys_end
1	Black Shoes	150	30	2014-04-15 12:53:25	9999-12-30 00:00:00

Table 12: Product_history table after DELETE statement

id	name	price	discount	sys_start	sys_end
1	Black Shoes	150	10	2014-04-13 17:53:25	2014-04-15 12:53:25
2	**Moccasin**	**100**	**4**	**2014-04-13 17:53:25**	**2014-04-20 12:13:45**

Conducting the temporal queries in tables with the system time is functioning on the same way as they functioning in table with business time. The only difference is that the result can contain history rows.

Before we represent bitemporal tables, there is overview which compares the key characteristics of system time and business time (Mathias, 2012).

Table 13: key characteristics of system time and business time

Characteristics of system time	Characteristics of business time
Captures the time when changes happen to data inside DB2 database.	Captures the time when changes happen to business objects in the real world
Maintains a history of updated and deleted rows, generated by DB2	Maintains application-driven changes to the time dimensions of business objects
History based on DB2 system timestamps	Dates or timestamps are provided by application
DB2's physical view of time	Your application's logical view of time
Spans from the past to the present time	Spans past, present, and future time
System validity (transaction time)	Business validity (valid time)
Supports queries such as: "Which policies were stored in the database on June 30?"	Support queries such as: "Which policies were valid on June 30?"

3.3. Bitemporal tables

Next example shows how to create bitemporal table:

```
CREATE TABLE Product(
id INT NOT NULL,
name VARCHAR(20),
price DECIMAL,
discount INT,
bus_start DATE NOT NULL,
bus_end DATE NOT NULL,
sys_start TIMESTAMP(12) GENERATED ALWAYS AS ROW BEGIN NOT NULL,
sys_end TIMESTAMP(12) GENERATED ALWAYS AS ROW END NOT NULL,
trans_start TIMESTAMP(12) GENERATED ALWAYS AS TRANSACTION START ID IMPLICITLY HIDDEN,
PERIOD BUSINESS_TIME(bus_start, bus_end),
PERIOD SYSTEM_TIME (sys_start, sys_end),
PRIMARY KEY(id, BUSINESS_TIME WITHOUT OVERLAPS));
```

Once the table is created as bitemporal, it is necessary to make a copy of the same table. After that it is necessary to link created tables, and allow versioning. Complete procedure is explained in the previous section.

For example, assume that product 1 is created by user on 19 Apr 2014 with discount of 10%. Discount is set to go into effect on 01 May 2014.

```
INSERT INTO Product(id, name, price, discount, bus_start, bus_end)
VALUES(1, 'Black Shoes', 150, 10, '2014-05-01', '9999-12-30');
```

Suppose that on 20 April 2014, someone change the terms of discount for product 1. Discount is set to go into effect on 01 June 2014 and discount increases to 20%.

```
UPDATE Product
 FOR PORTION OF BUSINESS_TIME FROM '2014-06-01' TO '9999-12-30'
SET discount = 20
WHERE id = 1;
```

Because of simplifying the display instead of TIMESTAMP data type for the system time we will show only the date part. Tables Product and Product_history look like Tables 14 and 15 respectively.

Table 14: Bitemporal table Product

id	name	price	discount	bus_start	bus_end	sys_start	sys_end
1	Black Shoes	150	20	2014-06-01	9999-12-30	2014-04-20	9999-12-30
1	Black Shoes	150	10	2014-05-01	2014-06-01	2014-04-20	9999-12-30

Table 15: Bitemporal table Product_history

id	name	price	discount	bus_start	bus_end	sys_start	sys_end
1	Black Shoes	150	10	2014-05-01	9999-12-30	2014-04-19	2014-04-20

Now let's look at an example showing the advantages of the bitemporal concept. Customer calls contact center on 15 July 2014 and complains about the bill. Customer thinks that value of discount is not adequate and requires all changes in price and discount in the last year.

Database administrator can set following query:

```
SELECT *
FROM Product
 FOR SYSTEM_TIME FROM '2013-07-15' TO '2014-07-15'
WHERE id = 1;
```

Result of this query is presented in Table 16.

Table 16.

id	name	price	discount	bus_start	bus_end	sys_start	sys_end
1	**Black Shoes**	**150**	**20**	**2014-06-01**	**9999-12-30**	**2014-04-20**	**9999-12-30**
1	**Black Shoes**	**150**	**10**	**2014-05-01**	**2014-06-01**	**2014-04-20**	**9999-12-30**
1	**Black Shoes**	**150**	**10**	**2014-05-01**	**9999-12-30**	**2014-04-19**	**2014-04-20**

Bitemporal tables can implement temporal queries with 3 types of conditions: conditions with business time only, conditions with system time only and conditions with combination of business time and system time. First two types are already mentioned when we talked about system-versioned tables and application time period tables. Third type of temporal queries combine conditions of these two groups.
Following 6 temporal conditions can be included in temporal queries:

- FOR BUSINESS_TIME AS OF . . .
- FOR BUSINESS_TIME FROM . . . TO . . .
- FOR BUSINESS_TIME BETWEEN . . . AND . . .
- FOR SYSTEM_TIME AS OF . . .
- FOR SYSTEM_TIME FROM . . . TO . . .
- FOR SYSTEM_TIME BETWEEN . . . AND . . .

Suppose that tables Product and Product_history are presented with data in Table 14 and Table 15.
Result of following query, which is combination of conditions with business and system time, is presented in Table 17.

```
SELECT *
FROM Product
 FOR BUSINESS_TIME AS OF '2014-05-01'
 FOR SYSTEM_TIME FROM '2014-04-19' TO '9999-12-30'
```

Table 17: Resulting query which is combination of conditions with business and system time

id	name	price	discount	bus_start	bus_end	sys_start	sys_end
1	**Black Shoes**	**150**	**10**	**2014-05-01**	**9999-12-30**	**2014-04-19**	**2014-04-20**
1	**Black Shoes**	**150**	**10**	**2014-05-01**	**2014-06-01**	**2014-04-20**	**9999-12-30**

4. CONCLUSION

Temporal concepts in transactional databases enable users to implement tracking the state in real system and tracking the state in database itself, and combination of both concepts. Using temporal concepts we can remove basic problem of these systems. Temporal concepts, specified in SQL:2011, simplify the logic of applications, stored procedures and triggers, which would be used if we want to implement tracking the state of tables in database. IBM DB2 10.5 is commercial solution that fully supports temporal concepts. Future directions should consider joins with temporal condition - temporal joins.

REFERENCE

Darwen, H., & Date, C. J. (2006). An overview and Analysis of Proposals Based on the TSQL2 Approach, In *Date on Database: Writings 2000-2006,* 481-514, Apress,

Elmasri, R., & Navathe, B. S. (2010). *Fundamentals of Database Systems*, Addison-Wesley, 943-967

Kulkarni, K., & Michels, J. E. (2012). Temporal features in SQL: 2011. *ACM SIGMOD Record, 41*(3), 34-43.

Matthias, N. (2012) – Best Practices Temporal Data Management with DB2, Retrieved from https://www.ibm.com/developerworks/community/wikis/form/anonymous/api/wiki/0fc2f498-7b3e-4285-8881-2b6c0490ceb9/page/7d8b3282-b3d3-42a2-b225-884a86429360/attachment/43b6d119-228b-4998-a436-dc301881d8de/media/DB2BP_Temporal_Data_Management_1012.pdf

Patel, J. (2003). Temporal Database System. Department of Computing, Imperial College, University of London.

Saracco, C.M. & Nicola, M. & Gandhi, L. (2012) - A matter of time: Temporal data management in DB2, Retrieved from www.ibm.com/developerworks/data/library/techarticle/dm-1204db2temporaldata/dm-1204db2temporaldata-pdf.pdf

Snodgrass, R. T. (1986). Temporal databases. In *IEEE computer(19)*, 35-42.

Snodgrass, R.T. et al (1994) - TSQL2 Language Specification, in *SIGMOD Record 23*(1).

Snodgrass, R. T. (Ed.). (1995). *The TSQL2 temporal query language* (Vol. 330). Springer.

PERFORMANCE EVALUATION OF TEMPORAL FEATURES DEFINED IN ORACLE 12C DATABASE

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Abstract: *Conventional relational databases represent state of the business entity at a moment. Although, data changes over time with insertion of new records, update of previous records or deletion of not needed records, these changes present a modification of the state of business entity. However, there exist applications where previous state of database should be kept. In conventional relational databases the attributes involving time are manipulated mainly by the application programs, with help from the database management system (DBMS). Therefore, a need to shift time manipulation from application to DBMS is identified and implemented in SQL:2011 standard. This research aims to evaluate performance of traditional relational DBMS (RDBMS) and temporal databases. Performance comparison is conducted in controlled, experimental environment using Oracle 12c DBMS.*

Keywords*: Temporal databases, SQL:2011 standard, DBMS, performance comparison*

1. INTRODUCTION

In majority of database systems time dimension of event (record) present one of the most important attributes in its application. This is especially true for analytical database such as data warehouses (Golfarelli & Rizzi, 2011). Every event important for operation of enterprise occurs at specific point of time. Also, object and relationships between two or more objects exist only for some interval point of time. Therefore, ability to model time of real world is one of the most important subjects in many applications such as financial application, medicine (Mahmood et al., 2013), web traffic (Mokbel et al., 2013) and geographical information systems (Siabato et al., 2014).

Traditional relational databases present state of enterprise at a current point of time. In other words, previous states of object or relationship between objects (after update or delete of some record) cannot be fully retrieved. However, historical data is needed in order to gain insightful knowledge from history and thus make better decision. In most applications this problem is solved on computer application side, which resulted in expensive development. Since this can pose a serious threat in real-time transactional systems need to mitigate this problem to DBMS is identified. In 1995, the ISO SQL committee initiated a project to create a language extension to support temporal features in SQL standard. A set of language extension based on TSQL2 (Snodgrass, 1995) were submitted for standardization at that time, but unfortunately these proposals generated considerable controversy and failed to get adequate support from the ISO SQL committee's members. In addition, there were no indications that key DBMS vendors were planning to implement temporal extensions in their products. Darwen & Date (2005) criticized TSQL2 language extension, which proved this language extension was not mature enough to be applied in real world systems. First, in each temporal table there were unnamed timestamp columns which are hidden from the user. Thus, user could not access this column through traditional relational theory simply referring to the columns by name. This property is inconsistent with the principles of relational database theory. It needed to include new syntax for expressing temporal queries and modifications. Additionally, new features were needed in the catalog in order to describe tables with temporal support. Second, statement modifier are said to be flawed because syntax for queries needed to change dramatically (adding VALIDTIME prefix before SELECT statement) which is not intended in relational theory to be used as statement operator. Finally, lack of generality was stated. Defined temporal intervals failed to include support for operations on intervals in general. Also, lack of generality is seen in question whether, if it is reasonable to use hidden columns for valid times and transaction times, would it not be equally reasonable to use hidden columns for other kinds of data. Eventually, the work on extending SQL language with temporal features was cancelled in 2001.

Second attempt to implement temporal features in SQL standard started in 2008, as proposal for system-versioned tables was accepted by INCITS DM32.2 and ISO/IEC JTC1 SC43 WG3. Additionally, application-time period tables were included. In 2011, a new set of language extensions for temporal data support were submitted and accepted by the ISO SQL committee. These language extensions are now part of SQL:2011

Part 2, SQL/Foundation (ISO/IEC 9075-2:2011, 2011) as T180 – System-versioned tables and T181 – Application-time period tables, instead of appearing as a new part (Zemke, 2012).

The goal of this paper is to test whether there is significantly different decrease in performance of temporal features compared to traditional relational databases in elementary functions (INSERT, UPDATE and DELETE). Tests are executed in controlled, experimental environment using following software setup: Oracle 12c DBMS and Windows 7 Ultimate (x64) operating system, and hardware setup: computer with 4GB of RAM memory and Intel(R) Core(TM) i5 M460 processor.

To best of our knowledge only few researches were made in this field. First research, conducted by Kaufmann et al. (2013), performed benchmark analysis of non-temporal and temporal queries (defined with SQL:2011 standard), where several combinations of selection of data was performed. In this research, based on provided schema, only SELECT statements were evaluated. Similar research, done for benchmark of bitemporal tables, was performed by Kaufmann et al. (2014). They came to conclusion that existing temporal database systems highlight significant optimization potential and insufficient support for common application use case. Testing was done on Oracle 12c DBMS. Temporal query processing in Teradata was performed by Al-Kateb et al. (2013). They discussed in depth the pros and cons of the rewrite and native implementation approaches. So far it seems that most of temporal features were implemented by IBM DB2 DBMS, which is presented in white paper by Saracco et al. (2012).

The remainder of the paper is structured as follows. Section 2 gives an overview of temporal features defined in SQL:2011 standard. In section 3 design of experiment, used for performance comparison of these two systems, is introduced. Section 4 provides experimental results for traditional table and temporal tables and results analysis. Section 5 provides conclusion and further research directions.

2. TEMPORAL FEATURES IN SQL:2011 STANDARD

Time itself is very complex concept. First, measuring of time is depended of application. In astronomy time is measured in eons and solar days, in production on daily level, in sales on day and time level and in chemistry can be on nanoseconds. Second, total order relationship cannot be fully developed, which means that one time element can have more higher level and lower level of granularity (i.e. for month, lower levels of granularities are week and day, while higher levels of granularities are semester and year). Third, time carries inherited inaccuracy (indeterminacy property). (Snodgrass, 1986)

2.1. Temporal concepts

In order to explain temporal features included in SQL:2011 standard several temporal concepts are going to be explained. These concepts are defined by (Anselma et al., 2013).

Definition 1: Chronon (time quantum or moment) *c* is basic inseparable time unit, defined on domain *TC*. Mathematically, $c \in TC$.

Chronon is the simplest time unit which cannot be divided to smaller units of time. It is defined on time domain *TC* called timeline, which is an ordered set of chronons $\{c_1,\ldots, c_i,\ldots, c_j,\ldots\}$, where $c_i < c_j$, $\forall i < j$.

Definition 2: Temporal element *TE* is a set of chronons, defined on domain *TC*. Mathematically, $TE = \{tc_1,\ldots,tc_n\}$, $tc_i \in TC$, $i=1,\ldots,n$.

Disjunctions of temporal elements are a natural way of coping with time indeterminacy, in which each temporal element models one of the alternative possible temporal scenarios, where any one of which could be valid.

Determinate times can be modeled through a disjunctive temporal element (DTE) containing just one temporal element (called singleton DTE). As a result of this, any determinate temporal element can be modeled with a singleton DTE.

Although, event (fact) can relate to temporal element of one record in database interpretation of that event can vary. Jensen (2000) defined two types of interpretation. First, if temporal element presents time or period of event in real world, then this point is *valid time* temporal element. Events of this type could present time in past, present or future. If database uses this concept it is called valid time database. On the other hand if time or period presents point of time where information was entered into database then this time or period is *transaction time* temporal element and databases which use this concept are called transaction time databases. However, there exists one more type of temporal elements, besides valid and transactional,

which is called *user defined* temporal element. In this case user defines semantic and meaning of temporal element. If table contains both valid time and transactional time then this table is called *bitemporal* table. Each of temporal features can be explained through following definition:

Definition 3: Given a schema $(A_1, A_2, \ldots, A_n)$ of non-temporal attributes defined on the domain $A_i \in D_i$, $i=1,\ldots,n$ temporal relation r is an instance of the schema $(A_1, A_2, \ldots, A_n \mid T)$, where T is temporal attribute. Then, r is defined on the domain $D_1 \times \ldots \times D_n \times TC$ in which empty temporal element and value equivalent tuples are not admitted.

With this definition expressiveness property is satisfied. This formalism allows one to express (i.e., to associate with each tuple) any combination of possible scenarios (i.e., any subset of the lattice of scenarios). Based on value of temporal element T, different types of temporal databases are presented. Each tuple $x=(v_1,\ldots, v_n \mid d) \in r$, where d is a DTE, is termed a valid-time tuple. If d is DTE which presents current (system) time stamp then this tuple is termed transaction-time tuple.

2.2. System-versioned tables

In SQL:2011 standard system-versioned tables are tables that include system timestamp and, therefore, correspond to transactional time. They must include PERIOD statement with two predefined columns and WITH SYSTEM VERSIONING statement. System-versioned tables must have two and only two additional columns, one for beginning and another for end SYSTEM_TIME period. These new columns cannot be changed by the user. In other words, system can only add or change values of these fields. As additional property of system-versioned tables history is saved. This means that with UPDATE statement close end time of updated record and creates new record with start time of current timestamp. Additionally, terminology for records that intersects with current time is called *current system rows*, while others are called *historical system rows*. Finally, only current system rows can be updated or deleted and every constraint can be applied only on these records.

In Oracle system-versioned tables are implemented through temporal validity feature which allows data that is older or no longer valid or not yet valid to be hidden from queries. In other words, only active data returned by queries. These features are achieved with FLASHBACK DATA ARCHIVE option, not needing to specify anything else on table level. With this feature user can query date as of some time and between some times (and this is defined in FROM part of statement). For this purpose, in this research, PERIOD has been created with hidden columns for start date and end date. User can access them (if he/she is SQL proficient), but cannot change values.

2.3. Application-time period tables

Application-time period tables are defined in SQL:2011 standard and relate to valid time or user defined temporal elements, since user defines and controls periods. These kinds of tables are defined with PERIOD statement with two predefined columns, one for beginning of period and another for end of period. In order to prevent user to create two or more records with same value, PERIOD can be included as primary key. Data manipulation (INSERT, UPDATE and DELETE statements) are executing in same manner as ordinary tables. In other words, user controls dates and times of PERIOD columns. Since user manipulates date and time columns, user can refer to any date and time (past, present or future). Additionally, one constraint is added, which disallows creating a record where end time is lower than beginning time. For UPDATE statements additional syntax is defined which allows row splitting. Row splitting means that if there exists record with period P and UPDATE query is updating subset of P then existing record will be updated (from records beginning time to UPDATE statement beginning time) and two additional rows will be created (one record from UPDATE statement beginning time to UPDATE statement end time and another from UPDATE statement end time to records end time) in order to maintain integrity of data. Also, for DELETE statements is defined additional syntax which deletes records that satisfy time period condition, but inserts additional two rows (one from records beginning time to DELETE statement beginning time and another from DELETE statement end time to records end time).

In Oracle DBMS application-time period tables are designed in similar fashion. Only difference is that start and end of period must be defined. Therefore, user can access and manipulate with period. Feature that disallows creation of overlapping period does not exist in Oracle 12c. Therefore, user must control insert and update of records.

3. EXPERIMENTAL SETUP

In the real world business applications can and should use a lot of temporal dimensions at the same time. However, for every data model additional temporal dimension increases the complexity. It is up to user (software developer) to make decision which database features to use. Therefore, in this research performance, in terms of execution time, of temporal features implemented in Oracle 12c is tested. If there is too much difference in execution time, then it will be unreasonable to use these features, but if there is no big difference a lot of benefits can be made. First, validation of data insertion is transferred to DBMS, which reduce possibility of human error in software design and speed up execution. Second, every record from past can be retrieved and used. Therefore, final user can, even if accidentally deletes or updates record see previous state of that record. Third, historical data can be used for analytical purposes, which can lead toward new business insights. On the other hand, if there are many data operations (many insertions, updates and deletes), then there is a reasonable doubt that database will grow much faster than ordinary, memory-less database. The goal is to inspect whether there exists statistically significant difference between execution time of INSERT, UPDATE and DELETE statements between these three groups. In this research comparison of execution time between two temporal and ordinary tables is made. Temporal tables used in this paper are system-versioned table, where transaction time is saved and application-time period table where valid time is saved. Ordinary table is table without temporal features included but having two additional attributes with timestamp data type, which are controlled through application. Experiments are conducted on Oracle 12c DBMS on Windows 7 Ultimate (x64) operating system in controlled environment on computer with 4GB of RAM memory and Intel(R) Core(TM) i5 M460 processor.

SELECT statement is omitted from this research since temporal databases will eventually generate more records and therefore execution time will surely be greater. Also, SELECT statement allows new features which are usable in different way and some of them cannot be recreated through ordinary SQL query. Analysis of SELECT statement in temporal databases is explained in detail in (Kaufmann et al, 2013; Kaufmann et al., 2014).

Oracle 12c adopted many temporal feature defined in SQL:2011 standard, but implementation is incomplete. First, a temporal data manipulation language (DML) API, temporal integrity constraints, temporal joins and temporal aggregations are missing. Also, support for multiple application-time period tables are missing too. On the other hand, Flashback Data Archive (system-versioned tables) allows user to go to history and check which record was active at a point in time. This feature is used with Temporal Flashback Query.

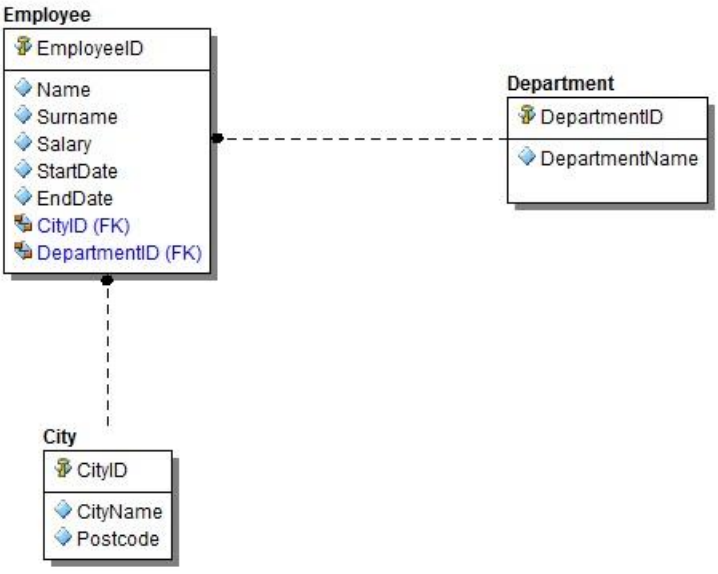

Figure 1: Idef1x schema of database

On Figure 1 Idef1x schema which is used for this research is presented. This model is used to keep records of changes of employee salary, city where employee lives and department. Columns *StartDate* and *EndDate* are temporal features. In case of system-versioned table these two columns are system times, while in case of application-time period table these columns are not overlapping time periods. SQL data definition language (DDL) for creation of tables is given below. First, ordinary table is created.

```
CREATE TABLE EMPLOYEE (
```

```
   EMPLOYEEID     NUMBER(38,0) NOT NULL,
   NAME           NVARCHAR2(250),
   SURNAME        NVARCHAR2(250),
   SALARY         NUMBER(38,2),
   STARTDATE      TIMESTAMP (6) NOT NULL,
   ENDDATE        TIMESTAMP (6) NOT NULL,
   CITYID         NUMBER(38,0) NOT NULL,
   DEPARTMENTID   NUMBER(38,0) NOT NULL,
   CONSTRAINT PK1 PRIMARY KEY ("EMPLOYEEID") )
```

Second, SQL code for system-versioned table is presented below. Since, system-versioned tables are implemented through Flashback Data Archive no need for any modification of SQL statement for creation of ordinary table, but in this paper PERIOD is created in order to get temporal validity features in transactional time. For system-versioned tables to work DBMS_FLASHBACK must be applied to tablespace. Since transactional time should not be changed start and end timestamp are marked as hidden, so it would not appear in SQL query. As a result of PERIOD part of statement, new constraint is added.

```
CREATE TABLE EMPLOYEE_SYS (
   EMPLOYEEID     NUMBER(38,0) NOT NULL,
   NAME           NVARCHAR2(250),
   SURNAME        NVARCHAR2(250),
   SYSTEM_START   TIMESTAMP(6) DEFAULT sysdate INVISIBLE,
   SYSTEM_END     TIMESTAMP(6) DEFAULT to_date('01-01-9999', 'dd-mm-yyyy')
INVISIBLE,
   PERIOD FOR SYSTEM_TIME(SYSTEM_START, SYSTEM_END),
   SALARY         NUMBER(38,2),
   CITYID         NUMBER(38,0) NOT NULL,
   DEPARTMENTID   NUMBER(38,0) NOT NULL,
   CONSTRAINT PK11 PRIMARY KEY ("EMPLOYEEID"),
   CONSTRAINT SYS_TIME1 CHECK ((SYSTEM_START<SYSTEM_END) and (SYSTEM_TIME>0))
ENABLE )
```

Finally, application-time period tables are implemented as temporal validity feature in Oracle 12c DBMS (in same manner as system-versioned table defined above). For system-versioned and application-time period visibility of data in tables with temporal support, `DBMS_FLASHBACK_ARCHIVE.enable_at_valid_time` procedure must be used.

```
CREATE TABLE EMPLOYEE_APP (
   EMPLOYEEID     NUMBER(38,0) NOT NULL,
   NAME           NVARCHAR2(250),
   SURNAME        NVARCHAR2(250),
   VALID_START    TIMESTAMP (6) NOT NULL,
   VALID_END      TIMESTAMP (6) NOT NULL,
   PERIOD FOR VALID_TIME(VALID_START, VALID_END),
   SALARY         NUMBER(38,2),
   CITYID         NUMBER(38,0) NOT NULL,
   DEPARTMENTID   NUMBER(38,0) NOT NULL,
   CONSTRAINT PK111 PRIMARY KEY ("EMPLOYEEID"),
   CONSTRAINT VALID_TIME1 CHECK ((VALID_START<VALID_END) and (VALID_TIME>0))
ENABLE )
```

For every table, defined above, following SQL command applies.

```
ALTER TABLE EMPLOYEE (
   CONSTRAINT FK1 FOREIGN KEY (CITYID) REFERENCES CITY (CITYID),
   CONSTRAINT FK2 FOREIGN KEY (DEPARTMENTID) REFERENCES DEPARTMENT
(DEPARTMENTID) )
```

For this experiment it is expected that temporal tables have slightly inferior performance since it needs more operations to process than ordinary table on all three tests. On the other hand, system-versioned tables should have better performance than application-time period tables since timestamps for start and end of period are not included (they are generated by default).

4. EXPERIMENTAL RESULTS

After conduction of 1000 INSERT statements, for three types of tables, results, shown in Table 1, were gathered. It can be seen that system-versioned tables performed the best with average of 8.21 milliseconds per insert, while application-time period tables performed the worst with 9.58 milliseconds insert on average. Also, each type had at least one long insert, which lasted over 100 milliseconds.

Table 1: Descriptive statistics of INSERT experiments

	Default			System-versioned tables			Application-time period tables		
	Mean	Max.	St. Dev.	Mean	Max.	St. Dev.	Mean	Max.	St. Dev.
Time	8.41	122.00	3.66	8.21	101.00	3.59	9.58	137.00	7.09

Since goal of this paper was to identify whether there exists statistically significant difference between execution time of insertion of data of different types of tables analysis of variance (ANOVA) test was conducted (since time execution have normal distribution). Results are shown in Table 2. Value of F statistic between groups is 21.351 with significance of 0.000, which means that there exists at least one statistically significant difference between groups. In order to see that information Levene homogeneity of variance test will be conducted followed by post-hoc analysis of variance.

Table 2: ANOVA test for INSERT statement

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1089.549	2	544.774	21.351	0.000
Within Groups	76469.835	2997	25.515		
Total	77559.384	2999			

In Table 3 homogeneity of variance test is shown. Value of Levene statistic is 48.370 with 2 and 2997 degrees of freedom and significance 0.000 which means that variance between groups is different and therefore Games-Howell post-hoc test will be used.

Table 3: Levene statistic of homogeneity of variance

Levene Statistic	df1	df2	Sig.
48.370	2	2997	0.000

Table 4 shows that application-time period tables performed statistically significant worse with both ordinary and system-versioned tables, which leads that this type of tables requires more computer resources, but allows using temporal features.

Table 4: Games-Howell ANOVA post-hoc analysis

(I) Type	(J) Type	Mean Difference (I-J)	Std. Error	Sig.
Default	System-versioned tables	0.20100	0.16215	0.430
	Application-time period tables	-1.16600*	0.25227	0.000
System-versioned tables	Default	-0.20100	0.16215	0.430
	Application-time period tables	-1.36700*	0.25131	0.000
Application-time period tables	Default	1.16600*	0.25227	0.000
	System-versioned tables	1.36700*	0.25131	0.000

Second type of experiment was conducted for UPDATE statements using same settings as for INSERT statement. In other words every group had 1000 executions. Time execution, in milliseconds, is presented in Table 5. As in INSERT statements experiment, system-versioned tables have shown the best performance with average 7.9 milliseconds of execution time. Similar execution time had nontemporal table with 7.94 milliseconds of execution time. Since standard deviation is low, it can be concluded that results are stable. It

is worth to notice that application-time period table had worse result, but not by far with 8.03 milliseconds average execution time.

Table 5: Descriptive statistics of UPDATE experiments

	Default			System-versioned tables			Application-time period tables		
	Mean	Max.	St. Dev.	Mean	Max.	St. Dev.	Mean	Max.	St. Dev.
Time	7.94	183.00	5.64	7.90	30.00	0.94	8.03	26.00	1.52

In order to conclude whether there are statistically significant differences between groups ANOVA test is conducted. Results are shown in Table 6. Value of F statistic is 0.368, which is explained through significance of difference execution time between groups. Since significance is 0.692, it can be stated that there are no statistically different groups, which means that execution time is approximately the same. Because of that post-hoc test should not be executed.

Table 6: ANOVA test for UPDATE statement

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.579	2	4.289	0.368	0.692
Within Groups	34917.788	2997	11.651		
Total	34926.367	2999			

Third part of experiment refers to difference in execution time of DELETE statement. Time execution, maximum deletion time and standard deviation are presented in Table 7. Ordinary and system-versioned tables have shown the best performance with average execution time 0.27 milliseconds, but since standard deviation of system-versioned table is lower it can be stated that this deletion was more stable. Application-time period table was, again, the worst with average execution time 0.57.

Table 7: Descriptive statistics of DELETE experiments

	Default			System-versioned tables			Application-time period tables		
	Mean	Max.	St. Dev.	Mean	Max.	St. Dev.	Mean	Max.	St. Dev.
Time	0.27	30.00	1.08	0.27	2.00	0.51	0.33	2.00	0.57

In order to inspect whether there are differences between execution time ANOVA test was performed. Results are shown in Table 8. Since difference in time execution between groups is not significant, it is 0.141 which is greater than 0.05, it can be stated that there are no statistically significant differences between execution times between default, system-versioned table and application-time period table.

Table 8: ANOVA test for DELETE experiments

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.275	2	1.137	1.960	0.141
Within Groups	1739.317	2997	0.580		
Total	1741.592	2999			

Finally, difference between default table and system-versioned table was not statistically significant, but system-versioned table have shown better performance. Therefore, this kind of temporal table have shown that temporal feature is capable to improve software development, since developer does not need to develop date time validation before insert, update or delete of records. Additionally, database administrators can perform history checkup of data, which can be useful in many data analysis applications. On the other hand, application-time period performed slightly worse with statistically significant slower execution time in data insertion, and slower but not statistically significant execution time in update and delete statements. Since difference was a little greater than 1.5 millisecond, it is up to user to calculate whether application will perform slower with DBMS controlling data validation or not. It is worth to state temporal features requires intuitive upgrade of SQL skills, which can be learned easily. On the other hand, Oracle 12c does not have implemented as much temporal features as IBM DB2 database, which can explain execution time performances. One possible usage of temporal features is in analytical databases, especially for slowly changing dimension (dynamic hierarchy) type 2, where ETL process could be carried out with less chance for error.

5. CONCLUSION

Experiment have shown that there exists statistically significant difference between application-time period tables and other types of tested tables, where application-time period tables have shown worse results in execution time. These results are gathered on execution time of 1000 insert statements of each type (total of 3000 records) for each of three experiments.

Conclusion can be made on two levels. First, since there are no statistically significant difference between system-versioned table and ordinary table and execution time of system-versioned tables were faster or with same execution time in every test (INSERT, UPDATE and DELETE) than ordinary tables it is better for software developers to use temporal features of database for several reasons. First, complexity of tedious validation of data is transferred to database level and it is concern of DBMS. This provides better time execution and more reliable data in organization. Second, every historical event can be reconstructed using temporal queries, which can be used for analytical purposes. As application-time period tables is concerned no grounded conclusions can be made, since performance for INSERT was statistically significant worse and for UPDATE and DELETE were just worse. It is up to user to measure whether time execution or data validation and historical information are more important. Second, it must be stated that implementation of temporal features of SQL:2011 standard is incomplete (temporal DML API, temporal integrity constraints, temporal joins and temporal aggregations are missing) and theory about temporal dimension is still in development. Also, it seems to be that Oracle did not want to cope with complexity of time dimension (support for time integrity constraint does not exist) and help software developers to build better software. It does not transfer data validation fully on DBMS. One possible explanation for the lack of temporal features is speed of execution, which we tested here. Therefore, in order to get full picture of performances of temporal features defined in SQL:2011 these experiments should be conducted on other DBMS vendors which implemented temporal features defined in SQL:2011 standard. Compared with DB2 (Saracco et al., 2012) it seems that IBM have made more work on temporal support in database with features like history table in system-versioned tables and ability to create application-time period tables for record without overlapping.

In a future, plan is to inspect other DBMS and compare performances and possibilities each of DBMS vendors. Also, it would be interesting to evaluate different performance of other statement and see whether there is correlation between them. Finally, experiment can be performed on different, much more data intensive, data models and compare performances and evaluate how much database grows (primarily, to compare whether size of database will become unpractical to use compared to memory-less databases).

REFERENCES

Al-Kateb, M., Ghazal, A., Crolotte, A., Bhashyam, R., Chimanchode, J., & Pakala, S. P. (2013, March). Temporal query processing in Teradata. In *Proceedings of the 16th International Conference on Extending Database Technology* (pp. 573-578). ACM. doi:10.1145/2452376.2452443

Anselma, L., Terenziani, P., & Snodgrass, R. T. (2013). Valid-Time Indeterminacy in Temporal Relational Databases: Semantics and Representations. *Knowledge and Data Engineering, IEEE Transactions on*, *25*(12), 2880-2894. doi:10.1109/TKDE.2012.199

Darwen, H., & Date, C. J. (2005). An Overview and Analysis of Proposals Based on the TSQL2 Approach.

Golfarelli, M., & Rizzi, S. (2011). Temporal Data Warehousing: Approaches and Techniques. In D. Taniar, & L. Chen (Eds.) *Integrations of Data Warehousing, Data Mining and Database Technologies: Innovative Approaches* (pp. 1-18). Hershey, PA: Information Science Reference. doi:10.4018/978-1-60960-537-7.ch001

ISO/IEC 9075-2:2011, Information technology - Database languages - SQL - Part 2: Foundation (SQL/Foundation), 2011.

Jensen, C. S. (2000). Introduction to temporal database research. *Temporal database management*.

Kaufmann, M., Fischer, P. M., May, N., & Kossmann, D. (2013). Benchmarking Databases with History Support. Eidgenössische Technische Hochschule Zürich, Departement Informatik. doi:10.3929/ethz-a-009994978

Kaufmann, M., Fischer, P. M., May, N., Tonder, A., & Kossmann, D. (2014). TPC-BiH: A Benchmark for Bitemporal Databases. In *Performance Characterization and Benchmarking* (pp. 16-31). Springer International Publishing. doi:10.1007/978-3-319-04936-6_2

Kulkarni, K., & Michels, J. E. (2012). Temporal features in SQL: 2011. *ACM SIGMOD Record*, *41*(3), 34-43. doi:10.1145/2380776.2380786

Mahmood, N., Burney, A., Abbas, Z., & Bari, A. K. (2013). Time Oriented Database System Using RFID. *International Journal of Computer Science Issues (IJCSI)*, *10*(3).

Mokbel, M. F., Alarabi, L., Bao, J., Eldawy, A., Magdy, A., Sarwat, M., ... & Yackel, S. (2013). Mntg: An extensible web-based traffic generator. In *Advances in Spatial and Temporal Databases* (pp. 38-55). Springer Berlin Heidelberg. doi:10.1007/978-3-642-40235-7_3

Saracco, C. M., Nicola, M., & Gandhi, L. (2012). A Matter of Time: Temporal Data Management in DB2 for z/OS.

Siabato, W., Claramunt, C., Manso-Callejo, M. Á., & Bernabé-Poveda, M. Á. (2014). TimeBliography: A Dynamic and Online Bibliography on Temporal GIS. *Transactions in GIS*. doi: 10.1111/tgis.12080

Snodgrass, R. T. (1986). Temporal databases. In *IEEE computer (19),* 35-42.

Snodgrass, R. T. (Ed.). (1995). *The TSQL2 temporal query language* (Vol. 330). Springer.

Zemke, F. (2012). What. s new in SQL:2011. *ACM SIGMOD Record*, *41*(1), 67-73. doi:10.1145/2206869.2206883

AUTOMATIC GENERATION OF EXECUTABLE UI PROTOTYPES USING SILABREQ LANGUAGE

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Abstract: *The subject of this paper is the identification of correlations between the use case model, data model and the desired user interface. Since use cases describe the interaction between the users and the system, implemented through the user interface with the aim of changing the state of the system, the correlation between these three components should be considered at the software requirements phase. Software requirements must somehow be formalized to accomplish the goal to be automatically processed and analyzed. On the other hand, these requirements need to use notation that is understandable for all participants in the software project. We strongly believe that controlled natural language with simple grammar can achieve this goal. Thereby, we have developed SilabReq project. This project includes SilabReq Language, SilabReq Transformation and SilabReq Visualization components. Using SilabReq components it is possible to establish the meta-model of software requirements which enables not only the design and implementation of the user interface, but also the automation of this process. In order to prove the sustainability of this approach, we have been development a software tool which performs the transformation of the model to an executable program code. As a final validation and verification, SilabReq project and the software tool for automation the user interface implementation process has been used for the Kostmod 4.0 project, which was implemented for the needs of the Royal Norwegian Ministry of Defense.*

Keywords: *use cases, use case specification, executable specification, user interface, user interface generation, prototype*

1. INTRODUCTION

The requirement specification, which is commonly represented by the use case model, should be detailed enough to provide the information necessary for the design and implementation of all elements of the software system - starting with the user interface, through application logic which encapsulates domain structure and system behavior, to data storage. However, the requirements specification often lacks the information required to design certain aspects of the system. In those cases, it is left to a programmer to interpret requirements and find solutions, which can often lead to results which do not meet the user's needs, e.g. when considering the user interface, one will find that the requirement specification rarely provides information about its appearance, content, types of components to be used, and so on.

The phases included in the software life cycle are the collection and specification of user requirements, analysis, design, implementation and testing. The design of the user interface starts only after the requirements phase has been completed, or even after the design of application logic.

Contrary to that, another approach to development exists - one which suggests designing the user interface parallel with the requirement specification. This approach is based on the way the user sees the software system, which can be summarized by saying that the user interface is the system! [Vliet, 2008] The reason for that is that the user is not familiar with the structural details and the ways in which the system is implemented. The requirement specification explains how the user wishes to execute a certain task using the software system. The execution of such a task entails an interaction between the user and the system, which forms a particular structure. According to this approach, the user interface should follow this structure so as to attain a higher level of software system usability. The early phases of creating a user interface often do not result in a fully functional user interface, but a prototype whose main goal is to emphasize the questions and presumptions that might not have been clarified using other approaches in requirements engineering. [Pfleeger and Atlee , 2006)]

A very important aspect in software development is the cost of a completion of software project. Given that the production of software is a series of intellectual and technical activities performed by highly-educated engineers, it becomes clear that the cost of the system greatly depends on the time and effort required for its production. The development of the user interface presents a significant part of such a process. [Kennard and Leaney,2010]. A survey [Myers and Rosson, 1992] found that 48% of a software system's programming code is related to the user interface, with about 50% of the entire development time being used for its implementation. Other research in this area has produced similar conclusions [Kivistö, 2000], regardless of the fact that tools which hasten this process and make it easier are utilized in development.

Due to the fact that the user interface represents a direct link between the user and the system, the user often alters the requirements regarding its appearance and structure during the development process. These

alterations occasionally cause changes to be made to the implemented system and often result in the discarding of the interface developed until that point. This means that the entire process must be started again. However, the user may find that even the new solution fails to meet their needs, as they often find it difficult to precisely define the requirement specification.

All these facts impose a need for the automation of the process whose goal is to devise a solution to speeding up the development of the user interface and cutting its costs. This tool would make a more efficient requirement specification process available. The user would then be able to quickly identify deficiencies in the requirement specification and remove them, resulting in the system which meets their needs as closely as possible.

The resulting user interface must be based on user requirements. The significance of software requirements in software development is best illustrated by the research which demonstrates that half of the factors which influence the success of a software project are linked specifically to software requirements. [6] Thereafter, this paper pays a great deal of attention to the process of collecting and specifying of software requirements.

The most widely used techniques for the collection of user requirements today are use case specification, [Cockburn,2000],[Jacobson et al.,1993] and user stories [Cohn, 2004]. The use case specification and user stories share certain characteristics (they are based on scenarios and user's aim oriented), but also differ in a number of ways (they vary in structure, the range of requirements covered, integrity, feasibility, and how detailed they are) [Stellman, 2009] [Cockburn, 2000] [Cohn, 2004]. The goal of both techniques is to specify the intent of the user - what the user wishes to achieve through a desired functionality. By considering the two aforementioned techniques for the collection and specification of user requirements, we can conclude that the use case specification presents a more acceptable solution than the user stories, especially when we wish to achieve automated development of certain software elements. The reason behind this is their structure, integrity, as well as the possibility of including additional details significant to different system aspects. The literature often suggests the use cases as the best choice when using the MDA (Model Driven Architecture) approach. [Fatolahi, Somé and Lethbridge, 2008].

Choosing a technique for the software requirements specification does not solve all the problems which can occur during this process, and which can later have significant consequences. One of the most common problems which occur during the use case specification process is the existence of ambiguities in use cases [Wiegers, 2006] [Silva et al., 2007]. All ambiguities in software requirements must be identified and removed as early as possible in order to avoid additional effort and save time [Frost and Campo, 2007]. Should ambiguity only occur once the implementation phase has been already reached, the necessary changes must be made, which is often very complex, time-consuming, and hard to trace [Lin, Prowell and Poore,2009].

In literature we can find a thesis: If ambiguous requirements are the enemy, the domain model is the first line of defense! [Rosemberg and Stewphens, 2007]. The literature [Cox and Phalp, 2010][Fortuna,Werner, and Borges, 2008] suggests the integration of the use case and the domain model as one way of ensuring validity of software requirements.

This paper will present the results of research whose goal has been to develop a model for the software requirement specification which would be semantically rich enough to enable the automation of the user interface implementation process.

The paper is organized as follows. In the next section, we present an overview of the Silab project and its main characteristics. Section III describes SilabReq project with emphasizes of its main component (SilabReq Language component). In Section IV, we present an overview of the SilabUI project. Finally, Section V concludes the paper and outlines some future works. The specification of the *Register new invoice* use case from the *Point of Sale System* is given in the Section III, while executable Java desktop UI prototype for this use case is shown in the Section IV.

2. AN OVERVIEW OF THE SILAB PROJECT

Silab Project was initiated in Software Engineering Laboratory at Faculty of Organizational Sciences, University of Belgrade in 2007. The main goal of this project was to enable automated analysis and processing of software requirements in order to achieve automatic generation of different parts of a software system.

At first project has been divided in two main subprojects SilabReq [Savic, Antovic, Vlajic, Stanojevic and Milic, 2011] and SilabUI projects that were being developing separately. SilabReq project considered formalization of user requirements and transformations to different UML models in order to facilitate the analyses process and to assure the validity and consistency of software requirements. On the other hand, SilabUI project considered impacts of particular elements of software requirements and data models on resulting user interface in order to develop a software tool that enables automatic generation of user interface based on the use case specification and the domain model.

When both subprojects reach desired level of maturity, they were integrated in a way that some results of SilabReq project can be used as input for SilabUI project.

As a proof of concept, Silab project has been used for the Kostmod 4.0 project, which was implemented for the needs of the Royal Norwegian Ministry of Defense. After finishing this project we have analyzed the results and we calculated that user interface for approximately 75% of total number of use cases have been

completely implemented using the Silab project, and other 10% needed minor manual development adjustments. For other 15% of use cases some parts of UI is also generated using Silab project, but it required much more manual development.

3. AN OVERVIEW OF THE SILABREQ PROJECT

It has been mentioned earlier that one of the advantages of the use case specification over other techniques for the collection and specification of requirements is its structure. This structure is not strictly defined, and different authors present the use case specification in different forms (templates).

Today's literature lists many different formats or templates for use case specification. [Malan and Bredemeyer, 1993][Bittner and Spence, 2003][Cockburn,1997][Coleman,1998.][Jacobsonet al.,1998] These templates primary provide guidelines for structuring use case description. They are a result of the need to standardize the use case specification, in order to ensure that the specification is complete and that the communication between team members in charge of the specification is comfortable.

The use case specification templates describe structural elements that each use case should contain. However, none of the those templates describes in detail the structure of the main scenario or the structure of scenario steps, except for some templates which recommend the numeration of the steps or the separation between the actions performed by the user and the ones executed by the system. The one of the key problems with use cases is their semantics, especially precise notation for specification of the use case actions. Because their semantic are poorly defined, it make them difficult to automatically process and analyze.

The authors [Cockburn, 2000] [Rosemberg and Stewphens, 2007] suggest that all steps in a scenario should be written in active voice, and in sentences with a Noun-Verb-Noun structure. The first noun signifies the doer - the user or the system as the subject of the sentence (depending on whether the action is performed by the user or the system), the verb represents the predicate of the sentence and denotes the action being executed, while the second noun marks the object of the action being performed.

The one of the key problems with use cases are their semantics, especially precise notation for specification use case actions. In his paper [Som´e, 2009], Some defines the abstract syntax of a textual presentation of the use case. The author emphasizes that certain elements (formalisms) of the UML languages such as actions, activities are formally defined through the meta-model (or the corresponding meta-class). On the other hand, UML has not formally defined meta-model for a textual description of the use cases, although text-based notation is a primary notation for the use case description. Therefore, the author defines the meta-model to describe the interaction between system users and systems. Jacobson has described steps in a use case as representing a transaction. He has identified four types of transactions:

- The primary actor sends request and data to the system.
- The system validates the request and the data.
- The system alters its internal state.
- The system replies to the actor with the result.

Even though Jacobson identified different actions in use cases the specification of these actions are left undefined in UML. In his work, Williams uses 4 basic actions (Input, Output, Computation, and Exception Handling) and 4 flow-of-control actions (Selection, Iteration, Inclusion and Extension) for use case specification [Williams, Kaplan, Klinger and Paradkar, 2005] In additional, in [Genilloud, Frank and Génova, 2006] authors were explained limitations of the graphical notation for use case specification and emphasize that use case specifications in natural language should describe the actors' actions of entering data, selecting an option, etc., and so that they can be easily read by system users and other stakeholders.

The SilabReq project includes SilabReq Language, SilabReq Transformation and SilabReq Visualization components. These components are shown in Fig. 1.

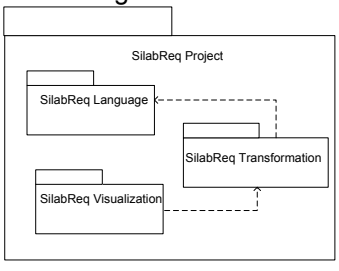

Figure 1. SilabReq main components

Because semantic of use cases are poorly defined, it make them difficult to automatically process and analyze. The goal of the SilabReq Language component is to solve these problems. The SilabReq Language component presents our SilabReq controlled natural language for use case specification [Savić, Silva,Vlajić,Lazarević, Antovic, Stanojevic and Milić, 2012]. It uses textual concrete syntax for definition of the use case context.

In order to accomplish goals SilabReq language is presented as a model. Thus, use cases can be automatically processed and analyzed. We have identified four different types of use case actions and we

have categorized them in two groups: actions which are executed by the user and actions which are executed by the system. Actor executes two types of the use case action:

- Action *Actor (user) Prepares Data for System Operation execution* (first type of user's action - APDSO)
- Action *Actor Call system to execute System Operation* (second type of user's action ACSO)

On the other hand, system executes two types of the use case action:

- Action *System Executes System Operation execution* (first type of system's action – SESO)
- Action *System Returns Results of system operation execution* (second type of system's action - SRR)

We have developed grammar for all of these actions and integrated them into SilabReq language. SilabReq is developed under XText framework. [XText] This framework is based on openArchitectureWare generator [oaW] framework, the Eclipse Modeling Framework (Eclipse Modeling Framework) [EMF] and Another Tool for Language Recognition (ANTLR) parser generator [ANTLR].

The SilabReq Transformation component is responsible for transformation software requirements into different models. Currently, we have developed transformations which transform SilabReq model into an appropriate UML model.

All of these transformations are defined through Kermeta language [30] for meta-modeling. Kermeta is the model-oriented language. Kermeta meta-model is fully compatible with Essential OMG Meta-Object Facility (EMOF) meta-model and Ecore meta-model, which is part of the Eclipse Modeling Framework (Eclipse Modeling Framework EMF).

The SilabReq Visualisation component is responsible for visual presentation of the specified software requirements. Currently, we have developed only UML presentation of these requirements. So, we can present SilabReq use cases through UML use case, UML sequence, UML activity or UML state-machine diagram.

The SilabReq Language component is the base component for the SilabReq project as well as the whole Silab project. Its main part is SilabReq language. The aim of this language is to be used for functional specification of the software requirements in use case form.

The abstract syntax of the SilabReq language is defined by meta-model, while SilabReq grammar is used to define concrete syntax of the language. One of the most import goals of the SilabReq project is to produce domain model [Larman, 2004] from use case model. In order to accomplish this goal we identified actions in use case which contain semantics that can be used to determine initial domain model of the system. In this section we present the meta-model of the SilabReq language and point out the part of this meta-model which is used to determine initial domain model. Fig. 2 shows the meta-model for SilabReq use case model.

We use SilabReq use case model (SilabReqUseCaseModel meta-class) to describe software requirements for particular software system. SilabReq use case model contains the users of the system (Actor meta-class), set of identified use cases (UseCase meta-class) and set of identified domain entities (DomainConcept meta-class). We have designed SilabReq language so that each domain entity that is determinate in use case specification must be declared firstly. Thus, we have reduced the possibility to use synonyms as well as homonyms in use case specification. Fig. 3 shows the meta-model for SilabReq use case.

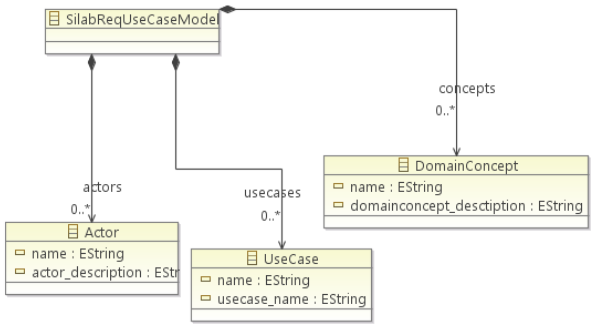

Figure 2: Meta-model for SilabReq use case model

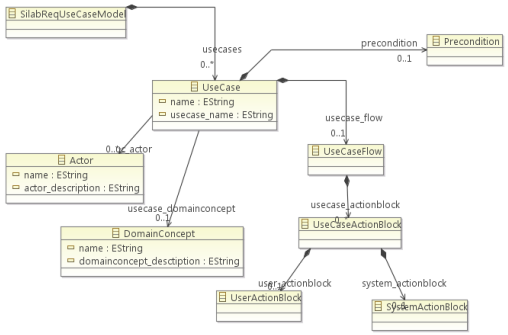

Figure 3: SilabReq use case meta-model

The following part of this section contains the specification of the *Register new invoice* use case from the *Point of Sale System* (Fig.4). This use case includes *Find customer* use case. Both of them are executed by the actor with Worker role.

Actor: Worker
Domain concept: Invoice
Domain concept: InvoiceItem
Domain concept: Product
Domain concept: Customer

UC: UC_FindCustomer "Find customer"
Actors: Worker
Use case domain concept : Customer
USE CASE FLOW
USER ACTIONS:
apdso: «1**»** Worker ENTERS data for search Customer "ID" or Customer "firstName" or Customer "lastName"
acso: «2**»** Worker **calls system to** find customer
SYSTEM ACTIONS:

```
    RESPONSE:
      SUCCESSFUL RESPONSE
        Data: SHOWS Customer  AND ALL CUSTOMER Invoice
      END SUCCESSFUL RESPONSE
    EXCEPTIONS
      "System did not found customer"  action "end use case"
    END EXCEPTIONS
    END RESPONSE
  END SYSTEM ACTIONS
  END USE CASE FLOW
END USE CASE

UC: UC_SaveInvoice "Register new invoice"
Actors:Worker
Use case domain concept : Invoice
  Precondition:
    Domain concept: Customer
    constraint description: "must be register in the system"
  End precondition
  USE CASE FLOW
  USER ACTIONS:
    include:UC_FindCustomer
    acso: «1» Worker calls system to create new invoice
  SYSTEM ACTIONS:
  RESPONSE:
    SUCCESSFUL RESPONSE
      Message: "Invoice is created"
      Data: THE LAST CREATED Invoice
    END SUCCESSFUL RESPONSE
    EXCEPTIONS
      "Invoice is not saved"  action "go to action 1"
    END EXCEPTIONS
  END RESPONSE
  END SYSTEM ACTIONS

  USER ACTIONS:
    apdso:«1» Worker ENTERS Invoice "date" when the Invoice is
created
    iterate
      apdso:«2» Worker CHOOSES Product which want to put on
InvoiceItem
      apdso:«3» Worker ENTERS InvoiceItem "quantity" per each
Product
      acso: «4» Worker calls system to add invoiceitem on the
invoice
    end iterate
    acso: «5» Worker calls system to save invoice
  SYSTEM ACTIONS:
  RESPONSE:
    SUCCESSFUL RESPONSE
      Message: "Invoice is saved"
      Data: THE LAST SAVED Invoice
    END SUCCESSFUL RESPONSE
    EXCEPTIONS
      "Invoice is not saved"  action "interruped use case"
    END EXCEPTIONS
  END RESPONSE
  END SYSTEM ACTIONS
  END USE CASE FLOW
END USE CASE
```

Figure 4. Use case specification in SilabReq language

The use case flow for the *Register new invoice* use case contains two pair of the user and the system blocks. The first block of actions is used by the actor to find an appropriate customer and to create new invoice. The second one is used by the actor to enter data for that invoice (actions form 1 to 4 in the second block).

4. AN OVERVIEW OF THE SILABUI PROJECT

The goal of SilabUI project is the identification of impacts of particular elements of software requirements and data models on resulting user interface in order to develop a software tool that enables automatic generation of user interface based on the use case specification and the domain model.

We can often find the recommendation to omit information about the user interface from the use case specification. [Larman, 2004] As one of the most common mistakes in the use case specification, authors mention existence of details related to the user interface. This recommendation comes from the legitimate concern that details related to the user interface can distract the stakeholders from the essence of the problem being analyzed when specifying software requirements. Information about the user interface is of no importance when describing the goal and the aim of the user, while the user's goal and aim are essential for use cases. However, the fact that information about the user interface is so often found within use case specification testifies to the necessity of establishing clear relations between the user interface design and the interaction between user and system as described by use cases. [Sinnig, Chalin, and Rioux, 2005]

A single use case can be realized through different templates [Antović, Vlajić, Milić, Savić and Stanojević, 2011]. By using the tools for automatic user interface generation created for the purposes of this research, it is possible to quickly and easily obtain a completely different user interface for the same use case by making simple adjustment of the selected template in the model. This way, the stakeholder can try out different templates during user requirement specifications, and decide which one suits their specific use case best. Templates are designed in such a way that they can be combined, which means that different templates can be used for a single use case and its parts.

The following part of this paper will provide an example of combining different templates into multiple depth levels. This example demonstrates one of the solutions, attained by automatically generating a user interface by utilizing a developed code generator, for a highly complicated use case which processes the entity in four levels of depth. The example shown is a part of the user interface designed for the project Kostmod 4.0, which was implemented for the needs of the Royal Norwegian Ministry of Defense. Even after familiarizing them with the potential problem, the customer decided not to deviate from their original plan. In the end, the problem was solved by combining a number different user interface templates (Fig. 6). The diagram shows a simplified data model - the part of the data model to which the aforementioned example refers to (Fig. 5).

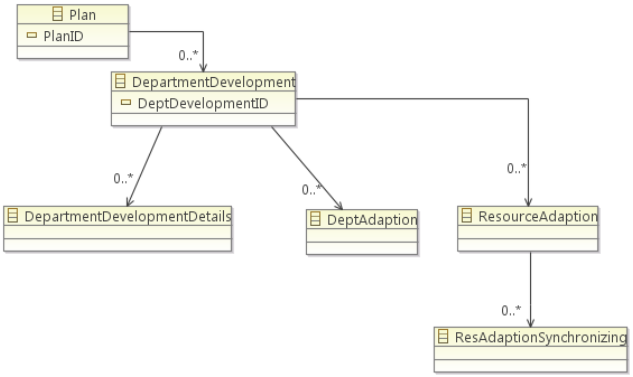

Figure 5. The part of the data model illustrating the example of combining different UI templates

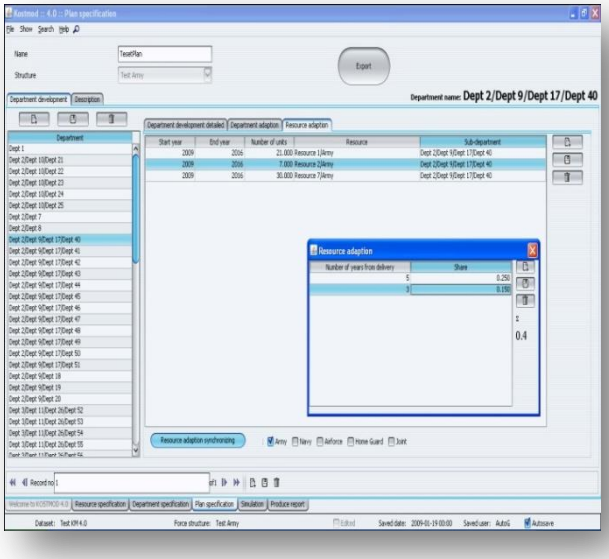

Figure 6. An example of combining different user interface templates with four levels of depth

The goal of SilabUI project was to develop a model for the specification of software requirements which would be semantically rich enough to enable the automation of the process of implementing the user interface. The basis for defining such a model are the relationship between the use case model, the data model, and the desired user interface, which were noted in the previous chapters. Considering how use cases describe the interaction between the user and the system, which is realized via the user interface and whose goal is to change the state of the system, the connection between these three components must be represented appropriately, so as to enable the automation of the user interface implementation. When defining a model, one must take care that the model follows good practice in the specification of software requirements, which means that it should provide a frame for the specification of requirements which will be understandable to all of the interested parties that take part in this process - from the engineers, to the final users.

The software requirement specification is supposed to contain information about the goal and aim of the user when executing certain system functions, and should not include implementation details, such as details about the user interface or the realization of other parts of the system. In order for the specification to remain completely in the domain of the problem, and not in the domain of the solution, it is necessary to split these two domains through a model, and make the problem domain independent of the solution domain, which usually contains one or more possible ways of realization. As the development of the model is based on the relationship observed among the use case elements, the data model, and the graphical user interface, a SilabUI meta-model has been developed. In order to enable the automatic generation of user interface through a model based on the illustrated meta-model, this model must be defined in a form which is suitable for manipulation by a Java program which will be used to realize a generator, but which is also readable and understandable by all the stakeholder during the process of requirement specification. XML is usually listed as the most suitable format for this purpose, as this language with a simple syntax is legible for both humans and computer programs.

In order to separate the specification of software requirements and information about the user interface, the user interface creation model would be specified using two separate XML documents. The first XML document represents the use cases, and part of the data model to which the use case relates, and this data is stored in the UIReq.xml file. This file can be manually created, but it can also be automatically created using SilabReq Transformation component from SilabReq project. The second XML document contains information about the elements of the graphic user interface, and every element of this document refers to a particular element from the defined UIReq.xml file. The content of the second document is specified in the UIReqExtension.xml file. The existence of the second document is not mandatory. In case the second document is not created, the default user interface elements (such as user interface templates and graphical components) will be used for displaying the use case described within UIReq.xml file. Should the requirement be that the user interface differs from the implied settings, these settings are specified in the UIReqExtension.xml file.

In order to prove the sustainability of this approach, a software tool – SilabUI generator was devised to conduct the transformation of the defined model into executable programming code. This will enable the creation of a user interface in the early phase of the software's life cycle. The figure bellow (Fig. 15) presents generated executable prototype the *Register new invoice* use case. This, in turn, gives the possibility to validate and verify user requirements, and reduces the time and effort required to implement the user interface. This software tool enables the generation of executable programming code for the interface of a

Java desktop application. The application can be used to perform basic operations on data from a relational database for a defined use case which, according to some research, includes up to 80% of all use cases describing a software system [Nakatani,Urai, Ohmura and Tamai, 2001].

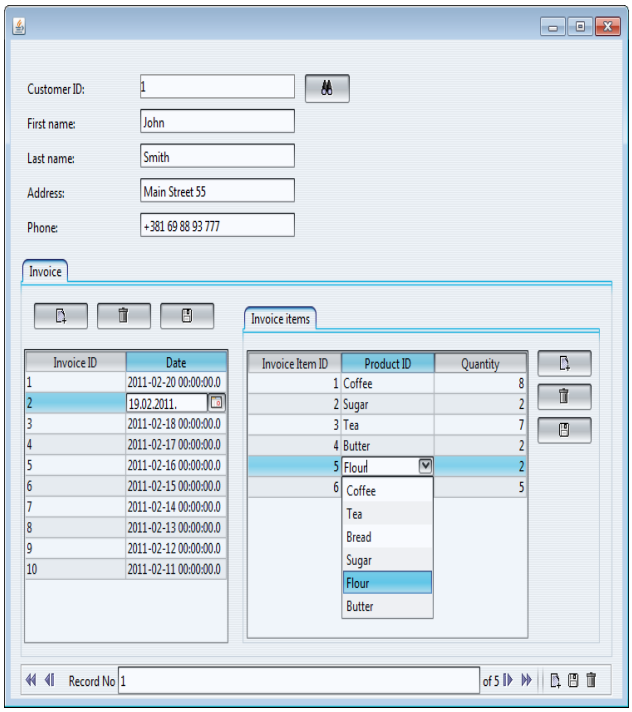

Figure 7. The prototype of the *Register new account* use case

5. CONCLUSION

This research considered the relationship which can be observed among the elements of the use case specification, the data model, and the user interface. Based on these perceived connections, a meta-model of software requirements had been developed - one which considers the elements of all three aforementioned system aspects. Using this meta-model, we can create a software requirement model which enables not only the formal specification of the user interface but the automation of this process as well. This process is supported through Silab project.

Potential further research in this area could relate to: (1) The examination of the applicability of the meta-model to various technologies and platforms (desktop applications in different technologies, web applications in different technologies and so forth), (2) The enrichment of the meta-model and generator so as to ensure support for the realization of various architectures of the resulting application, (3) The enrichment of the model with the possibility to specify more complex validation rules, (4) Ensuring the adaptability of the user interface (5) Generating different types of the automated tests.

REFERENCES

ANTLR,.ANother Tool for Language Recognition, http://www.antlr.org, access,April 2014

Antović, I., Vlajić, S., Milić, M., Savić, D. & Stanojević, V.(2011).Model and software tool for automatic generation of user interface based on use case and data model, Software, IET , vol.6, no.6, pp.559-573, Dec. 2012 doi: 10.1049/iet-sen.2011.0060D.

Bittner, K. & Spence, I. (2003). Use Case Modeling. Addison-Wesley

Cockburn. A. (1997). Structuring Use Cases with Goals, Journal of Object-Oriented Programming

Coleman.D., (1998). A Use Case Template: Draft for discussion. Fusion Newletter, http://www.bredemeyer.com/pdf_files/use_case.pdf

Cockburn, A.(2000). Writing Effective Use Cases, Addison Wesley Longman Publishing Co. Inc, Boston

Cohn, M.(2004). User Stories Applied: For Agile Software Development, Addison Wesley Longman Publishing Co. Inc, Boston.

Cox, K. & Phalp, K.T. (2010). Practical experience of eliciting classes from use case descriptions, Journal of Systems and Software, Volume 80, Issue 8

EMF,Eclipse Modeling Framework, http://www.eclipse.org/modeling/emf/, access ,April 2014

Fortuna, M. H., Werner, C. M.L. & Borges, M. R.S. (2008). "Info cases: Integrating use cases and domain models," re, pp.81-84, 2008 16th IEEE International Requirements Engineering Conference

Fatolahi, A., Somé, S., & Lethbridge, T.C.(2008). Towards A Semi-Automated Model-Driven Method for the Generation of Web-based Applications from Use Cases, In Proceedings of the 4th Model-Driven Web Engineering Workshop, Toulouse

Genilloud, G. Frank, W. F. & Génova G.(2006). Use cases, actions, and roles, Satellite Events at the MoDELS 2005 Conference, Lecture Notes in Computer Science, Springer Berlin
Frost, A. & Campo, M.(2007). Advancing Defect Containment to Quantitative Defect Management, The Journal of Defense Software Engineering, Dec. 2007. Issue
Jacobson, I., Christerson, M., Jonsson, P. & Overgaard, G.(1993). Object-Oriented Software Engineering –A Use Case Driven approach, Addison Wesley Longman Publishing Co. Inc, Boston
Jacobson, I. , Booch, G. & Rumbaugh, J.(1998). The Unified Software Development Process. Addison Wesley
Kennard, R., & Leaney, J. (2010). Towards a general purpose architecture for UI generation, Journal of Systems and Software, Volume 83, Issue 10
Kermeta, http://kermeta.org/, access, April 2014
Kivistö, K.(2000). A third generation object-oriented process model, Roles and architectures in focus, Academic Dissertation, Faculty of Science, University of Oulu, Oulu
Larman, C.(2004). Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development, Third Edition, Prentice Hall
Lin, L., Prowell, S. J., & Poore, J. H.(2009). The impact of requirements changes on specifications and state machines, Software: Practice and Experience, Volume 39, Issue 6, John Wiley & Sons Ltd
Malan. R. & Bredemeyer, D. (1993). Functional Requirements and Use Cases.
http://www.bredemeyer.com/pdf_files/functreq.pdf, June
Myers, B., & Rosson, M. (1992). Survey on user interface programming, ACM: Human Factors in Computing Systems, Proceedings SIGHI
Nakatani, T., Urai, T., Ohmura, S. & Tamai, T.(2001). A Requirements Description Metamodel for Use Cases, Eighth Asia-Pacific Software Engineering Conference (APSEC'01)
oAW, openArchitectureWare, http://www.openarchitectureware.org, access , April 2014
Pfleeger, S.L. & Atlee, J.M. (2006) Software Engineering Theory and Practice, Third edition, Prentice Hall, 2006.
Rosemberg, D. & Stewphens, M. (2007).Use Case Driven Object Modeling with UML: Theory and Practice, Apress, Berkeley
Savic, D., Antovic, I. , Vlajic, S., Stanojevic, V. & Milic, M.(2011). Language for Use Case Specification, Conference Publications of 34th Annual IEEE Software Engineering Workshop, IEEE Computer Society, 2011, Pages: 19-26, ISSN : 1550-6215, ISBN: 978-1-4673-0245-6, Limerick, Ireland, 20-21 June 2011, DOI: 10.1109/SEW.2011.9
Savić,D., Silva, A.R., Vlajić, S., Lazarević, S.D., Antovic,I. Stanojevic, V. & Milić, M. (2012). Use Case Specification at Different Abstraction Level, 8th International Conference on the Quality of Information and Communications Technology, Lisbon, Portugal, 03-06.09.
Silva, A. R. d., Saraiva, J., Ferreira, D., Silva, R. & Videira, C. (2007).Integration of RE and MDE Paradigms: The ProjectIT Approach and Tools, IET Software: On the Interplay of .NET and Contemporary Development Techniques, 2007
Sinnig, D.,Chalin, P. & Rioux, F. (2005). Use Cases in Practice: A Survey, Proceedings of CUSEC 05, Ottawa, Canada
Som´e, S.(2009). A Meta-model for Textaul Use Case Description, Journal of Object Techology, Zurich
Stellman, A.(2009). Requirements 101: User Stories vs. Use Cases, http://www.stellman-greene.com/2009/05/03/requirements-101-user-stories-vs-use-cases/, Building Better Software: Jennifer Greene and Andrew Stellman weblog, published: 3. 05. 2009, accessed: 1. 07.
Xtext, http://www.eclipse.org/Xtext/, access , April 2014
Wiegers, K.E.(2006). More About Software Requirements: Thorny Issues and Practical Advice, Microsoft Press
Williams, C. Kaplan, M., Klinger, T. & Paradkar, A. (2005). Toward engineered, useful use cases. In Journal of Object Technology, Special Issue: Use Case Modeling at UML-2004, volume 4, August 2005, pages 45-57
Vliet, V. (2008). Software engineering: principles and practice, John Wiley & Sons Ltd, 3rd edition, Chichester, West Sussex, England

SOFTWARE DELEGATES AS A METHOD OF CODE ORGANIZATION WITHIN CONTEXT ORIENTED PROGRAMMING ENVIRONMENT

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Abstract: *This paper will present a new approach in organizing elements and entities according to the specific demands of the Context oriented programming (COP) method in software engineering. Context oriented programming is defined by dynamic elements within the communicative organization of multiple entities and, as such is in contradiction with the usual software organization in programming languages with static type checking. After dealing with the mentioned problem for several years and existing published solutions created in the Software Engineering Laboratory at the Faculty of Organizational Sciences, the authors are presenting a new method of communication between entities and describe the outlines of reaching the solutions. In this way, advantages of Context oriented programming paradigm are presented in the modern static type checking programming languages, primarily C# which was used for the practical application of the presented model.*

Keywords: *software, software development, software pasterns, Context oriented programming, software engineering*

1. INTRODUCTION

Software engineers and architects community worldwide is constantly occupied with the search of better and more wholesome methods of describing real environments in computer software development. This search is fueled mostly through pressure of making quality software more efficient but also through the personal curiosity and challenges within the community. Context oriented programming is among newer methods of software development and presents an abstraction of context within software development. Context is a central place where all the executives of the practical tasks meet, scenario by which the task can and should be completed and finally, the skills required to solve the task successfully.
The paper will further examine all the entities that are taking place in developing COP software and will also include a short presentation of the application which authors use as a proof of the sustainability of the presented model. It will also include a theoretical overview of programming code organizations which influenced the implementation of the presented method of program structures. The paper will also describe the step-by-step solution for the problem at hand in detail.
In the next section will be introduced key elements and entities of COP model; the third section is about MixIn and Trait principle of organizing programming code; the forth section is about dynamic change of entities during the execution time; the fifth section is about the delegates' impact on the software design; the sixth section is about lambda expressions, anonymous methods and their place in method application; last sections, seventh and eighth, are dedicated to case study and application in practice.

2. KEY ELEMENTS AND ENTITIES IN THE PRESENTED COP MODEL

Within the suggested paradigm, context takes up the central place due to the fact that it determines the behavior of executive parts of the problem's solutions. In other words, different contexts require different behavior from the same executives in order to solve a context-defined problem successfully [1]. The paper will explore an example of the possibility of the same executive behaving in various solutions as well as the method by which it was applied in the suggested model. What is new and highly interesting is that the executive entity bears no knowledge of the ways to solve the problem prior to reaching the environment of the problem itself. Skills and knowledge required to solve a problem are only being awarded to the executive entity within the problems context, and in the end, upon solving the problem, the executive entity leaves the problem are with no saved knowledge of steps that brought it to

the solution. Each and every time the same entity encounters the same problem, it will receive the information all over again.
This method allows the entity to exist on a very simple level as it only bears information about itself, Changing the skills required to solve a problem, which is certainly a legitimate situation within software development, no changes will be required for the entity itself. It is protected in it's own ignorance (dumb entity) which in turn makes it simple and easy to maintain. Although the concept itself seems simple and logical, static type check languages have no easy solutions for the described method. Simply put, static checking types within those languages have to be fully described and formed prior to the execution time in order to pass the check during compiling. Workaround methods circumventing the static type check for the purpose of accomplishing the described functionality have been of interest to the authors of this paper for several years now and, after publishing other solutions we present a new way of solving the problem [2]
As already mentioned, COP model solution described in this paper contains several required elements:

- Context
- Scenario
- Skill
- Role

The following sections will further explore each of the mentioned elements:

2.1 Context

Context is the environment of the complete software process. Context is a singleton, there can only be a single one during the time of executing the application [3]. That's the place where roles meet their tasks. Context has no information of roles or tasks. It is externally initialized, mostly by the software's user and most often by the user's GUI. External initialization in the specific example means that the Scenario's name will be forwarded to the Context. Context has access to the catalog of scenarios which lists the known scenarios and related roles and skills. Engineering-wise, the catalog can be conceived in numerous ways, from a relational database entry to a simple text file. Application used as the example uses JSON (Java Script Object Notation) document as a catalog Based on the received Scenario name, context initializes the surrounding. Within our application, context uses the reflection space of the name and the possibility of dynamic creating of class instances in order to instance the already built Scenario. Scenario, further on, posses information about roles and required skills to complete the tasks successfully,

2.2 Scenario

Scenario bears information of the required tasks, it's executioners and the skills required for the task to be completed successfully. Scenario will instance all objects required for the completion of the task. Each scenario inherits the joint interface within the environment which acts as a contract that ensures a common collection of functionalities that are of interest for the environment. This allows for the coexistence of all scenarios. Scenario has the highest level of importance compared to other objects and also has the highest level of knowledge of other objects included in the process. Once instanced, scenarios does not communicate with context in any way.

2.3 Skill

Skill is the description of the algorithm used to solve a specific problem. It embodies the knowledge, the skill that the executioner has to possess in order to complete the task. The executioner is irrelevant for the skill meaning that anyone can execute the solution since the knowledge is in no way connected with it specifically. Executioner receives the required knowledge once it is required. In the same way, it 'forgets' it once the task is completed. Within COP, the knowledge is dynamically injected to the executioner during the executing time. Methods of injection the knowledge are the basis of interest of the paper's authors for quite some time and this paper is a result of exploring this specific problem. The methodology itself will be explained in more detail later in the text.

2.4 Role

Role or the executioner is the last required entity within the presented software model. The concept that the authors follow within their research is very well described by Koplin and Bjørnvig. According to them, the role entity should be knowledge-free or 'dumb', that is only the description of the entity and it's traits, not a description of the functionality. [4] Of course, in order for the executioner to complete the assigned tasks, there has to be a place where it will receive the necessary knowledge and also a way to activate that knowledge in order to complete the work. In the example application, each executioner inherits the Role interface that obligates each child object to implement the public method “DoIt” which is the place where the knowledge is provided and which can start the execution of the specific task.
This concludes the listing of the types of entities that form the presented model of Context oriented programming environment. This would also be a required minimum. The number of individual examples of each entity is not limited by anything other than the domain described by the software. Authors that wish to apply the model can implement other entities according to the needs of the software application they're writing. The authors of this paper themselves use other entities which do not fall strictly within the listed categories but are entities that further describe the domain that's being realized. The organizational model described in this paper is completely open to such independent objects.

3. PROGRAMMING INFLUENCES USED IN THE PROJECT

Software engineers are trying to fulfill the need for a different organization of the object oriented code for quite some time now, using different, more or less successful solutions. A distinct direction in new solutions is the tendency to compose objects out of different elements using a 'has a' rather than 'is a' approach. Suggested solutions which are explored in this and previous papers are Mixin and Trait objects which will be further explored.

3.1 Mixin principle of organizing programming code

Mixin objects are classes in object oriented programming that are ready to be 'mixed' with methods form other classes [5]. This allows for the avoidance of class inheritance thus following the Composition over Inheritance principle which, as a result, produces a readable code that can be used in multiple ways. [6] As per the original idea, Mixin delays the 'mixing' moment until the execution time. That way, Mixin also counters the primary idea behind the static type checking languages. This contradiction is being solved differently depending on the language used. C# can implement the Re-mix library (http://remix.codeplex.com/) which solves the basic problem of changing the class during execution time.

3.2 Trait principle of organizing programming code

Trait is by definition a "collection of methods used as a simple conceptual model for structuring object oriented programs" [7]. Trait is a simple group of methods that serve as building blocks for classes and are the basic element for code reuse. Scala programming language has trait usage implemented. Trait uses different language tricks, depending on the specific programming language in order to effectively and dynamically compose multiple classes into one. C# has no built-in ways to purely implement Trait concept. That way, Trait can only be seen as an influence while looking for original solutions within C#.

4. DYNAMIC CHANGE OF ENTITIES DURING THE EXECUTION TIME

The problem being considered here is directly connected with the basic characteristics of procedural programming languages. Among a number of different classifications, here, we're interested in the differences based on the built-in type checking mechanisms. In this respect, it's possible to isolate two major groups:

- Static type check languages
- Dynamic type check languages

Languages with static type check presume that each variable must be explicitly declared according to the type it belongs to because the type check will be completed prior to compiling, i.e. the compiling won't be possible if there's any doubts about the data type of each variable. This means that it's not possible to compile a program that includes a variable that can't be precisely attributed to a certain data type. The most widely used languages of

this kind are certainly Java and C#. The relation between dynamic and static type checks is of key significance for this research. Dynamic executive entity change during the execution time is the prerequisite for context oriented programming. This, of course, opens up the issue of implementing the paradigm in the static type check languages[8]. Previous papers we published explore several methods for dynamically changing user defined types during execution time. Some of the solutions presented directly stem from the evolution of C# itself. There's several possible ways of dynamically changing data types using new built-in language possibilities and that's by using:

- Type extensions
- Dynamic libraries

Both methods are the result of the Microsoft's DotNet Framework division's efforts in trying to bring C# closer to dynamic languages. The most probable reason is the growing popularity of web applications and languages such as JavaScript And Python [9]. It's a fact that a number of programmers today gains their first coding experiences using these languages and the goal is to bring C# closer to their way of thinking. It should be noted that after these changes, C# can't be easily classified as strictly a static type check language and the developer's tendency to make it more like dynamic languages must be taken into account.

Implementing dynamic entity characteristics using the Weaving method is not a part of built in C# capabilities but the result of the programming community's efforts to enable the Aspect oriented programming paradigm [10] in a DotNet environment. Weaving method is more of a brute force approach but is remains an effective form of changing user defined objects during execution time. [2]

5. DELEGATES, PRINCIPLES AND EXPLANATION OF THE SOFTWARE PARADIGM.

Delegates are not a new concept in OOP. They're not always called the same in different languages but all the relevant object oriented languages have a similar concept in place. In software engineering, the delegates influence the design to have each object delegate the assigned task to it's attached object, instead of doing it itself. That way, the responsibility of the software object is removed. Delegated object doesn't have to inform the delegator of the task completion.

In C#, the delegate is a type of data. It's a very important characteristic. The delegate is also a type with it's own signature in the form of a parameter list and the expect type of the return information.

Based on this, it's logical to expect that delegates in C# point to a method in a certain way. This is not a new concept either and has existed since C++ which had the concept of variable's function pointer which could be forwarded to a different entity as a parameter. Delegates in C# can also be forwarded as parameters to a different known instance. Delegate can activate each available method as long as the signatures' are appropriate i.e. as long as the elements of the parameter list are ordered by the same type and the expected result is of the same type as well. A typical delegate in C# would look like this:

```
public delegate int Calculate(int x, int y)
```

Calculate delegate can activate any operation that has two normal numbers as parameters and that expects two normal numbers as results as well. This way, it's possible to have a whole sequence of operations such as:

```
public int Add (int x, int y)
{
        return x+y;
}
```

or

```
public int Subtract (int x, int y)
{
        return x-y;
}
```

and of course, further on, the multiply method and many others as well, proved that the method signature is the same. It's obvious that, in this way, the concept of delaying the decision until the execution moment is possible, deciding on the specific method that has to

be called upon. Specifically, if during the execution, based on a dynamic condition two numbers need to be added, method Add will be called in the following way:

```
Calculate add = Add;
add(2,4);
```

The system will receive the return information as the sum of 2 and 4 (6). In the same way, if the conditions point to the need of subtracting the numbers, the Subtract method would be called in via Delegate in a similar way:

```
Calculate subtract = Subtract
subtract(2,4)
```

with the system receiving the value of -2 as the result.
What's even more interesting is the possibility to forwarded the method via delegate as a parameter. This way, the following method would be legitimate:

```
public int DistinctProcedure(Calculate operation)
{
        return operation(2,4)
}
```

and we could activate it from any available part of the application as:DistinctProcedure(add) orDistinctProcedure(subtract) etc.
This shows the general concept of placing the information during execution time into a different object which is the subject of this paper as well. A similar concept has been used in the example application and will be further explained.
The advantage of the method shown is the possibility to use the built-in capabilities of C# without the need for external libraries or complicated language tricks. Concept is known and used since the existence of C# as well.

6. LAMBDA EXPRESSIONS, ANONYMOUS METHODS AND THEIR PLACE IN METHOD APPLICATION

Lambda expressions have found widespread usage in numerous scientific and technical areas and their explanation in full overstretches the boundaries and possibilities of this article. In software engineering, lambda expressions have been used since the very first theoretical beginnings, Turing's universal machine and Turing's theory. C# borrows lambda expression elements on a large scale from mathematics, also with the theory of anonymous functions. The possibilities of lambda expressions in C# are relatively new and are present since version 3.0. What's written down in math as:

$$(x, y) \rightarrow x \times x + y \times y$$

can be written in C# as:

```
(x,y) =>{x*x+y*y};
```

The system will know to forward the values of the sorted couple to the anonymous function x*x+y*y and that it can await for the result of the function. Incorporating lambda expressions turned out to be a huge step forward for C#'s flexibility and compatibility. Anonymous functions also have their own technical specifications meaning that the system has no instanced method in memory, and thus, no references for the method either. Anonymous function has complete in-line execution - when the program flow encounters it, it executes the method and after execution there is no trace of it in the system until the next execution - that way, there's also no need to clear the system from methods or stack keeping etc. What's interesting for our research in regards to lambda expressions is the possibility (available since C# 3.0) to attach a lambda expression to the previously described delegates. This results in an encapsulated variable that carries with it complete information about the method being executed and, as such, can be forwarded as a parameter into any available part of the application. In the code itself, it's possible to write:

```
delegate int Calculate(int x,int y) = (x,y)=>{x+y;};
```

and to forward such a delegate as a parameter containing all the necessary information in regards to the execution of the required method. Even more compact, it's possible to make anonymous delegates and forward them as the method parameter. Since C# 3.0, special types of delegates have been introduced:

- Action (delegate with the return value of the void type)
- Func (delegate with the return value)

which make writing the previously mentioned expression as:

```
Func<int, int, int> calculate = (x,y) => x + y;
```

and forwarding it as a parameter in function:

```
DoIt (calculate, x, y);
```

which allows for a very compact way of information transferring which was of the prime interest for the research at hand.

In order to encapsulate functionalities in scenarios, authors use the Action<T> delegate type incorporated in C# which is a void type, meaning it sends no results back. Technically, there's no obstacles to do it via the Func<inT,outT> type and ultimately, there's no obstacles in using the delegates in the same way they were used prior to 3.0. It is necessary to adjust the scenario logic in those cases requiring return information.

7. DESCRIPTION OF THE APPLICATION USED AS A STUDY EXAMPLE:

The application used to confirm the theoretical model is created using solely C# 4.0 programming language. The development environment used was Microsoft VisualStudio 2012 (http://www.visualstudio.com/). Application's front end was developed using the WPF (Windows Presentation Foundation) technology but could also be completed using any other technology, bearing in mind that it's completely separated from the applications logic itself.

The idea was to create multiple scenarios which:

- don't have to be connected in any way
- share certain elements or entities

It's necessary to check the applications functionality in such conditions. That's how the following scenarios were created:

- Text manipulator
- Money transfer
- Square root computing using the Newton method
- Account cash payments

Scenarios' names themselves point to the fact that two of them share certain domain similarities and those are the money transfer and cash payment scenarios. It's also obvious that there's two additional scenarios that are in no way connected to the previous two. In this way, the application can be tested to solve a certain problem in three unrelated domains where each domain bears all the necessary elements that were described above but that there's also a domain that has all the elements but two scenarios solving independent problems as well. This domain proves the idea that a certain Role entity can be infused with different information and that it can successfully complete tasks requiring that information.

Meanwhile, there's no changes to the Role entity itself, as will be shown.

Each of the listed scenarios has it's individual characteristics. Most obvious ones would include the number and the type of parameters required to complete a task - the text manipulator requires the text to be edited, Money transfer has the accounts and money amount etc. A problem with unifying entities with different types and number of parameters is shown. This problem was solved in a way that has been present in C# for a long time and that's the making of a sequence of objects and using keyword params in order to inform the method that there's a possibility of no data showing as an argument[1]. This method itself is not particularly elegant since there's the need to convert the received parameters in the required data type. Still, it's efficient and simple enough for a junior programmer to use. Similar method is applied to the Main method in the command promp (console) of C# applications. The method is built in in the automatic creation of Console application projects within Microsoft Visual Studio environment. This makes the explained method familiar for most programmers using C#. This is probably the biggest compromise required for the survival of the entity consistence in the observed organizational model. Specifically, Role entity received a DoIt method that looks like this:

```
public override void DoIt(Action<object[]> action, params object[] args)
{
    action(args);
}
```

Skill entity now has an Action type property wit the following signature:

Action<object[]>

in order to be compatible with the DoIt method in the Role entity types.

[1] http://msdn.microsoft.com/en-us/library/w5zay9db.aspx

7.1 Text manipulator:

The text manipulator is the first scenario in the application. This is the simplest one, both logically and technically and it's purpose was solely to prove the concept on the simplest example. The scenario will be described since specifically due to it's compact and simple nature.
The task of the scenario is a menial one, inverse writing of the given text. The execution flow follows:

- User requests the context with the scenario's name text bia GUI
- Context looks for the Scenario within the catalog, based on the name given as a parameter
- Context creates the scenario and starts it's execution
- Context has no interaction with the started scenario anymore, it waits for the next new scenario request.
- Scenario knows who is included in the text manipulation and creates new TextManipulator instances, the Role type entity and instance TextManipulationSkill which is the skill type entity.
- It forwards the information to the TextManipulator in the form of an Action delegate with all the the necessary text transformation logic, as well as the text that needs to be changed as a second parameter of an object sequence type (object []).
- TextManipulator bears the DoIt method that was previously described. As soon as it receives the necessary arguments, DoIt method is executed using logic received as skill and application writes the inverted text at the user's screen.
- After executing the logic, all the entities from the TextManipulation scenario dissappear from the application's execution area automatically.
- Application is ready to execute a new scenario.

The same steps are used for all the other listed scenarios, the logic and the data is different but the sequence, being also the main algorithm of the system does not change with different scenarios. This results in a Context oriented programming environment as requested by this research.

8. TRANSFERRING MONEY AND CASH PAYMENTS, TWO SCENARIOS OF THE SAME ROLE

These two scenarios are no different to the already described Text manipulation scenario, in respect to the execution flow. The reason for explaining these two scenarios is the implemented realization of two scenarios with a single role. Both scenarios have the same executioner, a user type, class Accountant
that's being provided with different information for both of the scenarios and that can successfully complete the required tasks. This is in essence the proof of the concept described in regards to the Mixin organizational principle that speaks about creating a software code that requires no inheritance but works based on composition and valorizes composition over inheritance.
The usual way of creating a business application via Object oriented programming would be creating an Employee class and than a whole sequence of classes which would implement the Employee and provide it with one or more extensions in order to cover all the possible positions of the employee that are of interest to the application. In an average business informational center, this would very soon result in a huge number of classes which would complicate the understanding of the system and it's maintenance.
On the other hand, the shown model would contain the Employee class and than a sequence of skill classes which by themselves would be algorithms required for completing certain tasks. When needed, the Employee class would be provided with the required skills during execution time. We firmly believe that this would result in a more logical and easily understandable system, making it more simple to maintain as well.
Another observation is worth noting, in regards to these two scenarios. At the very beginning of this paper, we allowed for the possibility of enhancing the observed model with other entities, aside from the required ones. These entities would further describe the domain. In these scenarios, the Account entity is present - although not a pre required one, it is necessary for the domain's full description. This shows that the application works with no problems with additional user defined types, regardless of their form.

9. CONCLUSION

The goal of this paper was to point out to different possibilities of organizing large, mostly business applications written in C#. The paper describes one such system and the technical ways of making a functional solution possible. The described method is fully supported with built-in C# capabilities and requires no language tricks, external libraries or other exotic solutions. It only requires a slightly advanced understanding of the language and the good will to use according to the way shown. Applying this method in practice, however, is highly limited due to the established and worked-out solutions that are first of all satisfactory and also thoroughly backed up with literature, examples and experiences of the programming community. With this in mind, the authors bear no illusion that the suggested methodology would influence the practice significantly but they hope to contribute to the overall corpus of knowledge within the community by presenting and explaining an alternative concept which greatly differs from the mainstream solutions.

REFERENCES

Robert Hirschfeld, Pascal Costanza, Oscar Nierstrasz: "Context-oriented Programming", in Journal of Object Technology, vol. 7, no. 3, March-April 2008, pp. 125-151, http://www.jot.fm/issues/issue_2008_03/article4/.

Stevanović B, Lazarević D.S. „Implementation of DCI architecture by using .NET platform“ InfoM, Vol 46/2013

Gamma E., Helm R., Johnson R., Vissides J., Design Patterns: Elements of Reusable Object-Oriented Software; Addison-Wesley, 1995

Coplien J., Bjørnvig G., Lean Architecture: for Agile Software Development; Wiley 2010

Bracha G., Cook W.; Mixin-based Inheritance; Proceedings of the ACM Conference on Object-Oriented Programming: Systems, Languages, and Applications (OOPSLA) October 21- 25, 1990.

McConell S., Code Complete: A Practical Handbook of Software Construction, Second Edition; Microsoft Press 2004

Schärli N., Ducasse S., Nierstrasz O., Andrew P. Black A.P.; Traits: Composable Units of Behaviour. Proceedings of the European Conference on Object-Oriented Programming (ECOOP). Lecture Notes in Computer Science, Volume 2743, Springer-Verlag, 2003, pp. 248-274

Dickerson R.G., Further languages course; Department of Computer Science University of Hertfordshire Higher Education Corporation 1998

Stevanović B. Software Construction using Lean Development and DCI architecture; Master thesis, Software Develoment Department, FON, 2013

Kiczales G., Lamping J., Mendhekar A., Maeda C., Lopes C, Loingtier J., Irwin J., Aspect-oriented programming Xerox Palo Alto Research Center 1997

SERAPHIM: LINUX KERNEL MODULE FOR RESOURCE MANAGEMENT AND COMMAND EXECUTION

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Abstract: *This paper presents the ability to monitor the performance and usage of a target computer system running on the GNU/Linux operating system and predefined command execution using Seraphim, open-source Linux kernel module. Seraphim's primary target audience are business users. It provides the vital ability to answer the following question: „Who has asked for which resource, and at what time did he ask?". Seraphim can also be used for various other puproses, for example in education purposes. It has a modular structure and is easily extendable. Seraphim is published as an open-source project, under the GNU/GPL license.*

Keywords*: Linux, security, monitoring, kernel, module, system programming*

1. INTRODUCTION

In the previous years there has been an increased number of cyber attacks on operating systems based on the Linux kernel (Sophos Security Threat Report 2013, 2013). Considering the reasons that the number of computers and handheld devices running Linux is on the rise (The rise of Android: from 32% to 65% in two years, n.d.), there is an increased need for security and resource monitoring. Therefore, there is also a need for adequate software tools specially suited for such a task. Seraphim was created to aid in the prevention of Linux based operating systems (such as GNU/Linux and Android) abuse by providing an interface to keep track of specific Linux resources and execute specific commands. Its target audience are business users; however it can be used for various other purposes, for example in education.In the next section, problem statement and motivation for developing Seraphim are given. Section three provides with three use cases for Seraphim in its different configurations, while section four gives a review of existing tools for Linux resource management and command execution. In the Section five, Seraphim structure and subroutines are described. Following section contains information about kernel communication. Section seven describes Seraphim logging facilities, while Section eight presents the command execution feature. At the end of the paper, conclusions and suggestions for future work are given.

2. PROBLEM STATEMENT

Looking at the usage of Linux in business (Linux Adoption Trends End User Report 2013, 2013), one can conclude that security and continuous control are a necessity. In these turbulent times, the ability of knowing who asked for which resources and at what time is of vital importance, also activities such as auditing and user provisioning are important parts of an identity and access management system (Milenković, Šošević, & Simić, 2012). At the moment, there is no adequate tool on the market that could provide these features effectively. Consequently, there is definitely a need for tool which would allow business users to effectively track their resource usage and execute predefined commands to aid overall security of the system.

Furthermore, such software can be used in education, specifically in computer security training, where it could provide insight into key resources defined before compilation, allowing the user to see how the system is responding to a given training scenario. Another notable usage would be in the field of Electrical and Computer Engineering, providing a safe and redundant solution to tracking resources while testing new software and hardware configurations, without having to attach an external debugger.

The software that is the topic of this paper, Seraphim, tends to provide the ability to monitor Linux kernel resources, execute commands and keep logs of given actions. The software is provided as open-source, under the GNU/GPL license. (Ţivadinović, n.d.)

3. USE CASES

Seraphim may be used:
- as an intrusion detection and prevention tool,
- as a hardware and software configuration testing tool,
- as a resource monitoring tool,
- to avoid memory dumping for analysis,
- for honeypot computers, and honey networks,
- for tracing scripts,
- as an educational tool.

In this paper we present use cases for the first three possible applications of Seraphim.

Considering Seraphim's usage in detection of intrusions, assume the situation where a crucial computer system has been compromised by the means of infiltration by unauthorized users. In this specific case, Seraphim can generate a report of resources compromised with the dates and times of them expressing unusual behaviour, and, if programmed, execute sanitation and prevention commands that would reinfore the security of the computer system while preventing the malicious user from further action against the target computer system. Without specific software for the detection and prevention of intrusions, the computer system is left vulnerable to infiltration and exploitation, both internal and external.

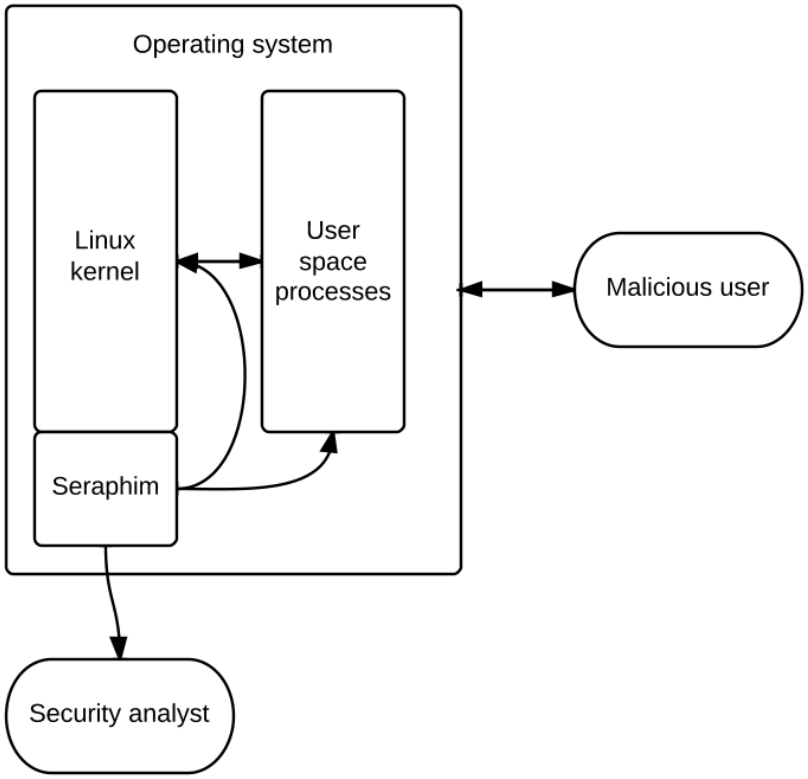

Figure 1: Usage of Seraphim as an intrusion detection and prevention tool

It is also noted that Seraphim can be used in the field of Electrical and Computer Engineering as a tool to track resources while testing new software and hardware configurations. The first step in using Seraphim for this purpose is to compile it with the list of resources that need to be tracked and, if required, commands that should be executed. After that, the person that is testing new software and hardware configurations must load Seraphim into the kernel before the testing begins. During testing, the person performing the tests can have direct access to predefined resources, vastly simplifying the cost and time required for testing with alternate tools, such as JTAG debuggers.

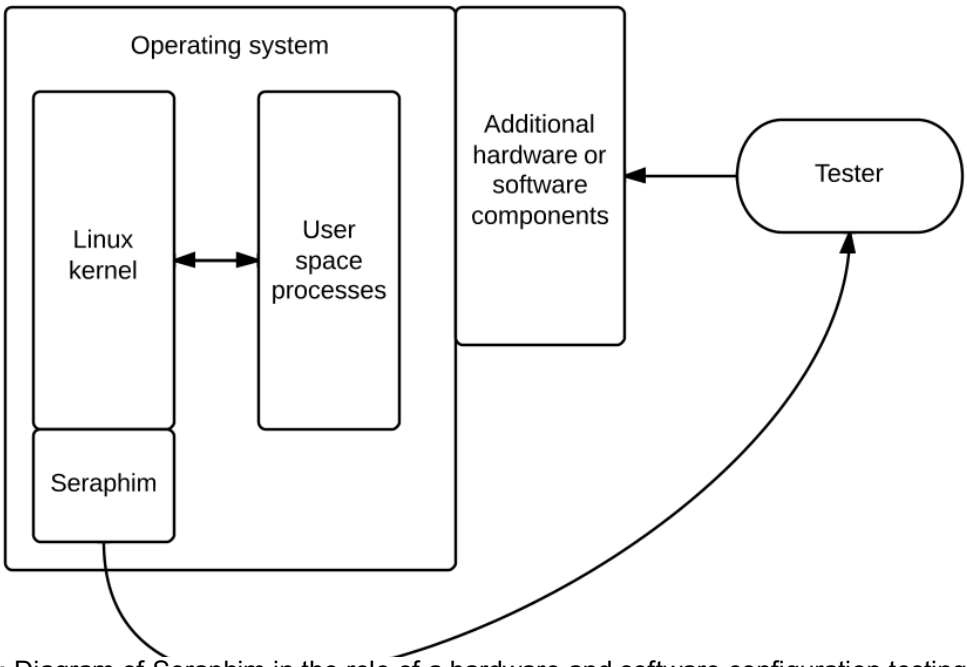

Figure 2: Diagram of Seraphim in the role of a hardware and software configuration testing tool

Another use case for Seraphim would be for constant resource monitoring with the goal of optimizing the target computer system, thus improving overall business performance. Employment of Seraphim as a resource monitor with the ability to generate periodical reports is similar to the last two use cases and requires the person gathering data for further analysis to predefine the resources that should be monitored and the required time intervals on which reports should be generated. These reports can later be aggregated and analyzed to show adequate steps to further optimization and improvement of business performance.

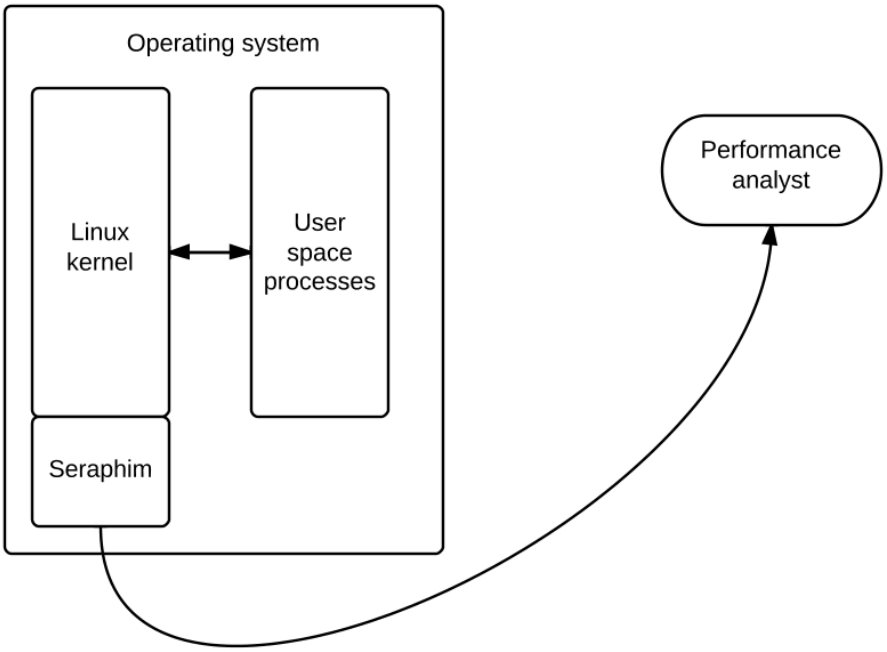

Figure 3: Usage of Seraphim as a resource monitoring tool by a performance analyst

4. EXISTING TOOLS

Currently, there is no adequate open-source tool on the market for Linux resource management and command execution via kernel module routines. Several years ago there were tools that fit the specification, but they were created for malicious purposes (Attack Sneaks Rootkits Into Linux Kernel, n.d.). Other tools, such as Nagios (Nagios, n.d.) and Tripwire (Tripwire, n.d.), which are proven solutions and industry standards, have become products with a large amount of legacy and archived code, considering they have been in use for more than a decade (Nagios History, n.d.). Some of them (like Knark (Intrusion Detection FAQ: Knark: Linux Kernel Subversion, n.d.)) which could have been implemented as tools without a

malicious purpose have been out of date for several years due to the advancement of the Linux kernel and the lack of development.

If implemented correctly into a target computer system, Nagios provides monitoring of computer resources and system metrics, including a powerful scripting API to modify Nagios to specific needs of the target computer system. Such integration allows the generation of detailed reports about security incidents, with the ability to extend the reporting system. (Nagios - Nagios Features, n.d.). Seraphim draws inspiration from several segments of Nagios, especially the extendable API and a report generating system.

Even though Knark hasn't been developed for several years, it still poses a threat to operating systems running the Linux 2.2 and Linux 2.4 kernel (Information about the Knark Rootkit, n.d.). Knark's attack vector is defined by the ability to hide TCP or UDP connections, perform system call injection, hide files, directories and processes and change the UID and GID of a process, just to name a few of its features (Intrusion Detection FAQ: Knark: Linux Kernel Subversion, n.d.). The distinguishing part of Knark is that it is implemented as a Linux kernel module, giving it automatically an advantage over other tools (such as Nagios and Tripwire) since it has access to the same resources as if it were the Linux kernel itself. Such design was a primary trigger for the development of Seraphim, considering that, as a Linux kernel module, it would have an amount of features not accessible if it were created as a regular, user space application.

Tripwire functions by defining policies, upon which are generated reference points of target computer resources (file systems, databases, virtual systems to name a few). Later ongoing integrity checks compare the current state of target computer resources with the reference points and, upon policy restrictions, can act if the modifications were unauthorized. (Tripwire Enterprise FAQs, n.d.). The predefined policy based system is a feature that was implemented in Seraphim as a set of commands defined in the application itself prior to compilation.

There are, in fact, tools that have adapted to the development of the Linux kernel and the need for adequate monitoring and system control (such as Nessus (Nessus Vulnerability Scanner, n.d.)), with the main drawback of price (Nessus: Tenable Store, Unified Security Monitoring, n.d.) and proprietary code.

5. SERAPHIM STRUCTURE

Seraphim consists of several subroutines, each providing a specific purpose. The main reason for making the features of the software atomic is the ability to easily extend it using a crude API.

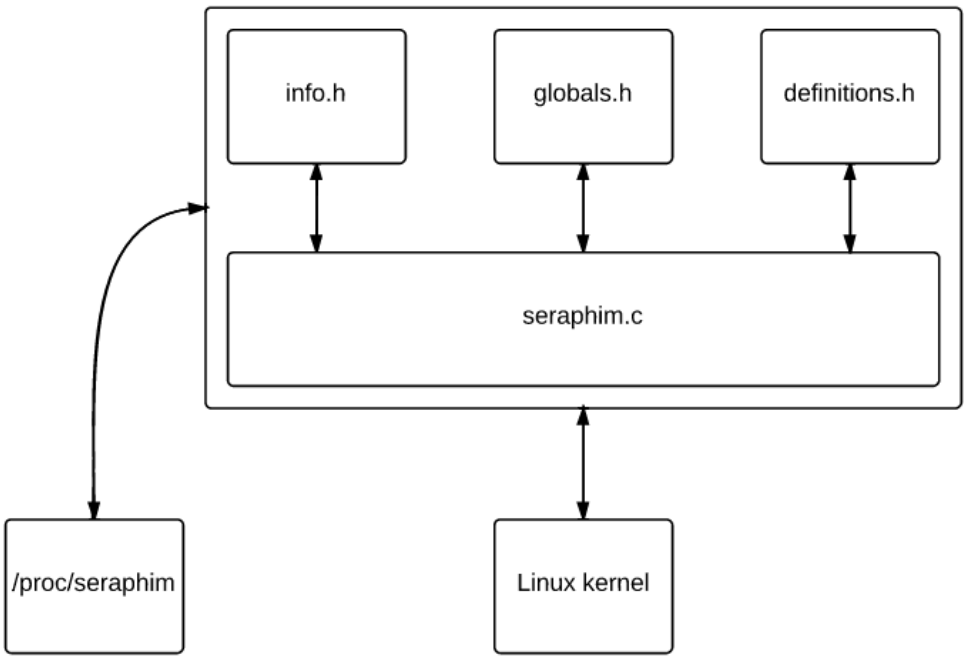

Figure 4: Block diagram of Seraphim structure and connections

To start the application, one must compile it on the target system (or a viable alternative) and then insert the kernel module into the Linux kernel using adequate system provided commands.

The entry point of the application is the file “seraphim.c” which is an aggregation of several files which provide adequate kernel communication and logging facilities. Kernel communication and logging facilities do not exist on their own, they are supplemented by several secondary subroutines which provide the actual interface into the Linux kernel. Secondary subroutines are defined in the file “globals.h”. Primary subroutines exist in the file “definitions.h”. The file “info.h” contains necessary author and licensing information.

Primary subroutines of Seraphim provide the implementation of secondary subroutines into forms that the Linux kernel can execute. The main part is the infinite loop that provides the execution of primary and secondary subroutines. Primary and secondary subroutines are duplicated at several places due to the fact that disk writing operations are categorized as slow operations, hence they were sometimes dropped from the Linux kernel process execution queue. After defining adequate primary and secondary subroutines, it is required of the programmer who is extending Seraphim to include the subroutine calls in the infinite loop so that they could be executed.

```
static void printString(char *string) {

    struct tty_struct *tty;

    tty = get_current_tty();

    if(tty != NULL) {

        (tty->driver->ops->write) (tty, string, strlen(string));

    }

    else
        printk(KERN_ALERT "TTY equals zero.\n");
}
```

Figure 5: Example of a secondary subroutine "printString" which prints the given string to the terminal console

Before the execution of the main loop, Seraphim registers itself to the kernel and provides an input/output interface under the /proc filesystem which allows an authorized user to manipulate the flow of the application.

6. KERNEL COMMUNICATION

Before each run, kernel modules must be loaded into the kernel. This is usually done with the command “insmod”. After they are loaded, kernel modules start their execution. The process of loading a kernel module implies that the kernel module is being added to the Linux kernel, forming an integrated entity between the raw kernel and the kernel module. Considering this, it is safe to conclude that Seraphim runs in the kernel space, a region in memory where the Linux kernel runs and provides defined services (Kernel Space Definition, 2005), unlike most other resource monitoring applications, which run in user space, a memory segment where user processes reside (User Space Definition, 2005).

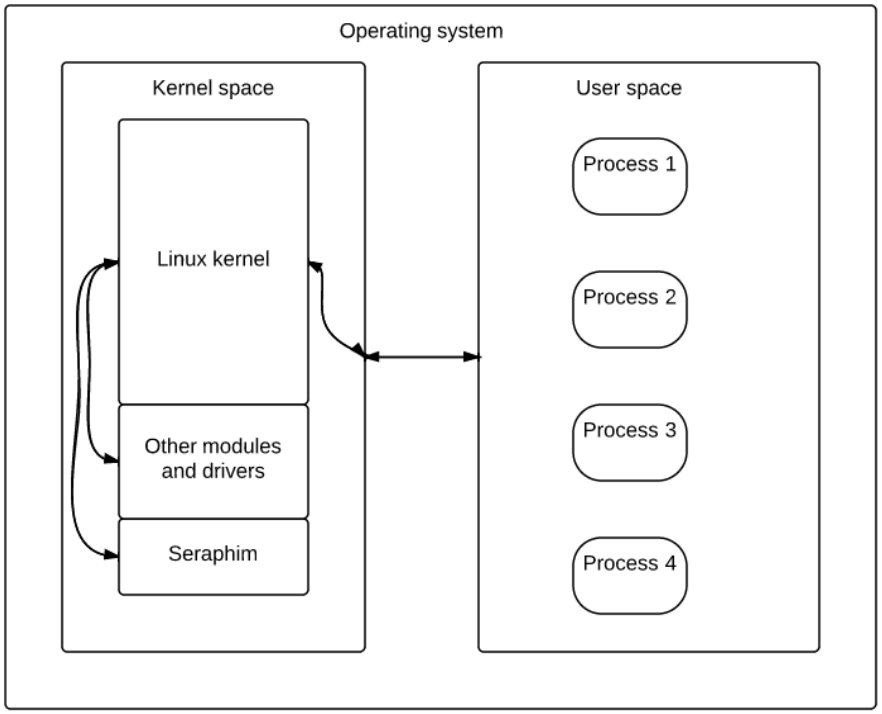

Figure 6: Seraphim integration within the operating system with four running processes; inter-process communication and communication with the user space kernel communication provider is abstracted

As defined earlier, the primary subroutines are defined in the file “definitions.h” and they are supplemented by secondary subroutines in the file “globals.h”. The main part of these subroutines, both primary and secondary, provide communication with the kernel. Kernel modules communicate with the kernel by having access to subroutines not normally available to user space applications due to the fact that kernel space applications (in this case kernel modules) are compiled against the Linux kernel itself, instead of compilation against the GNU Standard C library.

Communication with the kernel is defined on several fronts. One of them is the usage of existing teletype interfaces to provide the piping of data through the kernel to the end user, allowing real time monitoring from the teletype interface from which Seraphim was loaded into the kernel.

The most important part of Seraphim is the ability to execute system commands automatically as an administrator. That feature is provided by the “runner” subroutine which utilizes the kernel functions for string concatenation and memory management, creating a construct which is then called by the kernel and executed after passing the Linux process execution queue.

One of the other places where the kernel communication is extensively utilized is for the creation of adequate files under the /proc filesystem, providing a user interface for kernel communication, and the ability to log executed commands and the status of resources predefined before the compilation.

Commands used for communication with Seraphim are inspired by the BASIC programming language and consist of a single string which is then parsed inside of Seraphim to determine its meaning. Currently, the only implemented command is the command “STOP” which halts the execution of Seraphim.

7. LOGGING FACILITIES

The ability to log targeted resources and their states and also the results of executed commands from Seraphim is of vital importance to the security and integrity of the targeted system. Monitoring of resources is done several times per iteration of the main loop, providing redundancy in case of dropped statements from the Linux kernel process execution queue. Both the results of monitoring and command execution are logged in the messaging facilities of the kernel, from which they can be extracted for further analysis.

The process of monitoring and logging is done by executing a specially crafted command embedded inside a subroutine, which is modified before execution with the resource from the /proc filesystem that we wish to monitor. The location of the file where the log should be saved is predefined as a macro and can be changed prior to compilation and execution. Furthermore, the event of monitoring is logged in the kernel message device, along with a timestamp providing the system analyst with information at what time and which state was the system in when there was an unplanned event.

Each executed command is logged in the kernel message queue and in the adequate files on disk defined before the compilation of the kernel module. Furthermore, subsequent command executions are marked in the files on the disk. Timestamps of resource monitoring and command execution are written in the kernel message queue, allowing qualified persons to determine at which time since the start of the system has there been a breach of monitored resources or the execution of unauthorized commands.

8. COMMAND EXECUTION

As it was noted above, Seraphim provides the execution of commands under administrative privileges using the “runner” subroutine, providing a simple interface to execute additional commands to the system for maintenance and extended security monitoring which isn’t encompassed by Seraphim.

Similar to the logging facilities, command execution is encapsulated in a specific subroutine, which takes two parameters, first one being the command that is supposed to be executed and the second one which represents the location on the file system where the result of the execution will be written. The key component of this subroutine is “call_usermodehelper” (Linux Manual Documentation, n.d.), a subroutine which allows the calling of predefined commands as a superuser, having access to all components of the operating system. It is worth mentioning that both the logging facilities and command execution are based on the same principles and subroutines.

Using the ability that Seraphim can execute commands defined before compilation, one can theoretically infinitely extend and integrate Seraphim into the target system, using it as a hub for continuous monitoring and security activities, supplemented by its own integrated subroutines providing a low-level approach to the Linux kernel and operating system which applications running in userspace cannot achieve.

9. CONCLUSION

In these tempestuous times, the ability to have up to date logs of crucial data on your target systems is the primary concern, as is the execution of commands to mitigate attacks against the monitored system or simply the execution of commands to reinforce the system on which they are being run. A large number of solutions on the market simply do not provide the necessary features required for low level system monitoring or the management of computer resources and command execution.

Seraphim, at this current state, provides the answer to these problems by monitoring predefined files and executing predefined commands, without the need for external control. Furthermore, Seraphim is modularly built, allowing further expansion before compilation.

Further course of Seraphim development is porting the source code to the Microsoft Windows operating system, with the same or even greater features, and later, implementing additional features such as system call injection and scripting to the original Seraphim for the Linux kernel. Considering the alternate tools (Nagios, Tripwire and Nessus) and the man hours spent developing them, one can conclude that Seraphim, even though has a fraction of their possibilities, is a worthy contender, despite the fact that it was developed with a lot less man hours than its main competitors.

ACKNOWLEDGMENT

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REFERENCES

Attack Sneaks Rootkits Into Linux Kernel. (n.d.). Retrieved from www.darkreading.com: http://www.darkreading.com/vulnerabilities---threats/attack-sneaks-rootkits-into-linux-kernel/d/d-id/1130766

Information about the Knark Rootkit. (n.d.). Retrieved from ossec-docs.readthedocs.org: http://ossec-docs.readthedocs.org/en/latest/rootcheck/rootcheck-knark.html

Intrusion Detection FAQ: Knark: Linux Kernel Subversion. (n.d.). Retrieved from www.sans.org: http://www.sans.org/security-resources/idfaq/knark.php

Kernel Space Definition. (2005, February 8). Retrieved from www.linfo.org: http://www.linfo.org/user_space.html

Kerrisk, M. (2010). The Linux Programming Interface: A Linux and UNIX System Programming Handbook. San Francisco: No Starch Press, Inc.

ktap: A lightweight script-based dynamic tracing tool for Linux. (2013). Retrieved from www.ktap.org: http://www.ktap.org/

Linux - Monitoring Extension. (2014). Retrieved from www.community.appdynamics.com: http://community.appdynamics.com/t5/AppDynamics-eXchange/Linux-Monitoring-Extension/idi-p/5721

Linux Adoption Trends End User Report 2013. (2013). Retrieved from www.linuxfoundation.org: http://www.linuxfoundation.org/publications/linux-foundation/linux-adoption-trends-end-user-report-2013

Linux Cross Reference. (n.d.). Retrieved from xr.free-electrons.com: http://lxr.free-electrons.com/

Linux Manual Documentation. (n.d.). Retrieved from mirror.linux.org.au: http://mirror.linux.org.au/linux-mandocs/2.6.12.4/call_usermodehelper.html

Love, R. (2010). Linux Kernel Development (3rd Edition). San Francisco: Addison-Wesley.

Love, R. (2013). Linux System Programming: Talking Directly to the Kernel and C Library. Sebastopol: O'Reilly Media.

Mike Holenderski, Wim Cools, Reinder J. Bril, Johan J. Lukkien. (2010, October 11). Extending an Open-source Real-time Operating System with Hierarchical Scheduling.

Milenković, I., Šošević, U., & Simić, D. (2012). Architectures of comprehensive identity and access management. Electronic International Interdisciplinary Conference.

Nagios. (n.d.). Retrieved from www.nagios.org: http://www.nagios.org/

Nagios - Nagios Features. (n.d.). Retrieved from www.nagios.org: http://www.nagios.org/about/features

Nagios History. (n.d.). Retrieved from www.nagios.org: http://www.nagios.org/about/history

Nessus Vulnerability Scanner. (n.d.). Retrieved from www.tenable.com: http://www.tenable.com/products/nessus

Nessus: Tenable Store, Unified Security Monitoring. (n.d.). Retrieved from store.tenable.com: https://store.tenable.com/?main_page=index&cPath=1

Simić, D., & Bataveljić, P. (2011). Organizacija računara i operativni sistemi. Beograd: Fakultet organizacionih nauka, Beograd, Jove Ilića 154.

Sophos Security Threat Report 2013. (2013). Retrieved from www.sophos.com: http://www.sophos.com/en-us/medialibrary/PDFs/other/sophossecuritythreatreport2013.pdf

Takaya, B. I., Ayeb, B., & Graiet, M. (2013). TLID: A Tool for Linux Intrusion Detection. International Conference on Control, Engineering & Information Technology, (pp. 45-50). Retrieved from http://ipco-co.com/presented%20papers/202.pdf

The rise of Android: from 32% to 65% in two years. (n.d.). Retrieved from blog.globalwebindex.ne: http://blog.globalwebindex.net/rise-of-Android

Tripwire. (n.d.). Retrieved from www.tripwire.com: http://www.tripwire.com/

Tripwire Enterprise FAQs. (n.d.). Retrieved from www.tripwire.com: http://www.tripwire.com/it-security-software/scm/specifications/faq/

User Space Definition. (2005, February 8). Retrieved from www.linfo.org: http://www.linfo.org/user_space.html

Writing a Resource Manager – QNX Software Systems. (n.d.). Retrieved from www.qnx.com: http://www.qnx.com/developers/docs/6.3.2/neutrino/prog/resmgr.html

Ţivadinović, M. (n.d.). Seraphim repository. Retrieved from bitbucket.org: http://bitbucket.org/mzdv/seraphim

THE ARCHITECTURE OF INTEGRATED IDENTITY MANAGEMENT AND MULTIMODAL BIOMETRIC SYSTEM

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Abstract: *Identity management systems are used in different types of organizations. Most of them have remote users who access the organization's resources through the Internet. It is crucial to prevent frauds and unauthorized access to data. Techniques for authentication that are used in today's identity management systems are vulnerable when they are used over the Internet. Identity management systems integrated with multimodal biometric systems could build a more secure environment in which to perform critical operations. In this paper, we present the architecture of a prototype of an integrated system of identity management and multimodal biometrics. Special attention was given to how to integrate multimodal biometrics into existing identity management system.*

Keywords: identity management system, authentication, multimodal biometric, single sign-on, open source

1. INTRODUCTION

Modern information technologies have enabled information infrastructure to connect remote entities around the world by using large networks, relying on application level protocols and web services. The advantages of computing resources, which are available on the Internet via cloud computing and virtualization technologies, are being used by the companies to an increasing extent. Given that the number of online users is growing daily and approaching the actual total count of people, the issue of digital identity management arises in order to protect privacy and retain liabilities in transactions and interactions in accordance with the regulatory controls. Digital identity can be defined as the digital representation of information about a particular person or organization. Digital identity has a finite, but also an unlimited number of attributes. Digital identity may include attributes of a person such as: name and surname, personal identification number (PIN) or passport number. Additionally, it can obtain biometric data such as the iris of the eye or a fingerprint, as well as the information about the users' activities, including web searches and transactions during Internet purchase. Biometrics is a relatively new field, but today, in the process of verifying users' identity, multimodal biometrics is its greatest asset. In multimodal biometrics, different modalities are taken simultaneously in order to determine users' identity. Therefore, the probability of verifying an identity is high.

The identity management and access control involve several fundamental parts, such as: user identification, authentication and authorization. These three activities are strongly connected and, in fact, we can say that they form a chain of interdependence. Authorization depends on authentication, and the authentication itself is based on identification (Lynch, 2011). There are lots of other activities that are important for identity management, but particular emphasis is put on managing user accounts and monitoring of the system user activity.

In order to respond to current trends, a prototype system for identity management needs to be developed. It is necessary that this system fulfils requirements for identity management, policies and monitoring of the system user activities. In accordance with these requirements, a system has been designed for identity management based on FreeIPA solution for digital identity management and MMBio framework for multimodal biometrics.

2. IDENTITY MANAGEMENT

Identity management can be defined as the creation, management and use of digital identities. Identity management implies safe management of the entire digital identity's lifecycle, from its creation (registration of a digital identity), through maintenance (implementation of organizational policies with regard to the

access to electronic resources) and, eventually, the termination of digital identity. It allows efficient and safe access to data and applications.

Three key elements of identity management are: policies, processes and technology. Policies refer to limitations and standards that need to be followed in order to be in compliance with regulations and business practices, as FreeIPA allows by defining the policies. Processes describe the sequence of steps that lead to the completion of business tasks or functions. Technologies are automated tools that help achieve business goals more efficiently and accurately with regard to all limitations and guidelines outlined in the policy.

Identity management system of an organization does not remain stagnant over time. New technologies will be introduced into the system, new business models and limitations will change the processes and management type. Once one of the elements undergoes a change, a new balance needs to be established (Kong, 2011).

Three key elements of identity management are:
- Data access service
- Access control
- Identity life cycle management

Basic concepts of digital identity are:
- The subject, entity
- Resource
- Digital identity
- Authentication
- Authorization
- Federation
- Integrity
- Single sign-on (SSO)

The subject or an entity is a person, group of people, an organization, a virtual object (e.g., computer process, application, text file), tangible object (e.g., electrical appliances and computers) or any other entity that requires access to a particular resource.

A resource can be a specific data in the database, a remote server or a website, and what is common to all the resources is the access, i.e., the entity refers to its own digital identity when accessing the resource.

Digital identity, the very concept of it, represents an experience of one's' own identity, the identity of other people and things in the aspect of digital technologies (Prasad and Rajbhandari, 2011). The definition of digital identity consists of the following parts:
- Identifier
- Credentials
- Key attributes
- Context-specific attributes

The identifier or the key is a part of the information that uniquely identifies the object in a particular context. Examples of identifiers are email addresses, user names or the unique identification number that every person possesses.

Credentials are private or public data that could be used as proof of identity authentication.

Key attributes represent data that help describe identity. Key attributes can be used in a variety of different business and application contexts. For example, addresses and phone numbers are common attributes used in a variety of business application.

Context-specific attributes are data that help describe the identity, but these attributes are used only in specific contexts.

Authentication is a process of verifying the identity of the user, devices, or other entity in a computer system, which is often a prerequisite for gaining access to resources in the system.

Authorization is an approval given to the user, application program or a process to accesses a particular object or group of objects. Authorization is often resolved through the mechanism of roles. It is possible to

assign a specific role or group of roles to one user or a group of users. The role may consist of other roles, which together make up a set of privileges at the disposal of the authorized entity.

Federation enables secure sharing of information with external systems that need to manage the identities of foreign customers. Without this functionality, administrators would have to maintain a separate folder for all foreign users and manually update data about them (Williamson, Yip, Sharoni, and Spaulding, 2009). Identity Federation represents a circle of trust and allows users from one domain to access resources in another domain without any additional introduction.

Integrity is a guarantee that the content of the received message was not altered in respect to the content of the original message sent.

Single Sign-On (**SSO**) is a process of authentication that allows a user to access one or more resources within single security domain. SSO is a common procedure in Enterprises, where clients logs in once and gain access to different resources connected to a local area network (LAN), without the need to re-enter log-in credentials.

3. MULTIMODAL BIOMETRIC SYSTEMS

Problems that occur with previous methods of identification could be solved by recognition of a person based on something he or she is, by using biometric identification. In this way, issues with password memorization and safety of the object are resolved, and the identification of a person is enabled without external data or objects (Hermans and Valkenburg, 2009). This is particularly significant once we take into consideration the fact that distance communications are expanding. Throughout the Internet people use services such as electronic commerce and administration, they perform business transactions, study and maintain personal contacts. In all of the above mentioned situations it is crucial to establish the identity of the person performing a transaction, or the person with whom communication is maintained. This way frauds and unauthorized access to data are being prevented.

Similarly to the Internet technology, the first implementation of biometrics was for military purposes. Academic institutions have directed their efforts adequately with the more evident need for biometric technologies. Progress in the technology development, specifically in biometric sensors of affordable price, has enabled the implementation of biometric technology in new areas (O'Gorman, 2009). Now, even the smaller development teams with limited budget can afford the costs of procurement of appropriate equipment used for development and testing. This technology development trend has assisted the emergence of open source biometric solutions, developed by the open-source community. Systems that integrate multiple different biometric modalities, e.g., face and fingerprint, voice and the iris, are called multimodal biometric systems. Integral parts of multimodal biometric systems are methods for fusion of information concerning various modalities.

Multimodal biometric systems imply several processes:
- Acquisition of biometric data
- Biometric data processing
- Characteristics extraction
- Comparison and decision making

Each of these processes involves working with a multimedia database of multimodal biometric data. Depending on where the above processes are deployed, we can distinguish between distributed and centralized architecture of multimodal biometric system. In a centralized architecture all biometric processes are located on one host. Distributed architecture implicates the distribution process in several different places (machines), where they must have the ability to communicate through the network.

Potential users have at their disposal numerous commercial as well as open-source solutions. Commercial solutions often make up closed units, with all the advantages and disadvantages of this approach. Some of the open source solutions enable the development of flexible systems, which can have the same use value as commercial solutions in certain situations, but with much smaller financial investments. Also, the use of biometric authentication is not generally in the forefront and is offered as an optional possibility with some of the commercial producers' solutions (Bogicevic, Milenkovic and Simic, 2012).

The solution offered by Microsoft, Active Directory Services (ADS), includes an integrated identity management system. Ever since the Windows server 2003 R2, Active Directory Federation Service (AD FS) is an integral part of the ADS and is being used to create connections between organizations. This is

possible by user authentication through Active Directory which represents an identity provider. Moreover, AD FS issues tokens that are used in the authentication process. In addition to ADS, Microsoft has also developed MIIS-Microsoft Identity Integration Server, which has changed names, but in the year 2010 was presented as FIM – Forefront Identity Manager. FIM was developed in order to integrate with Active Directory and Microsoft Exchange solutions.

IBM offers an identity management system, which is a part of Tivoli and is called Tivoli Identity Manager, based on policies and roles. It provides a hierarchy of roles, web self-services, group management and synchronization of user data with different repositories. The advantage is in the possible synchronization of Tivoli with ERP systems. Furthermore, there is a possibility of using biometrics as an authentication method.

The imposed open source solution is the FreeIPA solution that allows creation of identity storages, centralized authentication, domain control for Kerberos and DNS services and authorization policies, and all this on Linux systems using the native Linux tools. Basically, the FreeIPA is a domain controller for Linux and Unix systems. FreeIPA defines the domains through control of the servers and reported client machines. That provides a centralized structure that was previously unavailable in Linux/Unix environments, and all this through the use of native Linux applications and protocols.

A suggested technical solution is based on FreeIPA and MMBio solutions. Identity management is done with the help of FreeIPA system, while MMBio framework for multimodal biometrics is responsible for working with biometric data. Data acquisition is done with the help of kerberized application for acquisition which uses functionalities of the FreeIPA solution.

A multimodal biometric application has been developed together with the use of framework. Within the application, three different open source solutions have been integrated and each of them works with different biometric modality. The modalities used are: fingerprint, face and voice. Although each of the open source solutions has lower accuracy than commercial solutions available on the market, when different modalities were combined, the accuracy of the system was at a considerably higher level than it was with any unimodal solution individually.

4. MMBIO – FRAMEWORK FOR MULTIMODAL BIOMETRICS

In order to build a multimodal biometric system from unimodal open-source solutions, several challenges have to be solved. It is necessary to establish communication between open-source unimodal solutions, acquisition sensors, biometric database and multimodal fusion algorithms. Also, this communication has to be implemented in accordance with the system distributed nature, as different system components can be deployed on various platforms. Moreover, biometric data management has to be implemented, with special focus on supplying data in accordance with unimodal biometric solutions specifications. Finally, framework has to support component reusability in new, different context.

MMBio framework for multimodal biometrics was developed to overcome these challenges (Milovanović, Minović and Starčević, 2012). Communication between different system parts is based on MMBio communication protocol. Communication protocol is used rather than object serialization because communication protocols are platform independent. However, unimodal solutions and acquisition sensors often support only nonstandard, solution specific communication methods. In such situation, it is necessary to develop a communication adapter in order to translate protocol commands to solution specific ones.

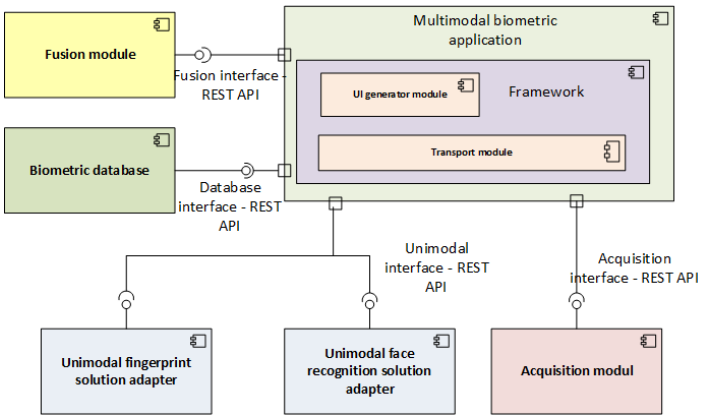

Figure 1: Multimodal biometric system architecture

MMBio framework supports different multimodal database work modes. It is possible to use either centralized or distributed database. Also, biometric data associated with an identity can significantly differ from one biometric system to another. In a multimodal biometric database, a person can have data about several different biometric modalities, and each modality may be represented by several data instances. Biometric data can be in raw form, or stored as biometric characteristics. Each type of biometric data can be stored in different file formats, and some file formats are solution specific. MMBio communication protocol has been designed to comply with different biometric database models, and supports different use case scenarios.
Figure 1 shows architecture of multimodal biometric system developed with MMBio framework. System components are biometric application, biometric database, acquisition module, and unimodal solutions (Milenković et all, 2013). Communication adapters are used for protocol message translation. Each component reports its functionalities to multimodal system during the initialization process. Communication between components is synchronized, based on request/response paradigm. In this use case, MMBio protocol is implemented by using REST (Representational State Transfer) services. Protocol messages are sent over HTTPS protocol. An example of protocol message is shown on Figure 2

```
POST /NBIS/resurs/match HTTPS/1.1
Content-Type: image/jpeg
User-Agent: Jersey/2.2 (HttpUrlConnection 1.7.0_25)
Host: 10.10.1.176:8080
Connection: keep-alive
ServiceName: NBISFingerprint
UserID: 1120
Timestamp:09.09.2013. 14:54:03
Modality:Fingerprint
Biometric-Sub-Type: index finger
Biometric-Sample-Type: raw image/bmp
Content-Length: 277921

PGh0bWw+CiAgPGhlYWQ+CiAgPC9oZWFkPgogIDxib2R5PgogICAgPHA+VGhpcyBpcyB0aGUg
 Ym9keSBvZiB0aGUgbWVzc2FnZS48L3A+CiAgPC9ib2R5Pgo8L2h0bWw+Cg==
.....................................................................
```

Figure 2: Protocol message example

HTTPS request line contains information about web service location. Example shows a biometric data match request which is being sent to a unimodal biometric solution. Header fields are used to describe request in detail. User ID, information about biometric modalities and sample types, content type are contained in the request header. Biometric-Sample-Type field describes whether biometric data is raw or processed. Payload contains extracted biometric characteristics that are to be verified. In the example, Jersey framework was used to implement REST web services.

5. FREEIPA

In theory, Identity management (IdM) describes the management of individual principals, their authentication, authorization, and privileges within or across some boundaries with goal of increasing security and productivity while decreasing cost, downtime and repetitive tasks. In practice, what this means? IdM manages over the following data, functions and processes:

- Identities (principals): users, machines, services and/or applications
- Authentication: password, biometry, 2 Factor Authentication (2FA)
- Authorization: Polices, ACLs, DAC, MAC

FreeIPA is built as a set of services over a single domain to achieve this goal. Its mission is to facilitate the management of the domain, the identity of the users, client machine, and configured services. Services used by FreeIPA are:

- Authentication: Kerberos KDC, Dogtag Certificate System
- Data Storage: 389 Directory Server
- Server/Client Discovery: DNS
- Management: NTP

FreeIPA itself defines a domain, a group of machines that have shared configuration, policies, and identity stores. This shared configuration allows the machines (and users) within the domain to be aware of each other and operate together.

Sharing configuration is done through a client-server paradigm. This means that FreeIPA have a client part. It must be installed on the machine before it can join to the domain.

For FreeIPA a client is simply any machine, which is configured to operate within the FreeIPA domain, using its Kerberos and DNS services, NTP settings, and certificate services. That is an important distinction: a client does not require a daemon or (necessarily) an installed product. It requires only system configurations that direct it to use FreeIPA services.

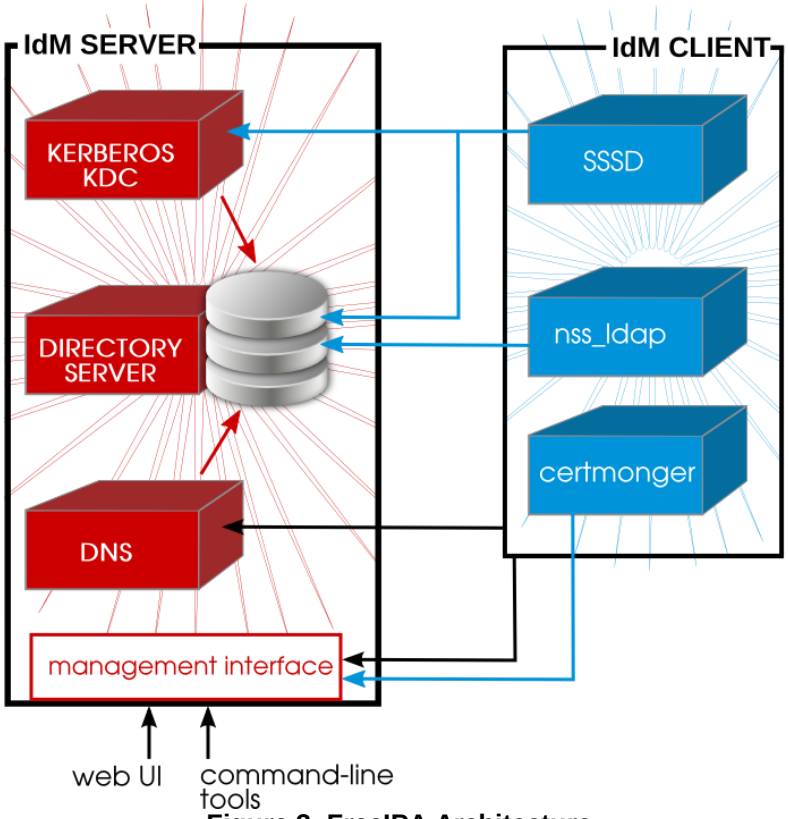

Figure 3: FreeIPA Architecture

IdM uses the local storage (cache) on a client to improve performance in a few ways:

- Store IdM information when the machine is offline.
- Keep information active beyond its normal timeout period if the client cannot access the central server. The cache is persistent even after rebooting the machine.
- Reduce the round-trip time of requests by checking information locally before looking at the server.

Information is stored either in an LDB database (similar to LDAP) or the local filesystem (as XML files), depending on the type of information. There is a two type of information: Identity information (about users, machines, and groups) and policies which are set globally on the server and then are propagated to the clients.

As Figure 3 shows that FreeIPA client uses two native daemons to interact with the IdM server:

- SSSD provides the user authentication for the machine and enforces host-based access control rules.
- Certmonger monitors and renews the certificates on the client. It can request new certificates for the services on the system, including virtual machines.

When a FreeIPA client is added to the domain (enrolled), its SSSD and certmonger are configured to connect to the IdM server and the required Kerberos keytab and host certificates are created. The host certificate is not used directly by IdM; it may be used by other services, such as a web server or any other local or remote applications.

6. ARCHITECTURE OF PROTOTYPE

Current operating systems use text password for user authentication. Almost everyone knows the weaknesses of this method of user authentication. The main objective of the proposed prototype is to extend the current one-component method of user authentication. As shown in Figure 4, a prototype extends FreeIPA authentication with a biometric sample of the user. During process of authentication it sends standard credentials of the current user together with biometric sample. Standard FreeIPA server does not know how to handle this request for authentication. Therefore, we added MMBIO server to FreeIPA services and diverted sending the request for authentication to it. MMBIO server extracts biometric sample from request and sends it to the MMBIO search engine (Multimodal Biometric Matcher). Also it must send standard request for authorization to the FreeIPA. Process of authorization can be counted as successful when both have got positive responses. MMBIO server sends back to the client consolidated response.

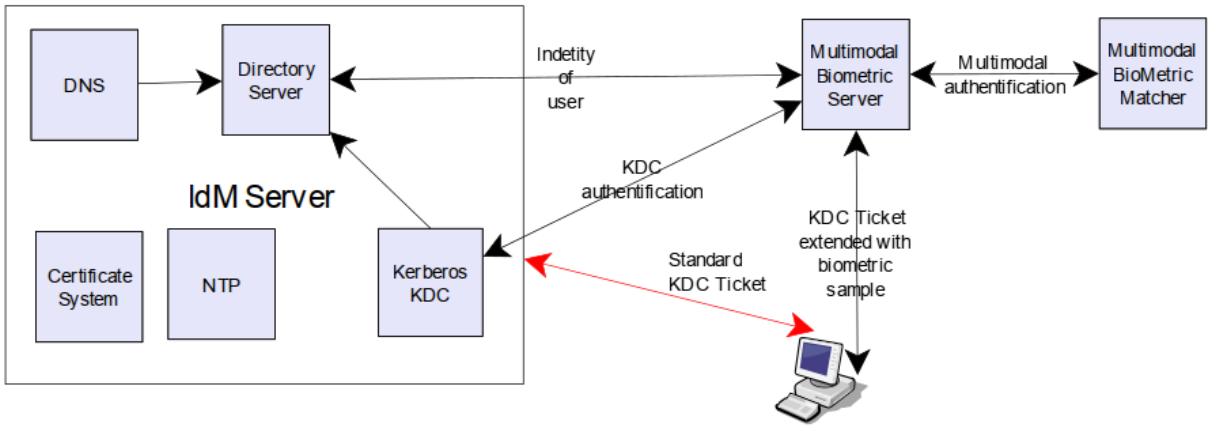

Figure 4: Prototype Architecture

It should be noted that it is necessary to pair the identities stored in the FreeIPA server and the MMBIO server due to different ways of storing user information. MMBIO server needs to know which identity from FreeIPA repository has biometric samples in its database and vice versa. In this way, communication between FreeIPA and mmbio server transmits a minimum set of data sufficient to unambiguously determine the identity of a user during authentication process.

MMBIO Matcher uses unique identifier MMBIOHashID to determine identity of the user. The process of adding users in MMBIO base is process of taking the biometric samples. Upon completion of the acquisition of samples it is necessary to bind MMBIOHashID to the identity of a user in FreeIPA storage.

On the other hand, the process of adding a new identity in FreeIPA environment includes creating a user profile and binding it to a MMBIOHashID. We have two scenarios:

- Newly created user does not have enrolled biometric samples in MMBIO database,
- Newly created user is already enrolled in MMBIO database

The second scenario is trivial. We need to bind the user identity with existing MMBIOHashID. In the first scenario we need to take biometric samples from the user and upload them to the MMBIO database.

During process of authorization, on the client side, key part is SSSD (System Security Services Daemon). It allows to any application, on the operating system which use NSS (Name Service Switch) for identity and PAM (Pluggable Authentication Module) for authorization, to use biometric sample along with standard password mechanism (shown in Figure 5.). An SSS Client Application is unaware that it is communicating with an SSS Client Library. It simply calls a standard NSS or PAM function, which is mapped by the NSS/PAM runtime to a module-specific function name, and which is then delivered to an SSS Client Library.

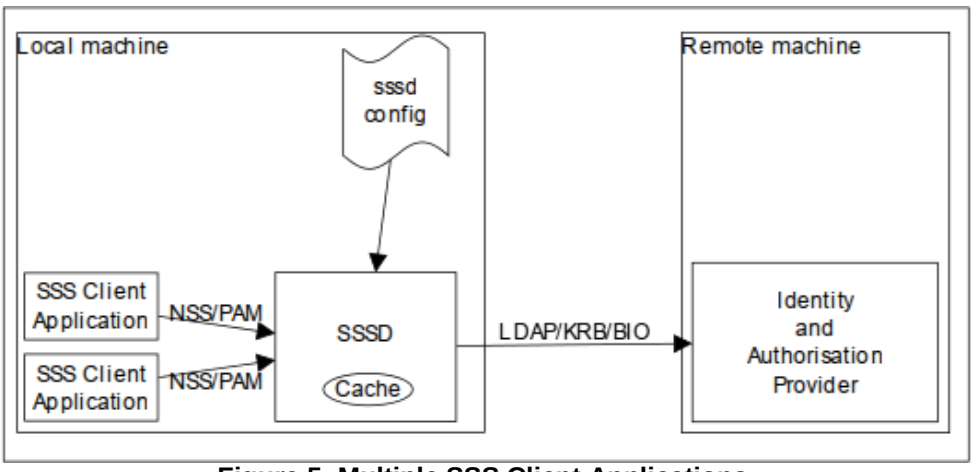

Figure 5: Multiple SSS Client Applications

Key features from SSSD are:

- NSS and PAM interface to the operating system
- Pluggable back-end system to connect to multiple different identity sources.
- Offline authentication

With SSSD it is possible to create multiple domains of the same, or of different types of identity provider. SSSD maintains a separate database file for each domain. This means that each domain has its own cache, and in the event that problems occur and maintenance is necessary, it is very easy to purge the cache for a single domain.

7. CONCLUSIONS

In this paper various important aspects of the Identity Management Systems and Multimodal Biometrics functionalities are revised. Most of Identity Management Systems allows Single Sign-on feature. With remote users and communications made through the Internet, the possibility of fraud and unauthorized access to data increased. Securing the authentication process is today's the biggest concern. Therefore, allowing the use of biometric data of one user in the process of authentication for access to critical data, it reduces the chance of fraud and unauthorized access.

Developed prototype confirms possible integration of identity management and multimodal biometric systems. During implementation of the prototype, some new issues concerning communication between client and server have risen, and they should be further investigated. Moreover, challenges connected to the acquisition of the biometric data and its upload to the MMBIO database are of great importance, and they are going to be an important part of future work on this topic.

ACKNOLEDGEMENT

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REFERENCES

Lynch, L. (2011). Inside the Identity Management Game, IEEE Internet Computing, vol 15,

Kong, L., et all. (2011). Identity Management White Paper - Draft, National Institute of Standards and Technology

Williamson, G., Yip, D., Sharoni, I., Spaulding, K. (2009). Identity Management: A Primer, MC Press, LLC

Bogicevic M., Milenkovic, I., Simic D. (2012) Identity Management – A Survey, XIII International Symposium Symorg, Serbia, Zlatibor, pp.900-907

Milovanović, M., Minović, M., Starčević, D. (2012). Interoperability Framework for Multimodal Biometry: Open Source in Action, Journal of Universal Computer Science 18, no. 11 pp. 1558-1575

Prasad G., Rajbhandari, U. (2011). Identity Management on a Shoestring, Retrieved from http://www.infoq.com/minibooks/Identity-Management-Shoestring, 2011.

Milenković, I., Latinović, O., Starčević, D., Simić, D. (2013). Communication Adapter Prototype for Unimodal Biometric Solution, ITEO 2013, Banjaluka, ISBN 978-99955-91-24-3

Hermans J., Valkenburg, P. (2009). “European Identity and Access Management Survey”, KPMG and Everett, Retrieved from http://www.everett.it

O'Gorman, L. (2003). Comparing Passwords, Tokens, and Biometrics for User Authentication, Proceedings of the IEEE, vol 91, issue 12, pp 2021-2040.

De Clercq, J. (2002). Single sign-on architectures. Infrastructure Security, 40-58.

Mueller, R., & Sanchez-Reillo, R. (2009, September). An approach to biometric identity management using low cost equipment. In Intelligent Information Hiding and Multimedia Signal Processing, 2009. IIH-MSP'09. Fifth International Conference on (pp. 1096-1100). IEEE.

Senk, C., & Dotzler, F. (2011, August). Biometric Authentication as a service for enterprise identity management deployment: a data protection perspective. In Availability, Reliability and Security (ARES), 2011 Sixth International Conference on (pp. 43-50). IEEE.

RedHat Enterprise Linux. (2013). Identity Management Guide. Retrieved from: https://access.redhat.com/site/documentation/en-US/Red_Hat_Enterprise_Linux/6/index.html

FreeIPA. (2014). FreeIPA: Identity/Policy Management. Retrived from: http://www.freeipa.org/docs/master/html-desktop/index.html

METHODS FOR BIOMETRIC DATA CONNECTION IN MULTIMODAL SYSTEMS

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Abstract: *Multimodal Biometric Systems in Identity Verification use statistical data on anatomical and physiological characteristics of humans and they always carry a dose of certain amount of uncertainty with regards to the accuracy of results. At some important social activities, like security, healthcare or finance, the accuracy of certain biometric systems becomes questionable as singular mismatches could cause irreparable damage harm to an individual person or the community. In recent years, in order to achieve a more reliable identification, there has been intensive application of multimodal biometrics systems, namely application of fusion of independent biometric data. Analyses that were conducted in recent years have shown numerous advantages in relation to the accuracy and the efficiency of implementation of biometric fusion. However, in order to accomplish this, attention must be paid to ways that data, in multimodal biometric systems, are connected.*

Keywords*: Biometric systems, methods for biometric data, biometric fusion, multimodal biometrics*

1. INTRODUCTION

The process of globalization is strongly connected to the issue of security and identity recognition and validation, due to which attention is paid to international connection of security mechanisms based on multimodal biometric systems. Biometric identification is becoming sophisticated because it combines different biometric modalities and techniques, and, in return, it gains higher accuracy or it notably reduces the effort of users in the process of identification. In recent years, there have been large amounts of data in literature about research in the field of multimodal biometrics, but the impact of certain combination of biometric modalities, the available methods of processing biometric data and the influence of the size of the biometric database on the system's overall performance hasn't been significantly analysed. This paper analyses multimodal biometric systems for identity verification that simultaneously use several biometric modalities i.e. a fusion of independent biometric characteristics. Special chapter of this paper refers to ways of connecting biometric data in multimodal biometric systems, because the method of data connection directly influences the overall system's performance in the realistic conditions of use.

2. MULTIMODAL BIOMETRIC SYSTEMS FOR DETERMINATION OF IDENTITY

When only one biometric characteristic is used for identification, or when several characteristics of a single mod are used, then some parts of the procedure for determining identity become critical with regards to the accuracy of the data for processing, i.e. their precision so errors occur more frequently in the work of the system compared to procedures that use a fusion of several independent biometric characteristics – specific mode of operation used for identification. Then we say that we are talking about multimodal biometrics i.e. multi-biometric system for identity recognition and verification with multiple biometric characteristics.

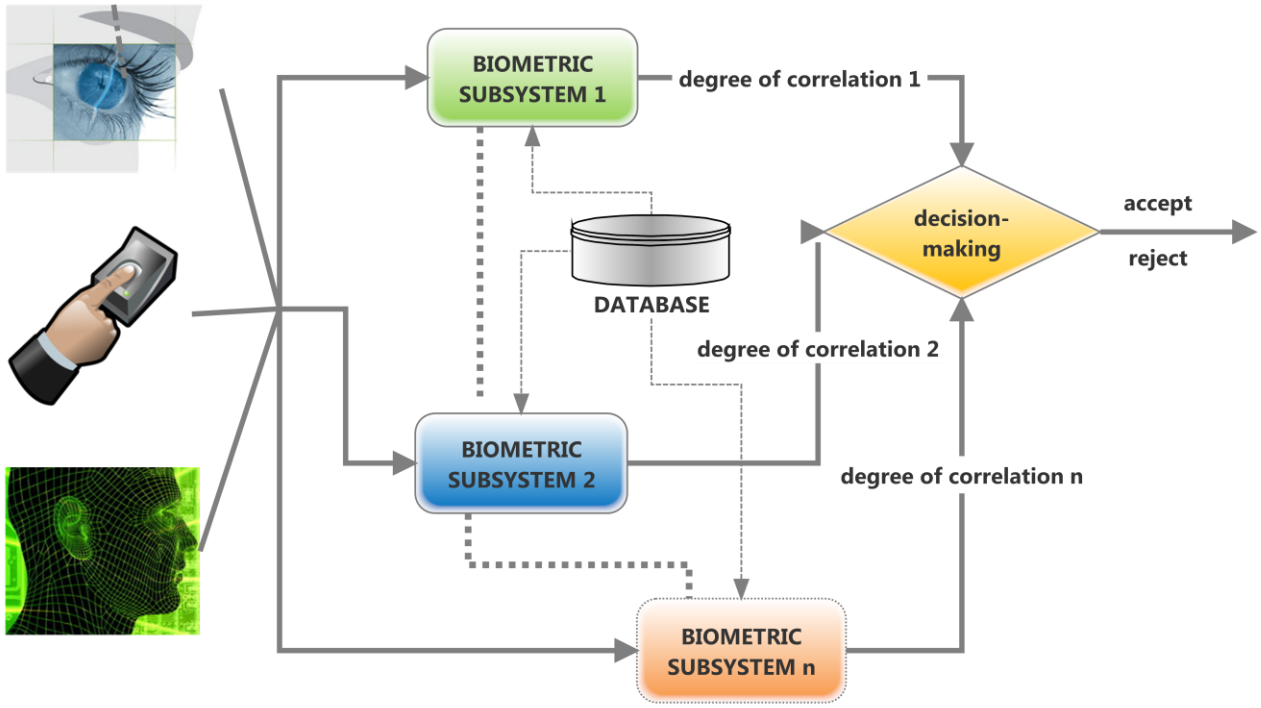
In order for multimodal systems to be more precise than unimodal, but also fast enough, it is important to find an efficient combination for the fusion of biometric characteristics. As mentioned, the first multimodal systems were those created by combining biometric characteristics of voice and face lines.[1] The aim of their application was to overcome the aforementioned limitations that appear in unimodal systems, which increased not only the precision of work but also the reliability of the process of identification, the overall number of implemented biometric systems as well as the number of different applications in the society[2]. Those multimodal biometric systems are showing significant advantage in prevention of abuse of biometric technologies because they provide a greater level of security of the system having in mind that they require a user to be physically present during data collection.

[1] A. Ross, K. Nandakumar, A. K. Jain, (2008).
[2] A. Nagar, K. Nandakumar, A. K. Jain, (2012). Technical report: Multibiometric Cryptosystems, vol. 7, NO.1.

The essence of multimodal systems is seen in the use of several independent procedures in a process of calculation of a degree to which the biometric data entered match to those stored in the database (Y.Xu, D.Zhang, J.Yang, 2010). This way, the number of components that in case of failure or malfunction could endanger the overall functioning of the system functioning is eliminated or significantly reduced. The collected intermediate results of independent system components are then adjusted for final process of decision making. The principle method of work of a multimodal system is illustrated in picture No.1.

By all means, the identification becomes more sophisticated and expensive as different techniques of biometric identification are combined, thereby gaining on reliability in precision and deduction while allowing the level of the requested effort on a side of a user in the process of identification to be influenced as well.

It should be emphasized that, in recent years, a more intensive application of multimodal systems is in use, so the results achieved in the field of testing the accuracy of certain multimodal combinations can be found in literature, but without data that refer to the performance of such systems. More importantly, the influence of the amount of data stored in database is in direct relationship with the system's performance.



Picture 1: The principle method of work of a multimodal system

According to the available sources, there is no simple way to choose biometric methods to be used in a multimodal system. However, we could still say that, in majority of different scenarios, the best results are achieved through a combination of biometric methods that, even in unimodal systems, offer a great level of accuracy, as expected, while satisfactory results are achieved by combining techniques that each, for itself, provides the average accuracy of the work of the system. The techniques most frequently used in multimodal biometrics include techniques that work with fingerprints, face lines and iris images.

A safer biometric system can be built if a larger number of the aforementioned methods are used. In practice, it is desirable to combine physical and behavioural characteristics, since it reduces the possibility of fraud of a biometric system in the process of the identification or verification. It is already mentioned that these methods are in use at border crossings to control passenger entry or exit, to control access to a certain area, the network protection etc.

Multimodal biometrics could also be used as a support to standard procedures of identity control when, from standard documents and papers, it is not possible to acquire a sufficient number of data that would describe a person... Therefore, due to the risk of abuse, it is recommended to use both standard protection mechanisms as well as biometric data. One of the examples is a fake fingerprint. If only one biometric technique is used, and the person possesses a fake fingerprint, which is used for authentication, on behalf of a person, it could result with abuse. However, if the verification is based on face recognition, or, better yet,

on iris detection or vein position check, it is possible to ascertain, with greater level of certainty, whether or not it is the person in question or it is an attempt of identity theft.

Multimodal systems have numerous advantages over unimodal ones. In case when one biometric characteristic is common to several persons, the presence of the other method prevents a scenario of wrong acceptance. System frauds are drastically limited by existence of larger number of methods that are used during identification.

3. METHODS FOR BIOMETRIC DATA CONNECTION IN MULTIMODAL SYSTEMS

Efficiency and precision of multimodal systems are greatly influenced by methods and means of interconnecting several biometric data and their respective fusion. The process of unification of biometric data itself can be accomplished using different logical processing levels. As the main task of biometric system is acquiring biometric samples, the first possible level at which the fusion could take place is the level where a process of acquiring samples is completed. The result of fusion, at this level, is an aggregated sample obtained by combining multiple samples acquired. For instance, aggregated sample is a combination or raw data obtained from several fingerprints of a single person.

In the second stage of processing, based on the acquired, raw biometric sample certain characteristics are derived and placed into a pattern, so fusion, at this level is conducted by unifying several formed patterns into a one unique pattern which is then recorded into the database. In the next, the third phase of processing, matching of the derived characteristic, with the existing one in the database, is tested where, in multimodal systems, matching is done among several derived characteristics or mods which are compared with equivalent recordings in the database, and results are, by fusion, combined in terms of similarity in order to get a unique result a scalar, as a measuring unit of similarity. Finally, in the last, the fourth stage of processing, a decision should be made whether or not the system determined or failed to determine the identity of the analysed person. The fusion of data, on a decision level, is made easy as decision is made for each tested biometric mod individually, and after that, the final decision is made by the means of majority selection (A. Hicklin, B. Ulery, C. Watson, 2006).

The most important preconditions for efficient and precise running of multimodal systems are related to the functioning of input sensors. Those sensors need to be designed in such a way that they are cost effective and able to rapidly collect biometric data and store them into the system, without an error. Apart from this, keeping in mind the possibilities of sensors and chosen combination of biometric characteristics, it is important to conduct the needed analyses of several possible levels of data fusion, in order to choose the level that is, under given conditions, the most precise and efficient. At present day, a large number of sensors as well as groups of acquired biometric data are available, therefore, it is necessary to find the best solution for each application.

Biometric fusion is used in processes of identification as well as in procedures of user verification. The task given to the system for identification is, of course, far more challenging than the one for the system of verification. Experiences in the application of such systems have shown that the best results are achieved by using biometric modality of fingerprint. The multibiometric systems which use combination of several fingerprints for identification, like AFIS does should be highlighted. Also, it is concluded that fusion on the level of characteristic comparison, so far produced the best results (A. Ross, A. K. Jain, 2004).

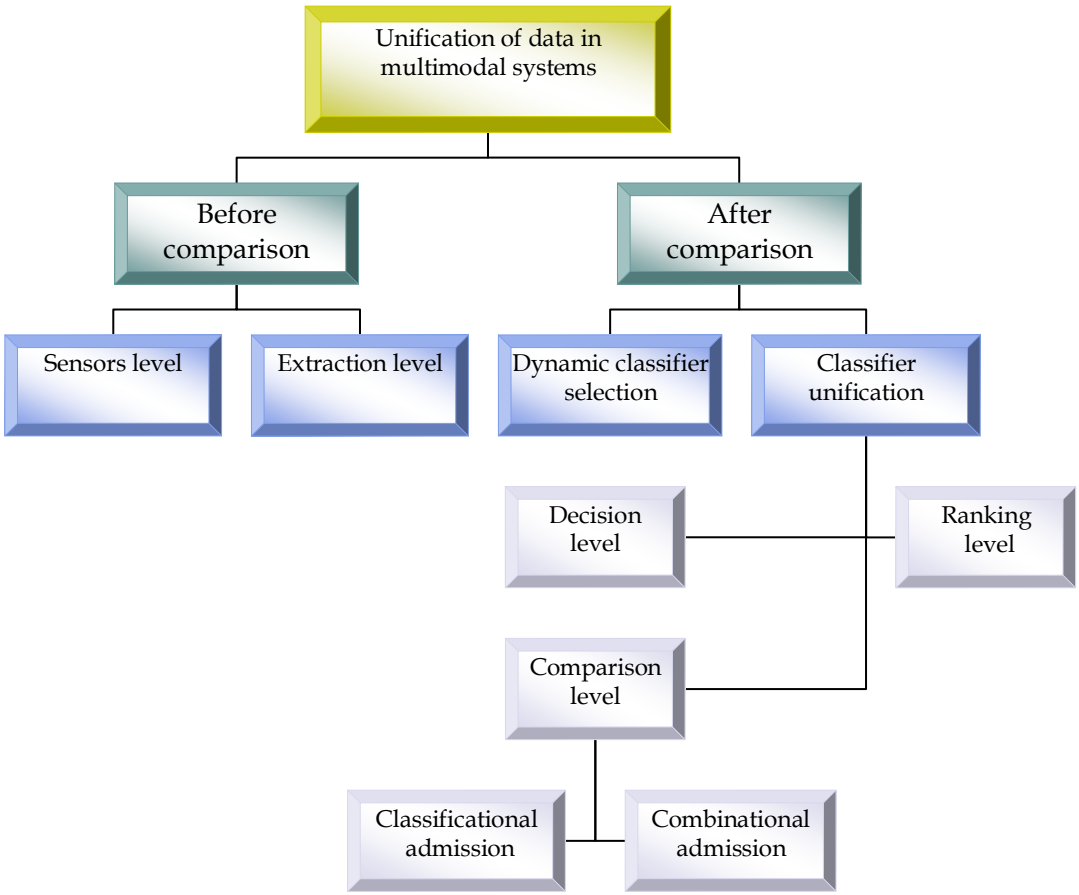
The analyses conducted in several cases, have shown that the two largest advantages that can be expected if biometric fusion is applied, are precision and efficiency. However, based on a fact that the fusion process is processing several aggregates of data, unlike in unimodal systems, it leads us towards demands for stronger computing systems and thereby higher expenses. Apart from this, more time is required to complete the task considering that more biometric data is being collected. Keeping in mind challenges that biometrics pose with regards to the right to privacy, we can say that the demand for collection of multiple data on a particular person does create a greater danger to violate one's privacy right.
Instead of a conventional approach to the location of potential combining of multimodal biometric data, Sanderson and Paliwal divided levels of fusion to two basic groups i.e. (A. Ross, K. Nandakumar, A. K. Jain, 2008): fusions prior to comparison and, fusions made after the comparison.

Approach to later fusions could be based on the concept of ranking of results or assigning points i.e. scores to comparison results. In terms of identification mode of work, the system's output result can be viewed as a ranking of identities entered into a database. In this case, the output result indicates a group of potential identities by sorting obtained matching scores, in a descending manner.

The goal of the method of fusion at this level is a consolidation of output rankings of singular biometric systems in order to obtain a common ranking for each identity. The ranking offers a better insight into a decision making process, but it reveals less information than the result represented in points, i.e. scores. Unlike scoring, ranking offers a possibility to compare the work of multiple biometric systems. Because of this, in this particular case, normalization of scores obtained is not needed (A. Ross, K. Nandakumar, A. K. Jain, 2008).

Normalization is an important phase with fusion technologies in multimodal biometrics. The goal of normalization is adjustment of parameters that refer to the location and scale of distribution of comparison results, scores, at the exit point of a separate module for comparison, in order to bring the results obtained from multiple modules, to the same level in order to allow further comparison (A. Ross, K. Nandakumar, A. K. Jain, 2008).

The picture No. 2 shows the taxonomy of possible techniques of unification of data in multimodal systems, according to *Sanderson* and *Paliwal*.



Picture 2: Taxonomy of possible techniques of unification of data in multimodal systems

The first group of techniques, prior to comparison, includes sensor and unification level fusions of the derived characteristics (a characteristic vector), while the second group includes match score and decision level fusions (A. Ross, K. Nandakumar, A. K. Jain, 2008).

4. CONCLUSION

Analysing the relationship between the group of techniques that belong to the model of earlier fusion, compared to those belonging to a later fusion, it can be concluded that techniques that belong to the model of earlier fusion, generally, have an advantage because the earlier fusion's algorithm does not include only biometric data, but their relationships, as well, which reduces the entropy of the system in question. As an

illustration of the expressed position, we can say that biometric characteristic contains more information on a concrete biometric modality than what we get at the exit of the comparison module (I. Milenković, D. Starčević, S. Paunović, 2011). The analysis of papers that deal with the problem of fusion, on all the aforementioned levels, indicate that the largest number of advantages is gained with unification at the level results of characteristic comparison because the previous results of processing of modalities within the system are relatively easily combined. The shortcoming of the fusion at the early stage of processing can be seen in the demand for compatibility of biometric data, which is not always easy to accomplish. As far as the fusion at a later stage is concerned, for example, decision making level, the research have indicated shortcomings of the fusion at this level because the possibilities for integration are very rigid as they possess a lesser number of information, unlike previous levels.

REFERENCES

A. Ross, A. K. Jain, (2004). Multimodal biometric: an overview, Appeared in Proc. of 12th European Signal Processing Conference (EUSIPCO), (Vienna, Austrija), pp. 1221-1224.

A. Ross, K. Nandakumar, A. K. Jain, (2008). "Introduction to Multibiometrics", Handbook of Biometric (eds. A.K. Jain, P. Flynn, A. A. Ross), Springer, pp. 272-283.

A. Nagar, K. Nandakumar, A. K. Jain, (2012). Technical report: Multibiometric Cryptosystems, Under review for IEEE TIFTS, vol. 7, NO.1.

A. Hicklin, B. Ulery, C. Watson, (2006). A Brief Introduction to Biometric Fusion, Mitretek Systems, National Institute of Standards and Technology, pp. 3-5.

I. Milenković, D. Starčević, S. Paunović, (2011). Fusion of information in multimodal biometrics, Catalogue of editions of the INFOTECH 2011 Conference, Vrnjačka Banja

Y. Xu, D. Zhang, J. Yang, (2010). A feature extraction method for use with bimodal biometrics, Pattern Recognition 43, pp. 1106–1115.

INTEROPERABILITY PROBLEM IN MULTIMODAL BIOMETRIC SYSTEMS

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Abstract: *The increasing utilization of biometric technologies in a variety of institutions and organizations requires constant research and improvement of biometric systems performance and precision. In such circumstances, combining several biometric technologies (multimodal approach) stands out as a possible solution. Using different biometric modalities and different biometric sensors and solutions developed by various companies, reveals the interoperability problem in multimodal biometric systems. This paper describes the aforementioned issue and lists currently available standards that address this issue. Also, a set of biometric communication protocols implemented in MMBIO framework that try to solve this problem are briefly presented in the paper.*

Keywords*: biometric systems, multimodal biometrics, MMBIO framework, interoperability, communication protocols*

1. INTRODUCTION

Utilization of biometrics for identification purposes dates from 1858. when Sir William Herschel, who worked for the Civil Service of India, recorded a handprint on the back of a contract for each worker in the organization (Komarinski, 2005). He used the recorded samples to distinguish real from fake employees when payday arrived. This is thought to be the first systematic capture of hand and finger samples that have been used for identification purpose. Later, in 1965. North American Aviation developed the first signature recognition system (Mauceri, 1965). In 1994. The Immigration and Naturalization Service Passenger Accelerated Service System (INSPASS) biometric system has been implemented which allowed travellers to bypass immigration lines at selected airports in US. Authorized travellers received a card with their hand geometry information (Wayman, 2004). They presented their cards along with approaching their hand to a biometric sensor. Upon authentication, passenger could proceed, thus bypassing the long lines. This system was discontinued in 2004.

One of the milestones in application of biometrics in organizations and institutions was also the so-called PIV (Personal Identity Verification) of federal employees and contractors (United States Department of Veterans Affairs, 2004). In August 2004. USA President Bush issued Homeland Security Presidential Directive 12 (HSPD-12) for a mandatory, government-wide personal identification card that all federal government departments and agencies will issue to their employees and contractors requiring access to Federal facilities and systems. The PIV for federal employees and contractors, specifies the technical and operational requirements for the PIV system and card. Also, in the same year several USA states established state-wide palm print databases that allow law enforcement agencies in each state to submit unidentified palm print samples in order to be searched against each other's database of known offenders. Biometric passports (Wikipedia), which contain biometric data about the passport owner, are also a mentionable milestone in biometric systems application in organizations and institutions. The biometric data is stored on a special chip, which contains information needed for face, fingerprint and iris recognition. Many developed European countries, but also a vast number of other world countries have implemented biometric passports, including Norway (2005), Japan (2006), Australia, USA (2007), Serbia, Montenegro (2008) and also Bosnia and Herzegovina (2009) .

All of aforementioned milestones show that implementation of biometric systems can improve authentication, security and identity management inside an institution in general. However, besides obvious opportunities and advantages of using biometrics in organizational settings, existing limitations must also be taken into account. As standard biometric system is not effective on its own, it must be improved in some manner. Usually, it is combined with a smart card system, but the cost of implementing both systems is significantly large (Nadir Blog, 2008). Also, lack of reliability of standard unimodal biometric systems is a mentionable disadvantage. Biometric devices can be fooled; if fingerprints or some other physical modality are compromised, they can't just be replaced like passwords or smart cards.

A possible solution for presented disadvantages could be the usage of multimodal biometric system, that uses several biometric modalities and in that way has improved performance and reliability. Also, by using different biometric solutions or devices, including those that are open-source, the cost of implementing such system could be drastically lower. However, combining those components and making them work together in a reliable manner is an issue that needs to be addressed. This issue is known as multimodal biometric system interoperability problem.

In the next chapter, the term interoperability is defined and also the problem that this paper tries to solve is stated. Currently available biometric standards that solve the problem of interoperability in biometrics are listed in third chapter and also each of presented standards is briefly described. In the fourth chapter, the solution that is used in MMBIO framework in order to solve the interoperability problem is briefly described. Conclusions, shortcomings and future work regarding the presented biometric communication protocols are defined in the last chapter.

2. INTEROPERABILITY IN BIOMETRIC SYSTEMS

This chapter presents the interoperability problem in biometrics research area. Afterwards, different formal definitions of interoperability, that are currently available in literature, will be listed.

In the research area of biometrics, several definitions of interoperability are present. (Wikipedia) defines the interoperability as an "ability of making systems and organizations to work together (inter-operate)". In (Microsoft, 2012), Microsoft states that "interoperability allows disparate information systems from multiple vendors to readily work together and exchange data". As for the software, term interoperability is used to explain the ability of various programs to:

- exchange data using some of standard formats for data exchange
- read and write same file formats
- use same protocols.

Term interoperability is most frequently used to annotate functioning of different biometric sensors in a number of IT environments (Biometric Web Services, 2012). On the other hand, within the ISO/IEC 2382-1:1993 standard (International Standards Organization, 1993), term interoperability is defined as "The capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units".

The problem of interoperability in biometric systems can be divided into a number of specific tasks. It is necessary to provide a communication tool between biometric solutions (both, open source and proprietary), biometric sensors and biometric database. One of the fundamentally important tasks is enabling communication and standard way of data exchange between biometric system and various types of biometric sensors, as well as acquisition devices. In this way, problem of dependence on a single manufacturer, also known as "vendor lock-in" is being solved. Last, but not the least important task in solving the problem of interoperability in multimodal biometric systems is standardization. In order to provide a wider application field of multimodal biometric systems, standardizing each segment of the system, especially communication, is of great importance. Also, it is necessary to include existing standards and allow their use within the system.

3. STATE OF THE ART

In this chapter, currently available biometric standards that solve the problem of interoperability in biometrics are listed and several most significant institutions in this research area are presented. Also, each of presented standards is briefly described.

There are several important standards which deal with interoperability problem between different biometric solutions, such as:

- MBARK
- BioAPI
- CBEFF
- ISO/JTC1/SC37
- FBI Wavelet Scalar Quantization
- Web Services for Biometric Devices
- OASIS/BIAS

Most of listed standards are not public. However, one of major problems is that none of available standards fully defines communication protocols required for network communication between all parts of a multimodal biometric system. In addition, these standards are mainly dealing with only one part of biometric system, usually the acquisition or data storing processes. Some of most important institutions in the world engaged in biometrics research field are:

- National Institute of Standards and Technology (NIST)
- International Organization of Standardization (ISO)
- International Electrotechnical Commission (IEC)

Tool for multimodal biometric application development MBARK (Multimodal Biometric Application Resource Kit) (Biometric Clients Group, Image Group, Information Access Division, Information Technology Lab, 2009), developed by the National Institute of Standards and Technology (NIST) tends to reduce complexity in the development of biometric applications. MBARK is open source software and it is available to public. It has valuable features, such as: consistent user interface, flexible user configuration and sensor interoperability. MBARK uses plug-in mechanism that enables real sensor interoperability based on mutual API. This API is used for integrating camera, fingerprint and iris scanners.

BioAPI (BioAPI Consortium, 2008) is a complete biometric standard that defines two application programming interfaces: interface for application programming (API) and interface for service programming (SPI). API enables application to utilize BioAPI framework functionalities, while SPI enables the framework to use biometric functionalities. Main goal of BioAPI standard is to enable communication between the application and biometric technologies independently from the manufacturer.

CBEFF is a standard for exchanging biometric data between different systems and organizations. It is adopted by ISO. This standard describes a structure and set of metadata elements necessary to support exchange of biometric information in a common way (National Institute of Standards and Technology, 2004). Among other features, CBEFF promotes interoperability of biometric-based applications and simplifies software and hardware integration process.

NIST recognized the potential of web services and their application in biometrics research field. Thus, project WS-BD (Web Services for Biometric Devices) (Micheals & Kevin, 2012) was created as a mean of providing interoperability of biometric systems. Limitation of WS-BD is that it only applies to the acquisition process of biometric samples.

OASIS BIAS represents efforts of the International Committee for IT Standards (INCITS) to provide a documented, open framework for developing functionalities needed for biometrics based identity management, which can be easily and conveniently accessed through web services. This standard defines and describes methods and relationships through which the BIAS framework can be used within Web services based on XML technology, as well as on service-oriented architectures (OASIS Committee Specification, 2011).

4. BIOMETRICS COMMUNICATION PROTOCOLS

As part of the project "Multimodal biometry in identity management", Laboratory for multimedia communications at the Faculty of Organizational sciences, develops framework for multimodal biometric system development (MMBIO) (Milovanović, Minović, & Starčević, 2012) . One of the problems that needed to be addressed within MMBIO framework is the interoperability problem. It is necessary to design communication protocols and implement software classes required for the functioning of framework in network environment. This chapter describes the solution that is used in MMBIO framework in order to solve the already mentioned issue (Šošević, 2013).

Biometric communication protocols within the framework are divided as follows:

- acquisition
- unimodal
- database
- multimodal

Commands that belong to above mentioned protocols are categorized according to their purpose. Database commands and unimodal commands are further divided into subcategories.

Unimodal commands

The unimodal category consists of those commands that are used to manipulate biometric samples, as well as those commands which are used for authentication. Manipulation of biometric samples includes commands CheckQuality, TransformData and ClassifyBiometricSamples. CheckQuality command is the quality check of the sample after the sample has been captured by the sensor. Using the TransformData command, biometric sample is being processed and transformed to another form. More specifically, some of pre-processing algorithms are applied to the biometric sample. There is a also the possibility to classify biometric sample using a classification algorithm or class. Classification can be done by issuing the ClassifyBiometricSample command.

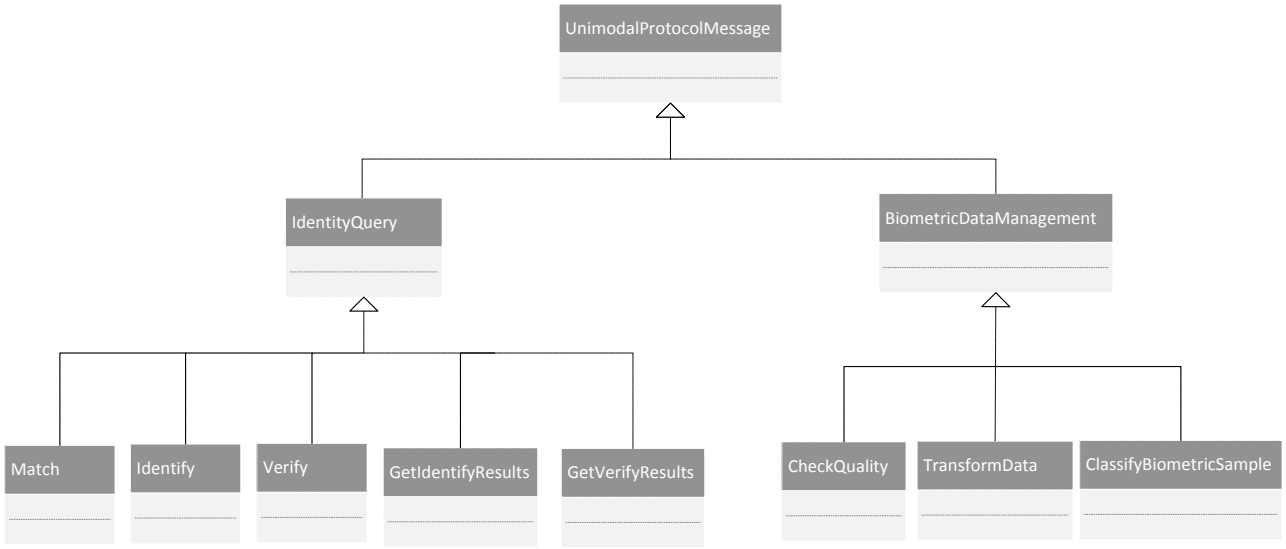

Figure 1: Unimodal commands class diagram

Authentication commands include the process of comparing biometric samples. Precisely, they include two main working modes of a biometric system - identification and verification. Match command initiates comparison of two biometric samples, resulting in a matching score. Besides this command, there are more complex commands - Identify, which executes identification process and Verify, which executes verification process. Two more commands are present in this category - GetIdentifyResults and GetVerifyResults, which are reserved for usage in case of asynchronous communication. Those commands are not yet defined in the current version of protocol specification, which is one of the issues that need to be solved.

Acquisition commands

Acquisition category consists of commands used for direct configuration and managing a biometric sensor. It includes commands SetConfiguration, GetConfiguration, TryLock, ReleaseLock and Capture. Settings to be used by the sensor during samples capture can be set by issuing the SetConfiguration command. There is also an option to view the current sensor configuration via the command GetConfiguration. TryLock and ReleaseLock commands are a part of the mechanism that enables concurrent access to each sensor. Before changing any settings, biometric system has to "take" the sensor by placing a lock (using the command TryLock). By issuing Capture command, the sensor is requested to perform a capture of biometric sample.

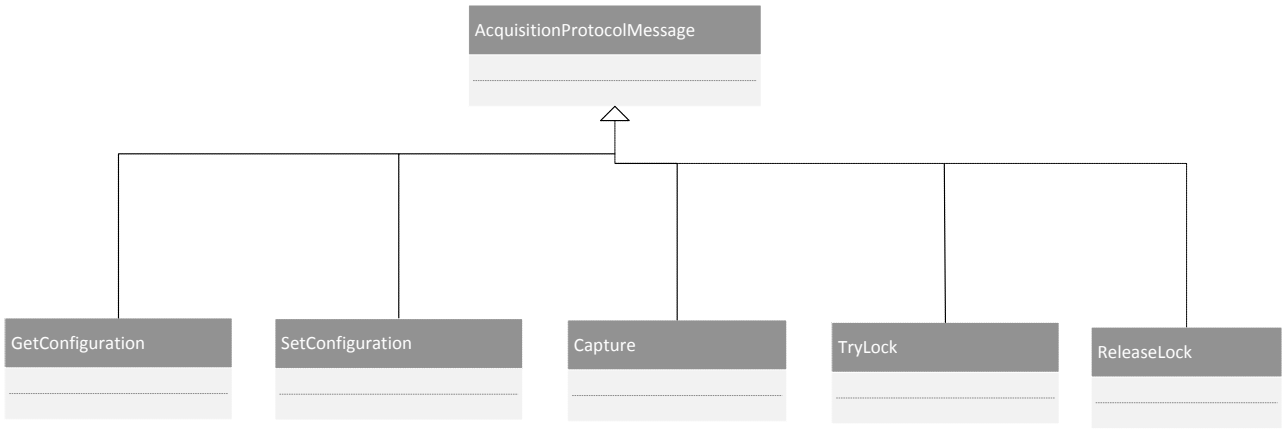

Figure 2: Acquisition commands class diagram

Database commands

Database commands are divided into two groups:

- metadata management commands
- biometric data management commands

Metadata management commands include CreateUser, AddUserToSubset, RemoveUserFromSubset, as well as commands for biographic data management - SetBiographicData, GetBiographicData, DeleteBiographicData and ListBiographicData. It is important to note that metadata also consists of users' biographical information. It is clear that in addition to storing multimodal biometric data in the database, it is also required to save information about users. New user in the database can be created using the CreateUser command. There is also an option to define user subsets in the database (i.e. users from Europe, America, Asia...). Users' belonging to a subset can be defined by issuing AddUserToSubset command. On the other hand, it is also possible to remove the user from the specified subset by using the RemoveUserFromSubset command.

Setting biographical information for the user can be done by calling the SetBiographicData command. Deleting biographical data from the database is done with DeleteBiographicData command. Proposed protocol also provides mechanism for viewing biographical data. Certain biographical data can be extracted from the database by issuing the GetBiographicData command. Also, ListBiographicData enables system user to list all biographical data for a targeted user.

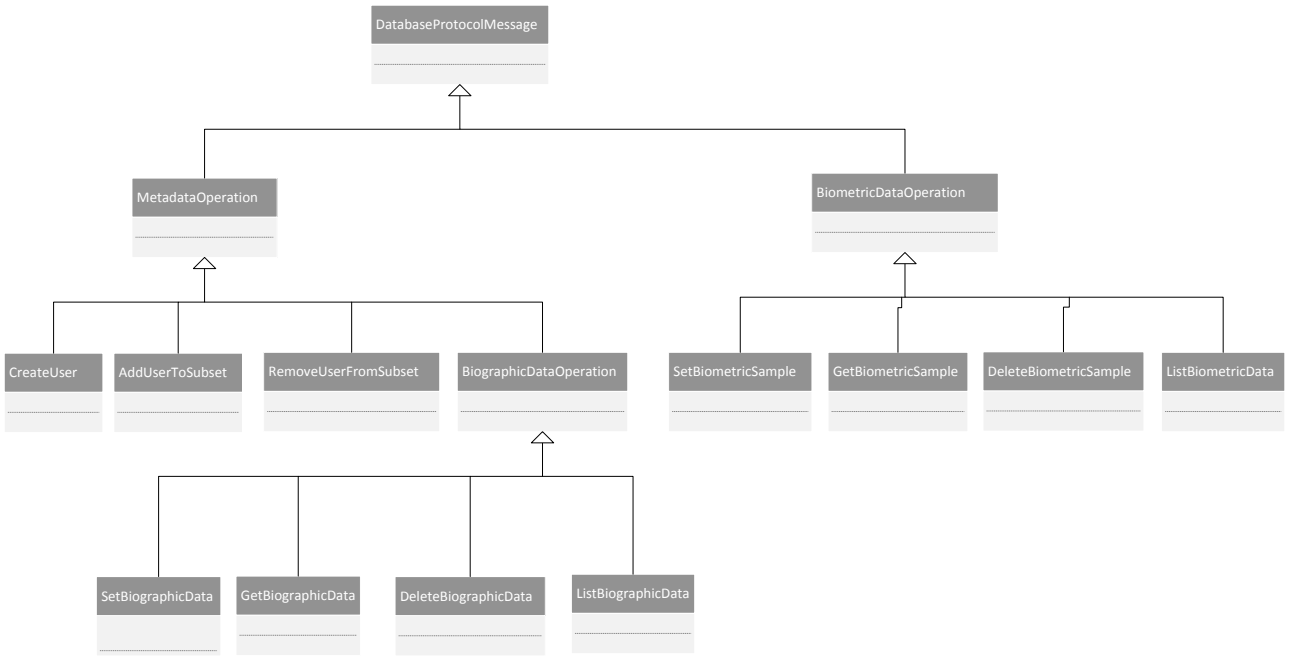

Figure 3: Database commands class diagram

Biometric data management includes similar commands as in biographical data management group. Those commands are SetBiometricSample, GetBiometricSample, DeleteBiometricSample and ListBiometricData. Using SetBiometricSample a biometric sample for a certain user is recorded in the database. If you need to retrieve biometric sample from the database, it can be done by issuing the GetBiometricSample command. To delete saved biometric sample of an user, DeleteBiometricSample command can be used. Also, it is possible to extract all biometric samples of desired user by using the ListBiometricData command.

Multimodal commands

Multimodal commands are those that are used to utilize the functionalities provided by a multimodal biometric system. FuseScores and FuseScoresList commands are members of this category. Using the FuseScores command, matching scores obtained by executing the verification process are fused. By issuing the FuseScoresList command, fusion of matching scores obtained by executing identification process is done. When using both of these commands it is required to define fusion algorithm that is desired to be applied in fusion process. The difference between verification scores fusion and identification scores fusion is that verification process returns only one matching score per modality, while identification process returns a list of matching scores. Thus, the result of FuseScores command is the score calculated by using selected

fusion algorithm. On the other hand, issuing FuseScoresList command results with a list of scores calculated by applying selected fusion algorithm on identification matching scores list.

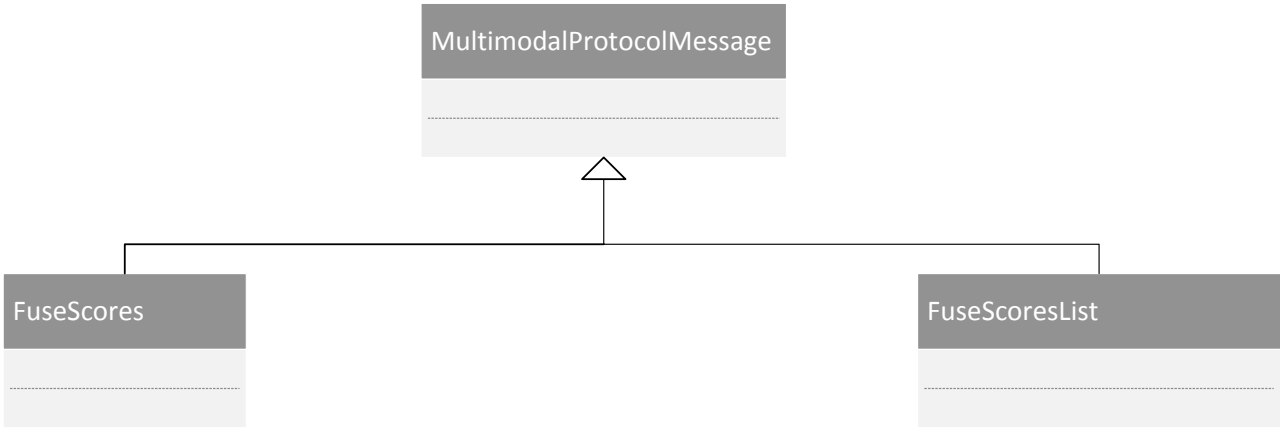

Figure 4: Multimodal commands class diagram

4. CONCLUSION

This paper describes the interoperability problem in multimodal biometric systems. First chapter provided an introduction to the application of biometric systems in institutions and organizations. Afterwards, the term interoperability has been defined and its meaning in the field of multimodal biometrics has been explained. Also, the biometric systems interoperability problem has been stated and current state of the problem has been presented by reviewing the existing relevant literature. In the final chapter, possible solution for the interoperability problem has been proposed in the form of biometric communication protocols and related commands.

Presented communication protocols are being used in MMBIO framework for multimodal biometric systems development. By implementing the defined protocols the interoperability problem in biometric systems is trying to be solved. Communication protocols must be sufficiently generic, but also they need to support all functionalities which are provided by integral parts of a multimodal biometric system. Throughout the paper, several communication protocols used in different segments of biometric system functioning have been presented. Those segments are acquisition, unimodal segment, database segment and segment related to the multimodal approach.

Of course, protocols presented in this paper have several shortcomings. Primarily, all protocol messages are designed in such way that they include synchronous communication. Asynchronous communication is not supported currently. Therefore, adaptation of protocols to asynchronous mode of communication is one of directions of further research. Also, it is necessary to define header fields and information transmitted via protocol messages. It should be considered adjusting developed protocols with existing standards such as CBEFF and/or BIAS.

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REFERENCES

BioAPI Consortium. (2008). BioAPI Specification. Retrieved March 12, 2014, from BioAPI: http://www.bioapi.org

Biometric Clients Group, Image Group, Information Access Division, Information Technology Lab. (2009). MBARK brosure. National Institute of Standards and Technology.

Biometric Web Services. (2012). Retrieved March 12, 2014, from National Institute of Standards and Technology: http://www.nist.gov/itl/iad/ig/bws.cfm

International Standards Organization. (1993). ISO/IEC 2382-1:1993 Information technology Vocabulary - Part 1: Fundamental terms. ISO.

Komarinski, P. (2005). Automated fingerprint identification systems (AFIS). Academic Press.

Mauceri, A. (1965). FEASIBILITY STUDY OF PERSONNEL IDENTIFICATION BY SIGNATURE VERIFICATION.

Micheals, R. J., & Kevin, M. (2012). Specification for WS-Biometric Devices (WS-BD) – Version 1. NIST.

Microsoft. (2012). Interoperability. Retrieved January 21, 2014, from Microsoft website: http://www.microsoft.com/en-us/legal/interoperability/default.aspx
Milovanović, M., Minović, M., & Starčević, D. (2012). Interoperability Framework for Multimodal Biometry: Open Source in Action. Journal of Universal Computer Sciences , 1558-1575.
Nadir Blog. (2008, November 26). The disadvantages of biometrics devices for organisations. Retrieved April 12, 2014, from Biometric devices: http://nadir-assignement3comm301c.blogspot.com/2008/11/disadvantages-of-biometrics-devices-for.html
National Institute of Standards and Technology. (2004). CBEFF specification. Retrieved March 22, 2014, from NIST official site: http://csrc.nist.gov/publications/nistir/NISTIR6529A.pdf
OASIS Committee Specification. (2011). Biometric Identity Assurance Services (BIAS) SOAP Profile Version 1.0.
Šošević, U. (2013). Developing communication protocols for integration of unimodal biometric solutions (Master's thesis. Belgrade, Serbia: University of Belgrade, Faculty of organizational sciences.
United States Department of Veterans Affairs. (2004). PIV card project. Retrieved February 2, 2014, from United States Department of Veterans Affairs: http://www.va.gov/pivproject/
Wayman, J. L. (2004). Biometrics–Now and Then: The development of biometrics over the last 40 years. Biometrics in the Reflection of requirements: Second BSI Symposium on Biometrics.
Wikipedia. (n.d.). Biometrijski pasoš. Retrieved March 2, 2014, from Wikipedia: http://sh.wikipedia.org/wiki/Biometrijski_paso%C5%A1
Wikipedia. (n.d.). Interoperability on Wikipedia. Retrieved February 11, 2014, from Wikipedia: https://en.wikipedia.org/wiki/Interoperability

THE IMPACT OF APPLYING INTERNATIONAL SPECIFICATIONS AND STANDARDS TO BIOMETRIC SYSTEMS

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Abstract: *The rapid development of biometric systems and their wide application in practice have led to the emergence of the large number of hardware and software manufacturers on the international market. This phenomenon caused the problem of interoperability of biometric systems. This problem significantly affects the functioning and performance of biometric systems, with special emphasis on the security of biometric data to be exchanged. In this paper, the application of international specifications and standards is suggested as an important part of the solution to this problem. These specifications and standards, such as BioAPI and CBEFF specifications, registered and published as multistandards by ISO (International Organization for Standardization), propose the establishment of single plaform (BioAPI) and unique format for data exchange (CBEFF), to facilitate the functioning of the biometric systems regardless of hardware or software manufacturers.*

Keywords*: Biometrics, Standards, Specifications, BioAPI, CBEFF*

1. INTRODUCTION

First of all, the term of interoperability should be defined. Li and Jane (2009, p. 27) state that “interoperability in the field of ICT includes the use of the same format or protocol without disrupting the performances of the system”. This is related to the functioning and communication between parts of the same system, as well as cooperation and communication between various systems.

Since Biometrics is increasingly presented on the market (for example, access control, e-commerce, internet banking and other areas that require a high level of data security in authentication) and, as Li and Jane (2009, p. 18) point out, “Biometrics uses physical or behavioral characteristics of an individual to uniquely identify the user during authentication”, the security of information as well as communication between the parts of a biometric system must be at the highest level. Deravi (2008, p. 34) discusses that “due to the fact that the development of biometric technologies and devices, as well as software applications, gained the momentum, there was the problem of large number of manufacturers and the problem of communication between the softwares and devices from different manufacturers (so-called "vendor lock-in")”.

Considering those facts, leck of unique platform as well as unique format for information exchange between components of one biometric system or between different biometric systems has become the big problem. So, as it stands in The BioAPI Consortium report (“BioAPI Specification Version 1.1”, 2001), in 1998 BioAPI Consortium has been formed with the main aim to create BioAPI specification and define a unique platform for communication between applications and biometric technologies regardless of the manufacturer. Subsequently, BioAPI with the status of an international standard should accelerate the acceptance of biometric technologies and a large number of commercial applications at the international level.

On the other hand, as Deravi (2008) points out, since there was no single format that would facilitate the exchange of biometric information, cooperation between NIST Institute and BioAPI Consortium has formed CBEFF (Common Biometric Exchange Formats Framework) as an idea to establish a unique format for the exchange of biometric information between different systems with the emphasis on data security. Primarily, the format for the exchange of fingerprints was established, followed by NISTIR 6529 specification, which applies to all biometric modalities, today now known as CBEFF. The current version NISTIR 6529-A is an extended version of CBEFF which, unlike previous versions, may contain information of various biometric modalities at the same time or more information of a single modality.

In the following text, these specifications are described through examples in detail, emphasizing their role in improvement of the interoperability of biometric systems.

2. BIOAPI SPECIFICATION

In The BioAPI Consortium report (“BioAPI Specification Version 1.1”, 2001, p. 7) stands that “BioAPI is a standard that defines a simple biometric application interfaces, standardized modular approach to biometric

functions, algorithms and devices, standardized methods for distinguishing biometric data and device types, and support for biometric identification in distributed computer environments".

In the same report ("BioAPI Specification Version 1.1", 2001) stands that BioAPI provides the basic functions of biometric systems, such as Enrollment, Verification and Identification, and includes a database interface that allows to BSP, a software which communicates with the device for enrollment and verification, to manage the Identification of the population. Also, BioAPI defines an API (Application Program Interface) for the application developers and SPI (Service Provider Interface) for developers in the field of biometric technology. Those interfaces present the two basic levels of BioAPI platform.

3. STRUCTURE OF BIOAPI PLATFORM

The basic version, BioAPI v1.1, consists of two essential parts presented in Figure 1 ("BioAPI Specification Version 1.1, 2001", p.17): API, Biometric Application Programming Interface, or application level, and the SPI or Biometric Service Provider Interface. API is the highest level where the basic biometric functions, that each software application must contain in order to communicate with BioAPI platform, are implemented.

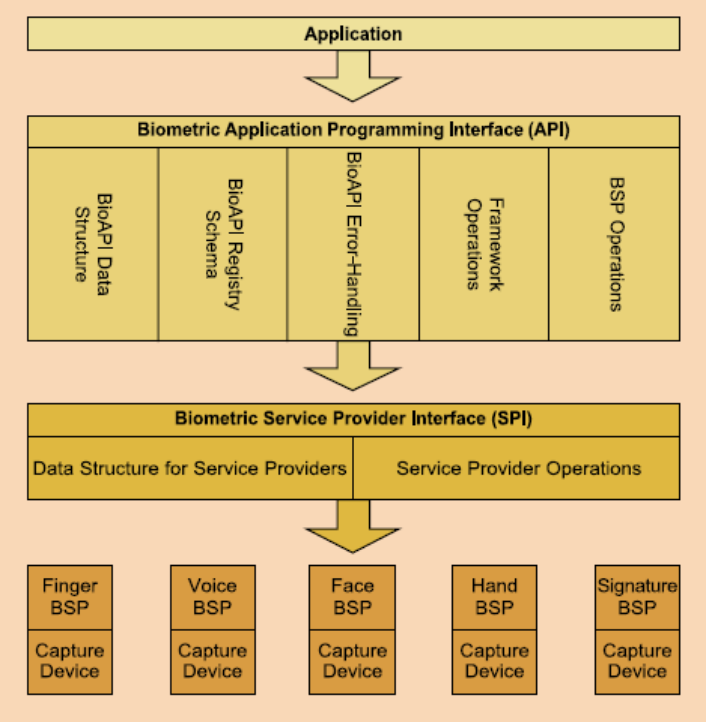

Figure 1: *Structure of BioAPI platform* ("BioAPI Specification Version 1.1, 2001", p.17)

In The BioAPI Consortium report ("BioAPI Specification Version 1.1", 2001) stands that API level is organized into five categories as shown in Figure 1. The first category is the Biometric Data Structure and defines all the data structures that are used in the application. BioAPI Regisity Schema is used to store information for each component within BioAPI. BioAPI Error Handling defines operations for error management within BioAPI. Framework Operations defines general operations for running and disabling applications. BSP Operations provides operations for data exchange and communication between the application and the BSP. All biometric operations Capture, Process, Enroll, Verify, Identify and so on, are defined by the BSP Operations. Among other things, BSP Operations provides operations that allow applications to access and manage biometric databases.

In the same report ("BioAPI Specification Version 1.1", 2001) stands that SPI consists of two categories: Data Structure for Service Providers and Service Provider Operations (BSP). SPI communicates 1-on-1 with the BSP. API calls are routed to the SPI. Every BSP is connected to the BioAPI via SPI. BSP (Biometric Service Provider), regardless of the manufacturer, is a software that communicates with the biometric device and must be compatible with SPI interface specification, because it is the only way to be engaged into the BioAPI working environment and to be used by all biometric applications compatible with BioAPI. BSP contains the unique aspects of individual biometric technologies, namely the products and devices of certain manufacturers (for example, there are BSP for face, hands, iris etc.). BSP can be local or distributed. Local BSP completely operates within a single platform, while distributed BSP can be instantiated and loaded as a separate client-server components with a client-server communication. For biometric applications, client-server architecture is usually applied because it is safer environment for the executive biometric algorithms,

and when it comes to the identification of a large population this architecture has enough power to run the biometric algorithm unlike local BSP. In addition, the database can be placed on a server, which makes client work easier.

4. BIOAPI COMPLIANT BIOMETRIC SYSTEM EXAMPLE

In the following text there is small example of a biometric system for face verification of the persons, which works within LAN (Local Area Network), and it is also compliant with BioAPI specification and based on a client-server architecture.

4.1 BSP FOR FACE VERIFICATION COMPLIANT WITH BIOAPI (SPI LEVEL)

In their paper, Yuan, Hui, Leung and Gao (2004) discuss the significance of compliance of biometric system with BioAPI explaining the small example of biometric system for face verification. Apart from the mandatory operations defined in the SPI, Yuan et al. (2004) explain that the four primitive biometric functions Capture, Process, CreateTemplate and VerifyMatch are implemented. LEM algorithm is used to compare face images due to recognizing a person. On a sample of 30 users LEM showed nearly a 100% accuracy in recognizing.

Capture is a function for taking a picture of an individual faces, when enrolling or verifying person. It provides a GUI or graphical user interface for taking a picture with the camera. Taking picture provides picture frame, face image and user information (such as Customer Identification Number).

Process function allows preprocessing and normalization of the face samples for verification. It takes the raw data after Capture function and output is processed biometric data.

CreateTemplate function processes the raw array of pictures (gallery) after the Capture function done working to create a template for enrolling. It involves three steps: pre-processing, normalization and LEM formatting. Array of nine images is generated from the raw data (in the form of a single data), which are standardized for LEM. After that, the image information is encoded and returned to the launched application and stored in the Application Database.

The last function VerifyMatch compares the processed biometric data after Process function and face templates from Application Database.

4.2 BIOAPI COMPATIBLE APPLICATION FOR FACE VERIFICATION (API LEVEL)

Yuan et al. (2004) in their paper explain the importance and performance of BioAPI compatible application, called FaceControl, for access control to the protected area. The application is implemented in a client-server architecture. The client makes a face image, while the server processes and verifies the raw image with the stored templates from the database. The client and the server communicate via LAN. Figure 2 (Yuan et al. 2004, p. 295) and Figure 3 (Yuan et al.,2004, p. 296) illustrate the client-server processing in FaceControl application by calling the primitive functions included within BSP.

Figure 2 (Yuan et al., 2004, p. 295) presents the process of enrollment. The client uses the Capture function to enroll. The output is an intermediate data in the form of image-array. It is sent to the server. Server calls CreateTemplate function from the BSP. After processing, template-array is created and recorded in the database.

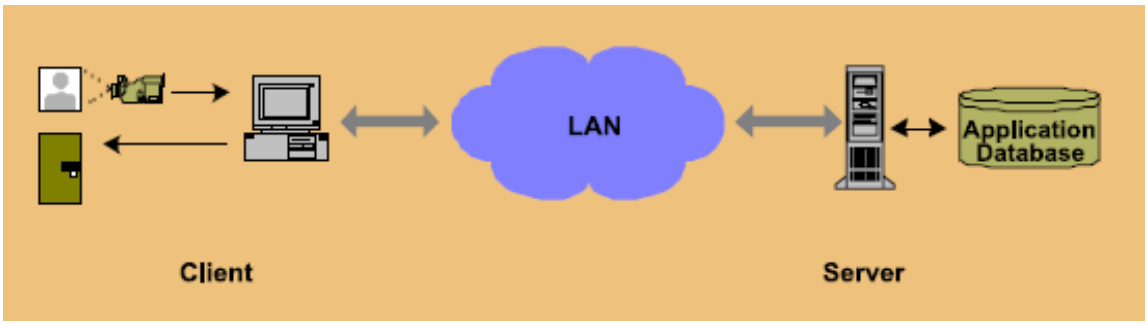

Figure 2: *Process of enrollment* (Yuan et al., 2004, p. 295)

Figure 3 (Yuan et al., 2004, p. 296) explains the verification process. On the client side, FaceControl calls Capture function for face verification. After taking picture output is intermediate biometric data that is sent to the server for verification. On the server side after Process function output is processed data and it will be compared using VerifyMatch function with template array called from the Application Database. The result is

returned to the application FaceControl on the the client side. The result of the verification implies whether person may approach to the protected area or not.

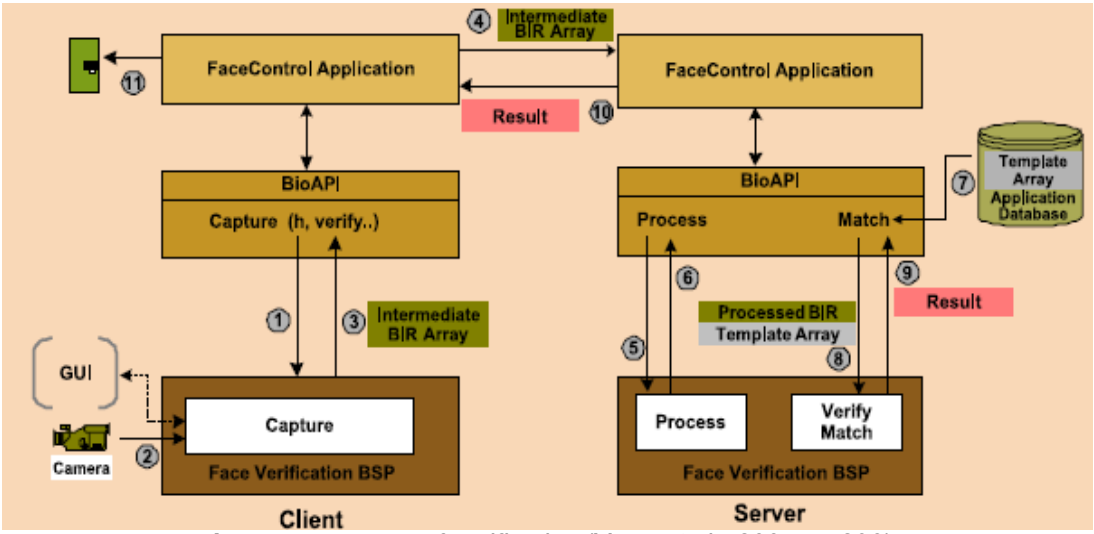

Figure 3: *Process of verification* (Yuan et al., 2004, p. 296)

5. CBEFF (COMMON BIOMETRIC EXCHANGE FORMATS FRAMEWORK)

Clarke (2011, p.57) defines CBEFF as "set of general guidelines for the establishment of standards or specifications compliant with standard, created by some of the so-called patron organizations like BioAPI Consortium, ISO, ANSI, NIST, etc.". Clarke (2011) state that CBEFF record comprises a set of elements of the biometric data used for biometric information exchange between the various components within one biometric system or between more biometric systems. CBEFF record is compliant with (patron) format defined by some of the standards. An essential part of CBEFF record is BDB defined by one of the client organizations that is registered with the IBIA association (International Biometric Industry Association).

Clarke (2011) points out that compatibility of biometric data with the standard or specification in the exchange of information enables smooth exchange of data regardless of the manufacturer or biometric technology. If two systems during data exchange use different standards or specifications that are consistent with CBEFF framework, there are standardized applications that transform CBEFF basic structure from one patron format to another patron format for easier communication, which improves system interoperability.

6. CBEFF DATA STRUCTURE

According to NIST report ("CBEFF", 2004) there are two CBEFF data structures: basic and nested. The basic CBEFF structure refers to one biometric modality such as face, iris, fingerprint, etc. The nested structure can be very complex and generally contains the data elements of two or more biometric modalities.

6.1 CBEFF BASIC DATA STRUCTURE

In the basic structure, CBEFF data elements are placed in the fields within CBEFF record (file). Fields are grouped into the three main sections: SBH, BDB and SB. Each section includes fields that are required or optional.

6.1.1 SBH (STANDARD BIOMETRIC HEADER)

In the NIST report ("CBEFF", 2004) stands that SBH is composed of the basic fields that may be required or optional, and carries a particular set of data necessary for the exchange within the system or between the different systems, as it is described in Table 1 (NIST report, "CBEFF", 2004, p.6). Each field is described and presented within Table 1.

Table 1: *SBH fields* (NIST report, "CBEFF", 2004, p.6)

Field Name	Required or Optional	Description
SBH Security Options	R	Defines data security
Integrity Options	R	This field defines which the integrity attribute goes with data. Signature or MAC.
CBEFF Header Version	O	-
Patron Header Version	O	Patron Format Specification or Standard version.
Biometric Type	O	Biometric type (e.g., fingerprint, voice, etc.).
Biometric Subtype	O	Additional specification within a biometric type.
Biometric Data Type	O	Level of processing applied to this data (e.g., raw, processed, etc.).
Biometric Purpose	O	Intended use of the data (e.g., enrolment, verification, etc.).
Biometric Data Quality	O	Quality of the biometric data.
Biometric Creation Date	O	Creation date and time of the biometric data.
Validity Period	O	Valid-From and Valid-Until Dates for this record.
Creator	O	Text identifier of the application's owner.
Index	O	Unique identifier for the biometric reference data within the record's application space.
Subheader/Basic Structure Count	O	Number of CBEFF Structures in the level below this header's level in a CBEFF nested structure.
BDB Format Owner	R	ID of the Group or Vendor which defined the BDB.
BDB Format Type	R	BDB Format Type as specified by the Format Owner.
Product Identifier (PID)	O	Unique (registered) identifier of the entity that created the biometric data.
Patron Format Identifier	O	Unique (registered) identifier of the patron format of the next lower nested level.
Biometric Data Block (BDB)	**R**	**Defined by the Format Owner. May be encrypted.**
Signature	**R**	**Signature or MAC. Only present if the SBH Security Options value is "Integ-rity-Only" or "Privacy-and-Integrity".**

It can be concluded that each biometric record with this kind of structure is standardized and ready to be exchanged with the component or system that uses the same CBEFF format, and used as well for different purpose such as enrollment, verification, etc.

6.1.2 BDB (BIOMETRIC DATA BLOCK)

This section according to NIST report ("CBEFF", 2004) contains the biometric data of a certain modality (iris, face, hand print, fingerprint, etc.). It represents a memory block specified by the owner of the data type (modality). It can be standardized and non-standardized, depending on whether it is adopted by an official body, working group or consortium. Manufacturer, the official body for standardization, working group or consortium may determine that this field contains only the biometric template. Also they can determine the structure of the data with additional parameters and information. Patron format specifications may require that BDB must be encrypted (specially defined encryption) or uncoded, which is an optional security measure.

6.1.3 SB (SIGNATURE BLOCK)

This field contains a unique digital signature (content was determined by the patron format specification) and it is a security measure.

6.2 CBEFF NESTED DATA STRUCTURE

In the NIST report ("CBEFF", 2004) stands that nested structure exists when it comes to exchange of more then one biometric modality (fingerprint, face, voice, iris, etc.) simultaneously and/or more biometric data of one modality. It contains root header and sub-headers. Each sub-header corresponds to a certain modality. In the Figure 4 (NIST report, "CBEFF", 2004, p.14) example of nested CBEFF structure is presented. This CBEFF record carries the data of two modalities: voice and fingerprints. BDB sections are standardized or non-standardized. The record is protected by the signature.

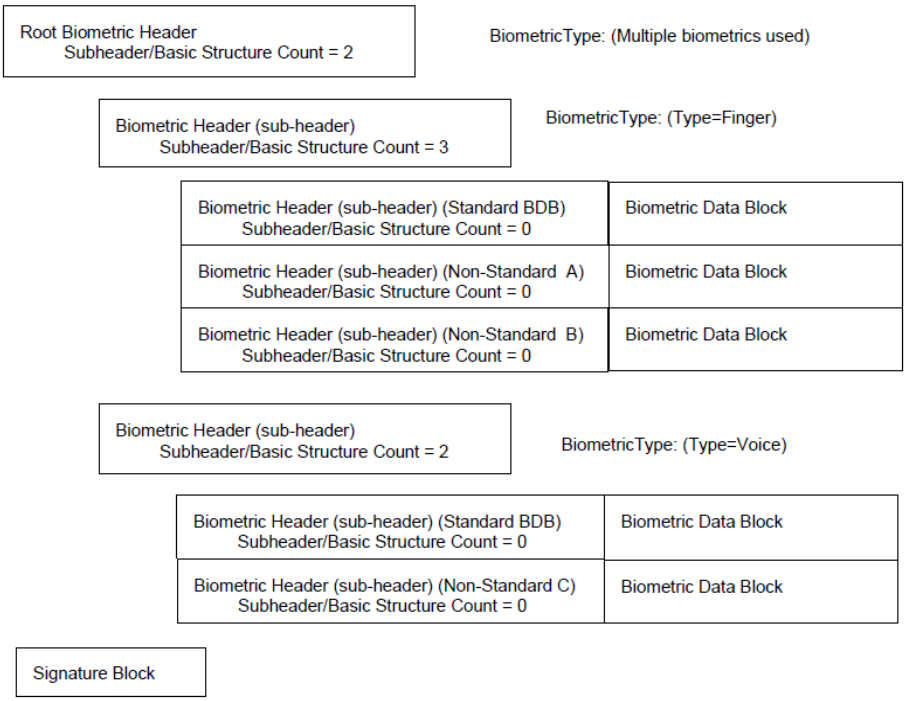

Figure 4: *CBEFF nested structure* (NIST report, "CBEFF", 2004, p.14)

7. CONCLUSION

Standardization of biometric systems is a key to their successful implementation and operation. The establishment of the unique working environment, unique working protocols, technical interfaces and everything else that makes a platform functionally independent such as BioAPI, implies that biometric systems gain two very important characteristics - interoperability and interchangeability (replacing system components without disturbing the operation of the system) that make them unique and allow system operating regardless of the origin of components. Components become changeable, systems become more functional and harmonized, communication within the system easier, and more important is that the costs of development and exploitation of components and systems are becoming lower.

On the other hand, several multiple standards published in U.S. (by ANSI, NIST) as well as worldwide (by ISO), based on CBEFF, proves the importance and the advantages of CBEFF framework in terms of improving system interoperability and security in exchanging data.

Simultaneous application of an independent platform and a unique format for the exchange of biometric information, solves the problem of interoperability of biometric systems as well as security of biometric data exchange, and elevates to a higher level the exploitation of existing biometric systems as well as development of modern and sophisticated biometric systems.

REFERENCES

Clarke, N. (2011). *Transparent User Authentication*. United Kingdom: Springer London.

Deravi, F. (2008). *Biometric Standards*., In N. K. Ratha & V. Govindaraju (Eds.), *Advances in Biometrics*, pp. 473-489. United Kingdom: Springer London.

Li, S., Z.,& Jain, A. (2009). *Encyclopedia of Biometrics*. United States of America: Springer US.

NIST. (2004, April 5). *Common Biometric Exchange Formats Framework (CBEFF).* Retrieved from http://csrc.nist.gov/publications/nistir/NISTIR6529A.pdf

The BioAPI Consortium. (2001, March 16). *BioAPI Specification Version 1.1*

Yuan, X., Hui, S.,C., Leung, M.,H.,K., & Gao, Y. (2004). *Towards a BioAPI compliant face verification system*, Computer Standards & Interfaces, No. 26, pp. 289-299. doi: 10.1016/j.csi.2003.09.002

NOVEL APPROACH FOR TEXT PLAGIARISM DETECTION

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Abstract: *With the widespread use of the Internet for educational and personal purposes, access to the online books and research papers have become much easier for everybody. But that has also resulted in making text plagiarism become much easier to perform and plague the research publishing industry. In this paper, we tackled the problem of computer-assisted text plagiarism detection. We have developed an algorithm for plagiarism detection based on the combination of string matching and bag of words techniques. The algorithm is language and topic agnostic and can be applied to different cases of text plagiarism problems. The evaluation has shown that algorithm gives good results in detecting text plagiarism in documents with different topics. Also, it gives almost the same results as a commercial tool it has been compared with. Future work would include more extensive evaluation and development of a full-fledged web application for plagiarism detection based on this algorithm*.

Keywords*: plagiarism detection, plagiarism detection systems, bag of words, string matching, algorithm*

1. INTRODUCTION

Problem of plagiarism of essays and thesis work in education is a growing nuisance. Omnipresence of the Web makes the process of finding similar works significantly easier and thus the opportunity for a student to copy/paste a paragraph, page or even a complete work of somebody else becomes trivial. Pew Research Centre has performed a study and reports that 89 percent of study participants credited the rise of plagiarism to the widespread use of computers and the Internet. In the same report, authors state that 55 percent of college presidents have seen increase of plagiarism in students' papers in the past 10 years, while only 2 percent declared plagiarism is on the decline (Parker et al, 2011). Proper procedure when re-using somebody else's work would be to properly reference the original paper and thus give the appropriate credits to the author. However, the problem arises in cases when other author's content is re-used without proper referencing, which arrogates his/her work and contribution.

The topic of this paper is to design a technique for plagiarism detection in texts. This technique should be language agnostic in order to avoid lexicological and morphological specificities of a language a text is written in. This would also enable wider use of the new technique. The technique for plagiarism detection is based on the algorithm for calculating text similarity of two text documents. The algorithm is described in this paper. It is assumed that if two documents have a high text similarity score, than one document is a plagiarism of the other. This paper also describes a reference implementation of the text plagiarism detection technique and it is written in the Java programming language. The reference implementation was used to test the technique and compare its results with other approaches and tools. Also, the reference application can be downloaded and used within other applications or as a separate program.

The following section (Sec. 2) will describe common methods of text plagiarism and approaches for their detection. Section 3 presents the new approach for calculating text similarity that we are introducing in this paper. After that, in Section 4, the algorithm for calculating text similarity score is described and is followed by an example of calculating text similarity score (Sec. 5). Section 6 presents the reference implementation software of the new algorithm that was used to perform the evaluation of the algorithm (Sec. 7). Finally, we conclude the paper and give outline of directions for the further research (Sec. 8).

2. STATE OF THE ART

By observing various examples of text plagiarism, commonly found methods for illegitimate text usage can be summarized as follows (Gipp et al, 2011):

- *Copy & Paste plagiarism* - the direct copying of an entire text or part without a quotation;
- *Disguised plagiarism* - includes addition or modification of some parts of a text in order to disguise the act of copying someone else's work;
- *Undue paraphrasing* - the intentional rewriting of other peoples' ideas;
- *Translated plagiarism* - the machine or human translation of paragraphs from other sources from one language to another without adding references;

- *Idea plagiarism* - the appropriation of research methods, experimental setups, argumentative structures, and background sources.

Clough (Clough, 2003) identifies similar forms of plagiarism methods and distinguishes between: Word-for-word plagiarism, Paraphrasing plagiarism, Plagiarism of secondary sources, Plagiarism of the form of a source, and Plagiarism of ideas.

Existing plagiarism detection systems (PDS) can be categorized into *extrinsic* and *intrinsic* plagiarism detection. Extrinsic PDS method is a comparison of a document with a corpus of reference documents. Intrinsic PDS method does not use a reference corpus for comparison, but uses methods that resembles human ability to spot potential cases of plagiarism just by reading the content and detect variations in writing style (Eiselt et al, 2009; Alzahrani et al, 2012; Seaward & Matwin, 2009).

There are many different approaches of plagiarism detection, as well as their variations. The most commonly used approaches are (Gipp et al, 2011; Gipp & Meuschke, 2011):

- *Fingerprinting* method is currently the most widely applied approach for plagiarism detection. Documents are represented as a digest composed of a set of substrings of original text. These sets are called fingerprints, and their elements are called minutiae. After the formation of fingerprints of two documents, matching of fingerprints and their minutiaes are performed;
- *String matching* involves searching for verbatim text overlaps between texts. If the matching string is longer than given threshold, then the text is considered as a plagiarism;
- *Bag of words* analysis assumes representing documents as one or multiple vectors, e.g. parts of the document, which are used to calculate text similarity.
- *Citation-based Plagiarism Detection* is intended for academic works that have a lot of references. This approach uses citations and references for determining similarities between documents in order to identify plagiarism;
- *Stylometry* is one of the most used methods for intrinsic plagiarism detection where linguistic features of a suspicious text are examined in order to detect variations in writing style.

3. DESCRIPTION OF A NOVEL ALGORITHM FOR CALCULATING TEXT SIMILARITY

The algorithm for calculating text similarity that is proposed in this paper receives as input two text documents whose contents are being compared. The result is a similarity score of these text documents that ranges between 0 and 1. The algorithm consists of the following steps:

1. Generating the list of the most frequent words in both documents separately. The number of the most frequent words the algorithm should find is configurable. All words that do not add to the context of the text content are ignored (prepositions, conjunctions, etc.). The most frequent words are sorted in descending order by the number of occurrences in the text.
2. Finding intersection of the most frequent words from both text documents.
3. In this step, occurrences of the most frequent words (from the intersection list generated in step 2) are looked up in both text documents. For each occurrence of the most frequent word, a context window is created. Context window is composed of the most frequent word and words that precedes and follows it. Context window enables detecting the same parts of sentences in two text documents as they preserve the context a frequent word has occurred in. That means if someone has copied someone else's text, context windows are going to be the same in both text documents.
4. Context windows for both text documents are compared and text similarity score is calculated according to the formula that is described in the following section.

Example of half context window

Listing 1 presents two examples of half context windows. Half context window consists of only one word that proceeds or one word follows the most frequent word. These two examples show context windows for the words *start* and *globalization*.

start: [
is ***start***,
start process,
its ***start***,
start corresponds,
one ***start***,
start is,
period ***start***,
start eight,
doesn't ***start***,
]

globalization: [
begin ***globalization***,
globalization reflected,
called ***globalization***,
globalization should,
is ***globalization***,
globalization occurs,
for ***globalization***,
globalization preceded,
is ***globalization***,
]

Listing 1: Example of half context window

Example of context window of length 1

Listing 2 presents examples of context windows of length 1 for words *start* and *globalization*. Context window of length 1 has one word preceding and one word following the most frequent word.

start: [
is ***start*** process,
its ***start*** corresponds,
one ***start*** is,
period ***start*** eight,
doesn't ***start*** training,
]

globalization: [
begin ***globalization*** reflected,
called ***globalization*** should,
is ***globalization*** occurs,
for ***globalization*** preceded,
is ***globalization*** made,
]

Listing 2: Example of context window length 1

4. CALCULATING TEXT SIMILARITY SCORE

First, for each of the most frequent words we calculate its context window matching score by using the formula (1).

$$cwm_l = \frac{ct}{st} \qquad (1)$$

where:

cwm (context window match score)	Score of the context window matching for the particular most frequent word
ct	Number of context windows that appear in both text documents for the particular most frequent word
st	Total number of unique context windows in both text documents for the particular most frequent word
l	Context window length

Word weight is obtained by the formula (2).

$$ww_i = \frac{cw_i}{\sum_{j=0}^{m} cw_j} \qquad (2)$$

where:

ww (word weight)	Word weight in relation to the whole set of the most frequent words
cw (context window)	Number of context windows for the i most frequent word
m	Number of the most frequent words in a document

The formula for calculating the text similarity score:

$$ss = \left(\sum_{i=0}^{k} ww_i \cdot cwm_i\right) \cdot \frac{k}{n} \qquad (3)$$

where:

ss (similarity score)	The similarity score of two text documents
ww (word weight)	Word weight of i in relation to whole set of the most frequent words
cwm_i (context window match)	The degree of matching of context windows for i the most frequent word
n	Number of the most frequent words
k	Number of words obtained by intersection of the most frequent words in two documents

5. EXAMPLE OF TEXT SIMILARITY CALCULATION

Figure 1 presents an example of calculating the text similarity score of two text documents. First, ten most frequent words are found in both texts (n = 10). In these two lists of the most frequent words, 7 words are the same (k=7). For example, the most frequent word “PHP” appears 20 times in the first text document, while it appears 30 times in the second text document. For each word from this intersection set, context windows are created and compared. For instance, for the word “PHP” the same context windows appear 15 times in both text documents (ct = 15), while there are 35 unique context windows in both text documents (st = 35). Context window match (cwm) score for this word is 15/35 = 0.43.

Word weight (ww) is the weight of a word in a document (from the set of the most frequent words). For example, the most frequent word “PHP” appears 20 times in the first document, while the total number of occurrences of all most frequent words is 142. When 20 is divided with 142, a calculated word weight for the word “PHP” is 0.14 (ww = 0.14).

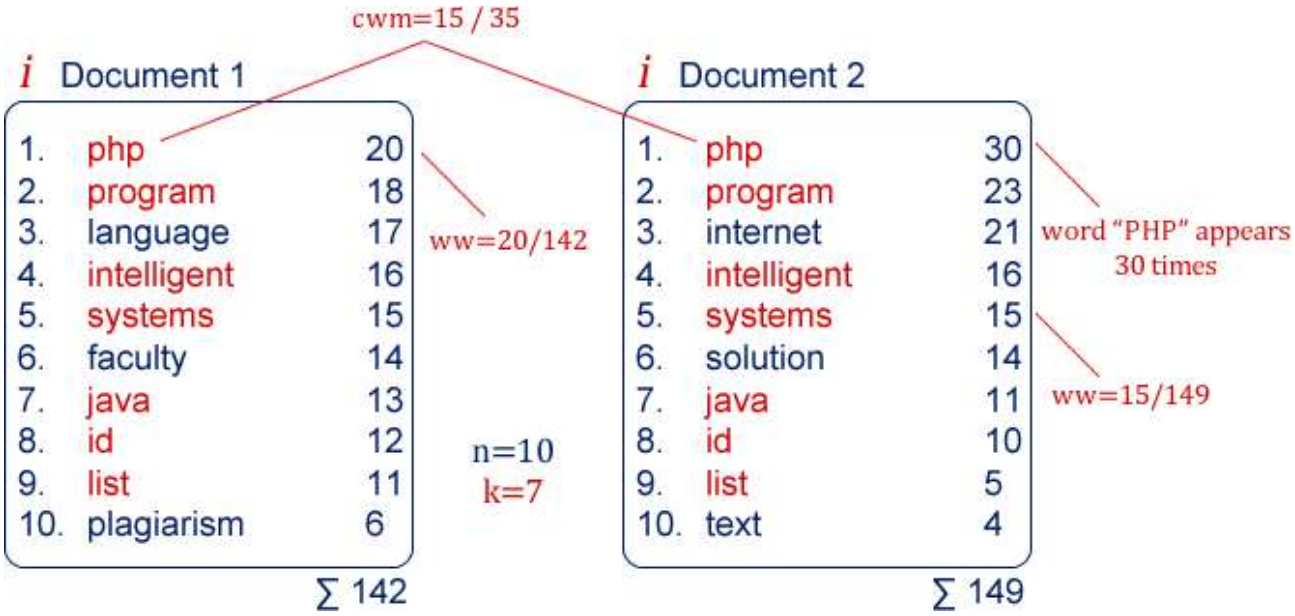

Figure 1: Example of computing the similarity score

For each of the most frequent words this process is repeated, and then these values are used for calculating the text similarity score. Values of context window match and word weight are multiplied and this value is summed for all of the most frequent words. In the end, the total sum of all final values is multiplied with a degree of matching of the most common words in both documents (k/n).

6. SOFTWARE DESCRIPTION

In order to evaluate this algorithm, we have created a prototype application in the Java programming language that implements the algorithm for calculating text similarity score (Fig. 2). The application allows loading original text document and several test documents that will be compared with the original. Also, the application supports loading content from .doc, .pdf and .txt files.

User can choose a number of the most frequent words to be looked for and the length of the context window, which can affect precision of calculating the text similarity score. When application finishes comparison of text documents, it displays the result of matching documents in the range of 0 to 100.

Also, after completion of documents comparison, application displays a report (Fig. 3) that contains all relevant information about the process of calculating text similarity score.

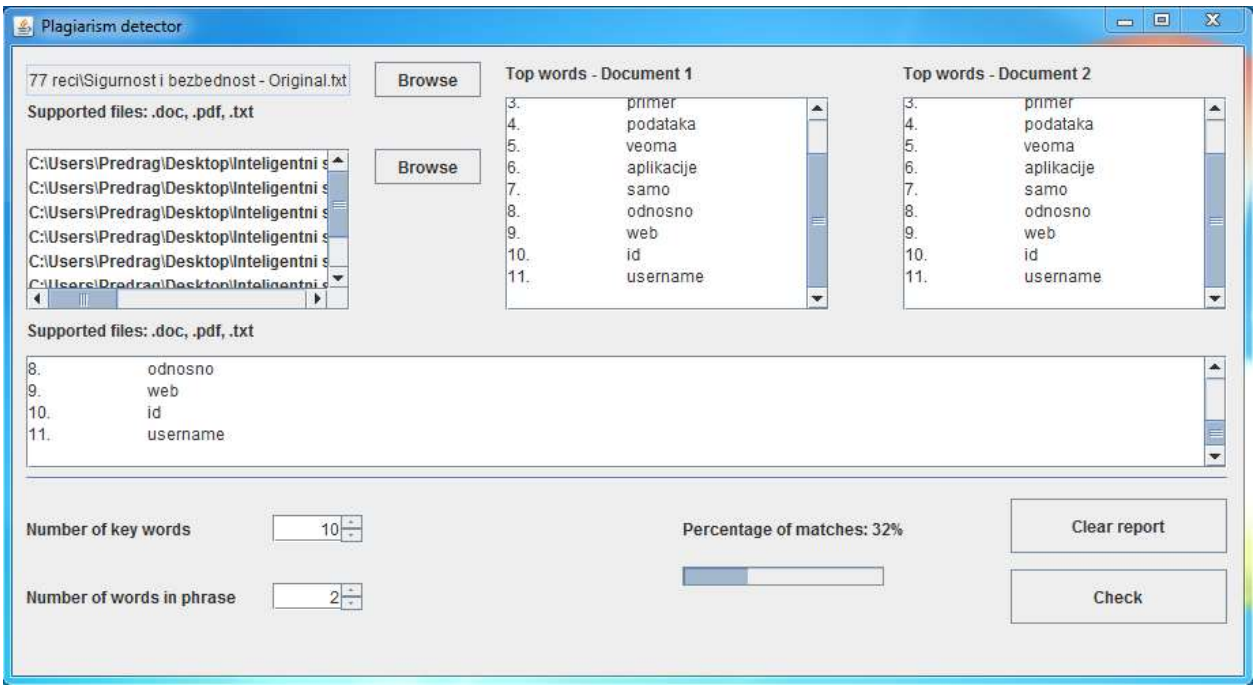

Figure 2: GUI of the plagiarism detection prototype application

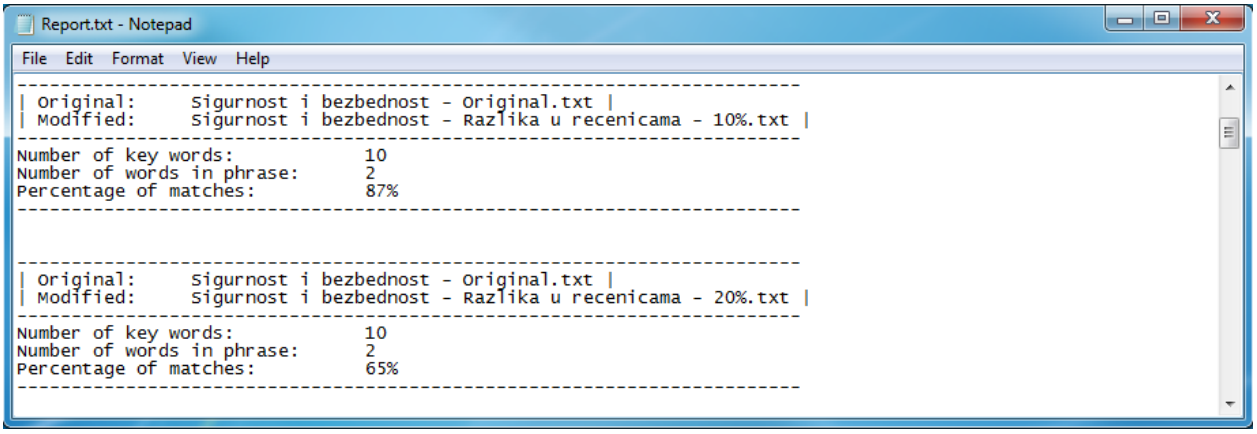

Figure 3: Report example

7. EVALUATION

Previously developed prototype application was used for the evaluation process. Six different text documents in Serbian language with different topics and number of words were selected. And for each of them we have created a comparison set consisting of the texts with the same content, but modified in a specific way. Modification was performed in two ways in order to get approximately realistic situation of re-using someone else's work. The first method, called *Random changed words*, consisted of randomly selecting words in a document and modifying it by adding several characters to the end of the word. The assumption behind this approach is that the potential plagiarist will modify only certain words in a document. In the second approach, called *Randomised sentence words*, a document was modified by randomly changing the order of words in a sentence. The assumption behind this approach is that a potential plagiarist will replace a sentence from the original document with another sentence that uses the same or similar words. In total, we have generated 84 different test documents to evaluate the algorithm with.

Table 1: Examples of modifications in test documents

Original text Globalization is the process of international integration arising from the interchange of world views, products, ideas, and other aspects of culture.
Random changed words Globalization is the <modified word> of international integration <modified word> from the interchange of world views, products, ideas, and <modified word> aspects of culture.
Randomized sentence words aspects integration is the world process products of international arising from the of views, ideas, interchange and other globalization of culture.

Using these two modification methods we have generated seven test versions of each original document, but with the content modified in 10, 20, 30, 40, 50, 60, and 70 percent.

Evaluation of the algorithm was performed by comparing content of each of the original text documents with respective versions of modified documents. We evaluated each test document with different configurations of the number of the most frequent words and different context widow lengths. The number of the most frequent words (*n*) was set to 10 and 30 words. And we have also tested the algorithm to compare different lengths of context windows (*cwl*), i.e. half context windows, context window of the length one and the length two. The algorithm was tested with these six combinations of configurations over the test documents generated by the two modification techniques. Configuration combinations are:

- C1 – n = 10, cwl = ½
- C2 – n = 30, cwl = ½
- C3 – n = 10, cwl = 1
- C4 – n = 30, cwl = 1
- C5 – n = 10, cwl = 2
- C6 – n = 30, cwl = 2

Also, with the same test dataset, we have tested the performance of the commercial plagiarism tool Plagiarism Checker X[1] in order to compare its results with the algorithm described in this paper.

Comparing document versions generated by the two modification methods, we can observe that the algorithm scored higher the documents modified with the *Randomised sentence words* approach. Out of 84 different versions of test documents, in 63 cases the algorithm gave the best results when configuration C2 was used. In 14 cases the best results were achieved with configuration C1 and in only 7 cases C4 gave the best results.

When observing the performance of the comercial tool Plagiarism Checker X, it gave slightly better results with documents generated with the *Randomised sentence words* modification method. But with documents generated with the *Random changed words* modification method, the comercial tool gave far worse results..

Tabelar presentation of the evaluation results can be found on the following page: http://is.fon.rs/node/29. Also, generated test documents used for the evaluation can be retrieved from the same page.

8. CONCLUSION AND FUTURE WORK

From the evaluation results, we can make a conclusion that the algorithm for plagiarism detection introduced in this paper has the best results when number of the most frequent words is set to 30 and half context window is used (configuration C2). This configuration gives the best results with test corpuses generated with both modification methods (*Random changed words* and *Randomised sentence words*). When compared with results of the commercial tool Plagiarism Checker X, the commercial tool gives slightly better results. But here, we should have in mind that this tool is commercial and closed source.

For the future work, we plan to further develop the algorithm. One of the improvements would be to combine this approach with the Citation-based Plagiarism Detection method. Also, we plan to perform evaluation of the algorithm with texts in other languages, first of all English. The prototype application developed for performing the evaluation will be documented in detail and published on the Web as an open-source library.

[1] Plagiarism Checker X is a commercial program for plagiarism detect with various functionalities, such as comparing two documents, compare multiple documents and online document search. link: http://plagiarismcheckerx.com/

The goal is to develop a full-fledged web application based on the new algorithm that can be used in educational institutions for plagiarism detection.

REFERENCE

Alzahrani, S. M., Salim, N., & Abraham, A. (2012). Understanding plagiarism linguistic patterns, textual features, and detection methods. Systems, Man, and Cybernetics, Part C: Applications and Reviews, IEEE Transactions on, 42(2), 133-149.

Clough, P. (2003). Old and new challenges in automatic plagiarism detection. In National Plagiarism Advisory Service, 2003.

Eiselt, M. P. B. S. A., & Rosso, A. B. C. P. Overview of the 1st International Competition on Plagiarism Detection. In 3rd PAN Workshop. Uncovering Plagiarism, Authorship and Social Software Misuse (p. 1), 2009.

Gipp, B., & Meuschke, N. (2011, September). Citation pattern matching algorithms for citation-based plagiarism detection: greedy citation tiling, citation chunking and longest common citation sequence. In Proceedings of the 11th ACM symposium on Document engineering (pp. 249-258). ACM.

Gipp, B., Meuschke, N., & Beel, J. (2011). Comparative evaluation of text-and citation-based plagiarism detection approaches using GuttenPlag. In Proceedings of the 11th annual international ACM/IEEE joint conference on Digital libraries (pp. 255-258). ACM.

Parker, Kim, Amanda Lenhart, and Kathleen Moore. "The Digital Revolution and Higher Education: College Presidents, Public Differ on Value of Online Learning." Pew Internet & American Life Project (2011).

Seaward, L., & Matwin, S. (2009, September). Intrinsic plagiarism detection using complexity analysis. In Proc. SEPLN (pp. 56-61).

NEW PROCUREMENT MODEL

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Abstract: *The new procurement model would serve for improvements of procurement process in many companies which use an old purchasing model which covered only procure to pay process. The procure-to-pay cycle, including all activities from the procurement of fixed assets, goods and services to receiving invoices and paying vendors, is the basic business process. The companies, especially in public sector, do not have optimal control of risks in procurement process and face with late fees, wasted time, break in business process and with non-compliance issues such as fraud or overlooked incidents. In order to mitigate these risks and increase market competitiveness, the company must to develop and implement the modern procurement model. Having after developing of new purchasing model which including the whole cycle from sourcing to paying of obligation in procurement, it would be crucial for company to implement an adequate software solution in order to automatize all purchasing processes as much as possible. SAP and Oracle EBS as ERP systems earned more than 38% of total ERP software revenues in 2012 on world-wide basis (Pang, Dharmasthira, Eschinger, Motoyoshi and Brant, 2012), offer up-to-date solutions for procurement processes. The choice of the right solution for companies is the last, but the most important stage in order to close procurement model (Manojlov, Lutovac, 2012 SymOrg). This paper is taken into consideration all the facts and standing conclusions from previous procurement models as the source for developing new solution. In order to create new business model for procurement, we used comparative method for analysis of software solutions by using of external sources, survey to assess level of centralization of procurement in several companies where data are collected through interviews with CEO and Managers of these companies. Additionally, description method is used in order to establish link between relations and rules in old procurement model. In most companies, the change of business model for procurement is seen as a necessary step and focus is placed on that a change of business model is needed. In this paper, we elaborate the characteristics of old procurement models and define steps & guidelines as approach in implementation of new procurement model. The benefits of creating the right procurement model for the company are substantial, not only in terms of cost reduction, but also in the ability to better focus resources, enhance value from supplier collaboration and innovation, and more fully captured contractual promises.*

Keywords*: New procurement model, procure to pay, optimization in purchasing, ERP*

1. INTRODUCTION

The role of the procurement can be formulated on many ways depending of the specifics in the company. The connection between the company`s operation and procurement is very closed. The significance of procurement processes has strong relation with definition of final product of the company. If company is repetitive manufacturer with classic finished products included various raw materials plus external services in their BOM`s, the procurement department plays the critical role. In discrete manufacturing and service companies, the procurement model has the less influence on the whole business process. However, the procurement is basic process for trading companies. Many trading (distribution & retail) companies structure their business model on discount model with vendor who deliver strategic goods to them. The typical examples of these companies are Agroglobe d.o.o. (structure their Profitability Analysis model based on earning per vendor) and Phoenix (has the methodology of discounts related to rebates and early payments).

The cost of raw materials occupies the first position of all the other costs, so any deviations emerged during the links of purchasing have an effect on the realization of the company"s anticipated goal, and further will have an influence on the enterprise profit target. While abundant of potential risks and uncertainty exist in the whole process of purchasing in such a changeable environment of market economy.

The role of procurement in Serbia is still defined very differently than the rest of the developed world. The public companies in Serbia have the limitation of law who prescribed strict rules in Public procurement act (Ministry of finance Serbia, 2014). On the other hand, there is no clear approach related to procurement strategy in private sector. The main decision about procurements in private sectors for strategic materials, services or fixed assets are mainly based on friendly relationships between vendor and customer.

Till the middle of the 90`s due to the generally accepted view, the procurement department belonged to the production in production company and belonged to the sales in distribution company. According to this traditional approach, the objective of the procurement model has to follow settings in production process: Right Quality, the Right Quantity, at the Right Price, at the Right Place, at the Right Time (P. N. Mukherjee, 2006). It is not so far till the true from today`s practice in procurement. Instead of this, purchasing must become supply management. New approach of procurement must to be much wider, primarily the procurement serves to the sales and adversely the sales must to dictate procurement. Anyhow, new procurement model must to operate with many variables in order to obtain competitive advantage.

2. OLD PROCUREMENT MODELS

What procurement exactly means? According to Oxford English Dictionary, “procure” means to obtain some item, while “purchase” means also to obtain some item in exchange for payment. So, although sometimes these two words are used interchangeably, they have varied interpretations. Tony Colwell (Colwell 2011) referred to “procurement” in the public sector as “care and effort” in upstream activities – strategy, sourcing and negotiating – up to execution of a contract. The exact responsibility of the procurement division may vary across organizations, but often post-execution activities, like contract management, placement of orders for deliveries, the management of day-to-day supplies, and processing payments, are also included in its scope.

Considering level of centralization, there are 3 basic models for procurement, any others are hybrid models, a combination of these three (Colwell, 2011):

- Local, where all activity, decision making and control is managed locally and is autonomous.
- Central, where decision making and procurement activity is coordinated centrally. (There may be local activity and controls outside the scope of procurement, for example, calling off supply under a centrally negotiated contract.)
- Networked, where decision making is not independent, but is controlled in some way across local units, like node, or nodes, on the network.

The combinations of vertical and horizontal centralization in purchasing process divided procurement model on federal procurement and centrally led procurement model.

- At federal procurement, managed by the central governance, some items are controlled at local level, while others are controlled centrally. Usually the centre defines the autonomy degree of local level by mutual agreement or by mandate.
- At centrally-led network procurement, activity is managed across local unit, the control is performed by the nodes on the network where the centre acts as the primary node.

Generally, centralized procurement in mid and big companies often fails to live up to its promises. Apart from historically falling short on delivering to the bottom line, we are facing new issues such as sustainability. The size of the company is the most important variable for level of centralization of procurement in the companies.

For purpose of this work, we performed research with CEO and/or Procurement Managers in several companies during first quarter of 2014. The main point of this research was impact of level of centralization and planning on the size of the company. Some of the companies who participated in research are TENT d.o.o., Sintelon, Relja Junior, Computer Shop etc.). The results are in table below:

Table 1: Level on centralization on size of the company

	Annual level of sales	Planning	Centralization
Small company	Under 20k EUR	Annual	High
Mid company	From 20k-100k EUR	Monthly	Mid
Big company	Under 100k EUR	Daily based on MRP	Low

This research shows that level of centralization in procurement decreases in large companies and the planning is most complicated organized in large companies. Anyhow, this paper will count of all facts in old procurement model and generate the new one which focused on supply management.

Generally, the base for old procurement models lies in their centralization. Our research shows that centralization is valid in small and low organized companies. The crucial point of modern procurement model is considering many variables.

The top priority in putting together a powerful operating model is not the issue of overall centralization or decentralization; it is determining how best to structure procurement"s various roles in corporate, business unit, and functional-level purchasing. Should the procurement function own, control, and manage the entire process for every corporate stakeholder? Should it participate actively in the purchasing decisions and processes of the individual business units, functions, and geographic regions in which the company operates? Or should it merely carry out those purchasing decisions?

Additionally, some authors (G. Zakeri, D. Craigiey, A. Philpottz and M. Todd, 2013) used linear programming of demands in order to have optimal procurement. They proved that an efficient linear programming formulation for the demand response of a price taker, industrial or commercial user of electricity has some ability to self-generate. According to them, new procurement initiated new procurement. They established a monotonicity result that indicates fuel supply of S may be spent in successive steps adding to S in total.

There are many reasons that the operating models constructed to procure and pay for goods and services prove inadequate. They may not include the processes, tools, or resources needed to fully execute the sourcing strategy.

They may not be properly connected to organizational decision making or sufficiently integrated into key corporate planning processes. Decision making authority and accountability may not be clearly defined. Or the IT systems that enable them may be fragmented, impeding efficiency and clouding the visibility necessary to ensure compliance with overall purchasing policies and objectives.

3. SPEND ANALYSIS

One of the most powerful tools in procurement process is spend analysis. Any procurement analyst must to operate with some kind of spend analyze. It is the basic report in procurement cycle. Generally, spend analysis is the process of collecting, cleansing, classifying and analyzing expenditure data from all sources within the organization (i.e. purchasing card, eProcurement systems, etc.). The process analyzes the current, past and forecasted expenditures to allow visibility of data by vendor, by commodity or service, and by department within the organization. Spend analysis can be used to make future management decisions by providing answers to such questions as: what was bought; when was it bought; where was it purchased; how many vendors were used and how much was spent with each; how much was paid for the item.

Procurement should work to identify all spend data, internal and external, for the organization. Once spend data sources are identified, the data should be collected and automated. The second steps in spend analyze is cleansing. This process is necessary to insure accurate organization and correlation of spend data and to enable actionable analyses. The cleansing must to include the following activities:

- Grouping and categorizing spend data should be done by adopting an internal taxonomy or by adopting an industry-standard classification scheme.
- Higher-level classification of spend at the category or vendor level is the first step in grouping and categorizing spend data. Examples include: categorizing goods and services that are being acquired; determining how many vendors are being used for specific categories; and how much the organization is spending on specific categories, in total and with each vendor.
- Item-level detail of spend data enables a precise view of spending with each vendor and for each commodity on an organizational, departmental, project, and buyer basis.
- Additional enhancements should also be applied to the collected spend data. These include but are not limited to: contract terms, minority or women owned business status, alternative parts data, industry pricing indexes, average selling prices, vendor financial risk scores, performance information, lead times and inflation.

The third phase is automation of data extraction, classification, enhancement, and analysis and services that can streamline existing procedures and make spending analysis a repeatable process.

Last phase is analyzing of spend data. In this phase, the procurement analyst make must to assess whether the current procurement structure, processes, and roles are adequate to support a more strategic approach to acquiring goods and services (e.g. whether cross-functional commodity teams would provide more effective, coordinated management of high-dollar, high-volume categories of goods, services, and vendors on an on-going basis).

Ernst & Young, leading auditing & consulting company in USA, presented several benefits from spend analyze in procurement process on US markets in research from 2012.

Table 2: List of benefits for companies from spend analyse (EY publication, 2012)

Eliminate duplicate vendors (Reduction depends on previous efforts.)
Reduce material and service costs through informed strategic sourcing strategies based on the data
Improve contract compliance
Use contract pricing to create savings
Meet regulatory reporting rules
Improve inventory management by cutting excess stocks
Lower inventory costs
Reduce expediting costs
Improve product management by cutting unnecessary part introductions
Increase part reuse
Align design and supply strategies
Facilitate early vendor integration
Reduce spend analysis project cycles
Refocus procurement professionals on strategic tasks

Normally, the significance of certain benefit depends of various factors in the company. These results arisen from procurement models on US companies must be projected on other world-wide market.

As an example, we examined two companies with different size (one is more and other is large) and their management view of these benefits in Serbia. For small company such as Relja Junior d.o.o., the most important thing in the business is to have lower inventory costs and reduce expediting costs. On the other hand, expectations from spend analysis for energy Serbian giant EPS are much different. They expect elimination of duplicate vendors and reducing of material and service costs through informed strategic sourcing strategies based on the data.

Spend analysis begins with identifying internal and external sources for collecting spend related data for the organization. Once data is collected, it should be cleansed, grouped, categorized and analyzed.

Finally, the data should be updated regularly and the spend analysis process should be performed on a continual basis to support decisions on strategic sourcing and procurement management for the organization.

4. PROCUREMENT MODELS IN EPR SYSTEMS – SAP EPR AND ORACLE EBS

As previously mentioned, they are two main players on ERP market related to procurement, SAP and Oracle. Additionally, four major technology segments are recognized in analyze from Deloitte Central Europe from 2012 including: 1) Spend Visibility, 2) eSourcing/Decision Support, 3) eProcurement/EIPP, and 4) Information, Performance, and Risk Management. The marketplace is characterized by a dominance of „top tier" vendors such as Ariba, SAP, and Oracle with an array of niche vendors providing technology and services. According to the last news published by SAP in 2013, Ariba became the contained part of SAP, so Oracle and SAP are the main players.

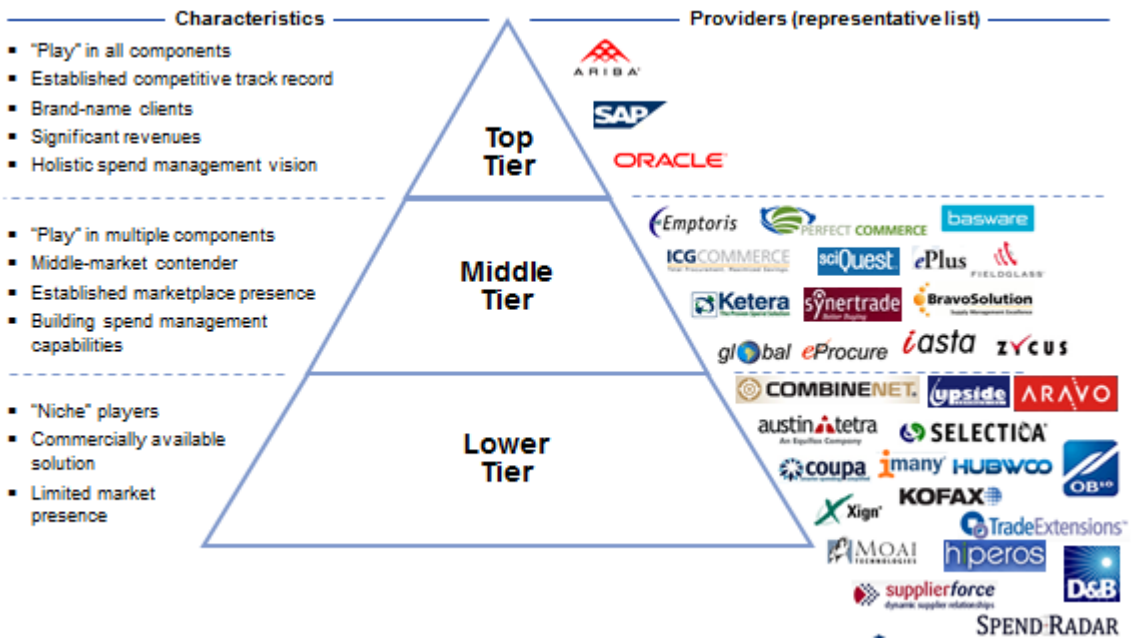

Figure 1: Sourcing & Procurement Technology Landscape

Anyhow, the both ERP systems offer the functionalities for procurement. In SAP, the procurement, also called Material Management module has two sub-modules: Purchasing and Inventory Management. Purchasing relies on master data such as Material Master, Vendor Master, and Info Records. An Inventory Management component handles all movements in inventory management process. Purchasing integrates tightly with other SAP modules such as Financial Accounting, Sales and Distribution, and Controlling. Purchasing causes commitments to be posted to Controlling; and when goods are received, posting can be made against cost centers. Also, when goods are received, SAP posts an Accounting document to Financial Accounting (FI) against a specified General Ledger account. Sales and Distribution passes requirements to Purchasing in the form of Procurement Proposals generated during MRP.

Oracle EBS has stand-alone application called Purchasing. Additionally, Oracle launched "Oracle Advanced Procurement Application". "Oracle Advanced Procurement" is the integrated suite of applications that dramatically cut all supply management costs. Oracle Advanced Procurement reduces spending on goods and services, streamlines procure-to-pay processes, and drives policy compliance.

Analyzing of SAP ERP 7.0 and Oracle EBS 12, the both solutions have the following advantages comparing to other software technology for automatization of procurement processes:

- Automated posting in General Ledger application
- Various field and consequently controls in purchasing master data
- MRP workflow process (some technical prerequisite must to be established for Oracle EBS)
- Integrated planning with production and sales
- Complete procure-to-pay automation
- Budget-based procurement (SAP solved this problem with Ariba and Oracle EBS with extension on Oracle Advanced Procurement)

The client that implements the ERP system has no usually internal expertise that is necessary for the implementation of complex software. Thus, the client engages an external consulting company to actively lead and participate in the implementation of the ERP project (Manojlov & Lutovac, 2012). The company must to pay attention of functionalities related to procurement processes, because it is the main point for integration on other separated modules.

5. NEW MODEL BASED ON COMBINING „SOURSE TO CONTRACT (S2C)" AND „PROCURE TO PAY (P2P)"

The new procurement model should be divided into two models. First is S2C and the second one is P2P. S2C covers all activities from sourcing to contracting and P2P covers all activities from purchasing to paying of vendors. Implementation of these two components is not "must", but desired. The company will have an optimal procurement optimization, only if implement the both components.

Generally, an old fashion companies had to have P2P concept without S2C component. Especially, S2C add value for the company in combination with well-structured P2P concept. Source to contract and procure to pay must to feed each other. In modern company, P2P co-exist with S2C and adversely. During an investigation an old procurement models, we defined several phase for P2P and S2C cycle. P2P are consisting from the following phases:

a) *Identify Need* as identification of requirement to purchase products and/or services, either planned or unplanned
b) *Create Requisition* as creation of a formal request for goods and/or services
c) *Approvals* which allows necessary company`s approver to review and sign-off on purchase requisition
d) *Create purchase order* as creation and issuance of an order to vendors, including acknowledgement, confirmation and any changes
e) *Receive* as formal receipt of goods and services, including quality inspection checks and appropriate escalation in case of errors
f) *Payment* in the form of efficient and accurate payment to vendor after verification of goods receipt and purchase order matching (2-way or 3-way matching) to ensure compliance
g) *Collect Performance Data* as measurement and collection of metrics (lead time variability, defect rate, etc.) used for continuous improvement of internal and vendor performance

The last phase called “Collect Performance Data” of P2P model should be starting point for analyze spend in S2C model. Therefore S2M model are consisting from:

a) *Analyze Spend* as systematic categorization, archival, retrieval and analysis of spend-related information
b) *Conduct Demand Management* as proactive management of demand
c) *Analyze the Supply Market* as active tracking of industry trends and relevant changes in the supplier base
d) *Define Sourcing Strategies* as application of the most relevant sourcing strategy and tactics for each spend category
e) *Tender Bid Process / Negotiate* in the way of standardized process to conduct bid process and vendor negotiations
f) *Finalize KPIs (Key Performance Indicators) & Contract* - key performance indices that track and measure the supplier performance and internal compliance to preferred vendor lists and contracts

Last phase “Defining of KPI & Contract” (f) initiate identification of needs as lighter for starting point in P2P model (a). Also, the company must to define the relevant persons in order to manage in each step of these two models. The most important thing is defining of leaders i.e. there should be two persons: Leader of P2P and Leader of S2C models.

Additionally, P2P and S2C should be treated as horizontal approach of procurement. S2C is upstream application and P2P is downstream application. However, the most important thing is to define a set of core principles guide “The Source-To-Contract” and “Procure-To-Pay” processes. These set of core principles must to be developed as a basic for implementation of procurement model in the company. Normally, adaption of this model has to follow and consider the company`s specifics. In table 3, the boundaries of new procurement model is set for each components.

Therefore, the source-to-contract capability is built on a dynamic, closed-loop process that has the ability to address and focus on both indirect and direct spend. On the other hand “procure-to-pay” capability is built on the above principles in a way that reduces transactional work to enable increased focus on value-added strategic activities.

The benefits of adopting the right procurement model for the company are substantial, not only in terms of cost reduction but also in the ability to better focus resources, enhance value from supplier collaboration and innovation, and more fully capture contractual promises.

Table 3: S2C (Upstream) and P2P (Downstream) instructions for implementation of model

SOURCE TO CONTRACT (UPSTREAM)	PROCURE TO PAY (DOWNSTREAM)
Spend Intelligence	**Automation & Intelligence**
Create automated "company-wide" spend analysis that generates periodic "canned" and ad-hoc reporting aligned with strategic sourcing goals and category requirements	Create a "lights out" automated transaction factory where cost effective to do so and capture data in a clean way that allows analysis that creates procurement intelligence
Organizational Planning	**Governance & Compliance**
Create a 2 to 3 year "calendar" prioritizing sourcing opportunities / events company-wide, which is updated annually and for market/contract events to manage ad-hoc needs	Create a common standard of company-wide policies, procedures, and approvals that are integrated into the P2P workflow and tie to other functional systems to drive compliance and individual adherence
Formalized Strategies & Management	**Strategic Management**
Create uniform category playbooks defining the driving forces behind price, market complexity, and business impact. The primary category value levers & tactics are defined with total cost of ownership (TCO) in mind and tied to operating guidelines	Create procurement and category strategies that minimize the need for ad-hoc /exception management and incorporates supplier scorecards, supplier management tools, and preferred supplier compliance reporting/monitoring
Governance & Compliance	**Self-Service & Connectivity**
Create defined policies, procedures, and roles & responsibilities that manage strategic sourcing and category management (e.g. mission, guiding principles, category span of control, category segmentation, etc.)	Create the system connectivity necessary to support user and supplier self-service; online catalogs, product/service master, supplier portal, electronic document exchange, etc.

Theoretical validation of the new procurement model will initiate the following facts:

- Globalization trend is the lighter for the company to drive of best pricing model / reduce of costs and have the process called "spend under management" during the S2C phase of the model.
- Improving of management of supplies, qualities, and cost risks in the step of spend analyze.
- Enabling of operational excellence and aligning to the needs of the business. Supply chain risks in term of increased regulatory, supply security, quality, and recall risks are forcing some companies to evaluate their risk mitigation strategies during the S2C phase of the model.
- Operate "As One". S2C and P2P phase must to be operated as one in order establish an optimal procurement organization and mitigation the risk of failures in whole business process.
- Proactively manage strategic supplier relationship in the step of analyzing of supply market in order to increase focus sustainability. Key trend for proactive procurement management is the fact that customers and governments become demanding companies which have plans to make their operations more sustainable.

6. CONCLUSION

The main strength of new procurement model is strong cooperation between P2P and S2C phases in procurement. An old procurement models take into consideration only P2P part of procurement. New procurement model, presented in last chapter of this paper, has holistic approach and P2P and S2C are strongly cooperated. It covers the processes from initiation of need to realization of procurement in P2P component which serving as input data in analysing of spend to finalization of key performance indicators in S2P component.

Additionally, the new procurement model must to provide the basic assumption for providing of robust supply-side information, metrics, and alerts that integrate with implementation of technology applications such as Oracle BI Applications or SAP Ariba. It delivers specific insight across the organization in order to increase the company"s performances in managing its customers, suppliers, and financial decisions.

Many authors tried to develop procurement model such as Tony Colwell (2011), G. Zakeri, D. Craigiey, A. Philpottz, M. Todd (2013), but nobody from them is not taking into considering all relevant facts in procurement process.

This model will be the starting point for many companies to define their procurement strategy and consequently redefine their position on the market. The next step will be practical validation of new procurement model through implementation of the model in real company.

REFERENCES

Analysis of sourcing process through SAP–LAP framework - a case study on apparel manufacturing company use to make the change from one business model to another.

Anand S., (2013) Oracle"s Application Implementation Methodology (AIM); Retrieved from www.oracleappshub.com.

Bartolini A. (2012). CPO Rising 2012: Keeping score. Retrieved from http://www.ey.com/Publication/

Colwell T. (2014). Tony Colwell's Blog post, Retrieved from http://acuityconsultants.com/wp/

Han C., Li J., Espada I. (2014). Procurement of ITS (international practice), Paper presented ARRB Group Limited; ISBN: 9781925037432

Ernst&Young publication (2012), Retrived from http://www.ey.com/Publication/

Lutovac M. and Manojlov D. (2012) „The Successful Methodology for Enterprise Resource Planning (ERP) Implementation", Journal of Modern Accounting and Auditing, ISSN 1548-6583, December 2012, Vol. 8, No. 12, ISSN: 1838-1847

Lutovac M. and Manojlov D. (2012), Impact of methodology in the success of enterprise resource planning (ERP) implementation, Paper presented at SymOrg 2012

Manojlov D. (2012), Impact of ERP consulting companies in surveillance of personal and business data in e-commerce. 19th International Conference on Technology, Culture, and Development, Tivat, Montenegro, August 28-30, 2012

Ministry of Finance. (2014). Retrieved from http://www.ujn.gov.rs/sr/news/story/180/Novi+Zakon+o+javnim+nabavkama.html

Mukherjee P. N. (2006), Total quality management, Paper presented in Prentice, Hall of India, New Delhi

Pang C., Dharmasthira Y., Eschinger C., Motoyoshi K. and Brant K. (2014), Market Share Analysis: ERP Software Worldwide

Pesamaa O., Erikson P.E., Joseph F. H. (2009), Validating a model of cooperative procurement in the construction industry, Paper presented at International Journal of Project Management

Philpott A. B. and Pritchard G. (2012). An Electricity Procurement Model With Energy and Peak Charges, Paper presented in Applications in Finance, Energy, Planning and Logistics b1392-ch14

Tipping, J. and E. G. Read (2010). Hybrid bottom-up/top-down modeling of prices in deregulated wholesale power markets. In S. Rebennack, P. M. Pardalos, M. V. F. Pereira, and N. A. Iliadis, eds., Handbook of Power Systems II, Energy Systems. Berlin Heidelberg: Springer 2010

Venkatesh A., Rameshwar D., Padmanabha A. (2014). Analysis of sourcing process through SAP–LAP framework - a case study on apparel manufacturing company use to make the change from one business model to another. Published in International Journal of Procurement Management, ISSN 1753-8440

Zakeri G., Craigiey D., Philpottz A. and Todd M. (2014). Optimization of Demand Response Through Peak Shaving, Published in Operations Research Letters, Volume 42, Issue 1.

Wang, M., (2011).Integrating SAP to Information Systems Curriculum: Design and Delivery, Information Systems Education Journal, 9(5), 97-104.

WEARABLE COMPUTING IN EDUCATION

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Abstract: *This paper represents an overview of wearable computing technologies that have been applied in education. The focus of this paper is on the existing models of the application trough the method of analyzing different authors and their ideas. Purpose of this analysis is sublimation of knowledge and current practice trough analytical and deductive methods, as well as the proposal of wearable computing model in education. Utility of this model is primarily sublimation of previous knowledge and emphasis to its use in education. Most important finding is that wearable computing is still poorly used in education, therefore further study of its potential academic use is recommended. Consequently, this paper contains a proposal model for introducing wearable computing technologies and Google Glass in academic educational institutions.*

Keywords*: wearable computing, education, ubiquitous computing, blending learning, Smart Watches, Google Glass, NFC tags*

1. INTRODUCTION

New technologies are changing the way of the daily life. Education is just one of the aspects of the modern world that can not be imagined without use of technology. In the current academic education using desktop computing is quite common. Desktop environment (PC, Laptop, Mobile phones) involves the use of graphical interfaces and is based on work with icons, windows, folders, wallpapers, tool-bars and desktop widgets (Desktop environment). The use of technology in all aspects of life including education led to the creation of the following concepts: ubiquitous computing (ubiquitous computing), a hybrid learning (blending learning) and wearable computing (wearable computing). These concepts are interrelated. To understand the idea of wearable computing in education it is necessary to understand all three terms which will also be discussed in this paper.

The first part of the paper begins with brief description of the concept of wearable computing and its historical review. The second part is a review of literature and existing models as well as the review of commercializes wearable computing technologies that are used in medicine, sports or entertainment, and may represent a “milestone” for application in education. The third part of the paper contains a proposal of introducing these technologies in academic educational institutions as a learning tool. Through this paper will be shown that wearable computing technologies can be used in two ways: for learning technical science in specialized curses for students and as a tool for each individual which should facilitate communication among students and professors, provide better flow of information and knowledge and enable easier and more reproductive learning at any time. While the analytical part of this paper covers both scenarios, proposed model highlights the second approach. Thus, research direction focus on increasing communication between students and professors, increasing the efficiency of information distribution and increasing the quality of group assignments by using Google glasses in correlation with other wearable computer elements.

2. WEARABLE COMPUTING CONCEPT AND HISTORY

Wearable computing that use sensors, wireless communication and mobile phones is just one part of the ubiquitous computing concept. Contemporary concept of ubiquitous computing was set by Weiser (1988) and it is based on the interaction between man and computer, where the computer is integrated into everyday objects used by everyone. He predicted widespread use of computers and "omnipresence" in all aspects of life. Further, ubiquitous computing in education was initiated by the creation of ubiquitous learning paradigm which is a transition from traditional learning to e-learning. Mentioned paradigm implies to environment that enables learning anywhere and anytime, with the help of computers and computer-based technologies (Yahya et al., 2010). This type of learning completely disregards traditional teachings, which in practice has not yet occurred. Despite the application of technology for learning the traditional view is not completely replaced, which leads to the creation of blended learning concept. The so-called “hybrid learning” or blended learning is a learning system based on synergy of traditional and e-learning. Charles R Graham in

his work synthesizes different definitions for this term, and sets blended learning as: "a combination of online learning and face-to-face learning" (Bonk & Graham, 2006).
Blended learning uses web - based courses, collaboration software in real-time systems, knowledge management, combined with self-learning and face-to-face (Singh, 2003) and it can be use for tutoring through blended learning platform, which has proven more effective in "sharing information, for clarification of learning areas and planning activities" then traditional approach to tutoring (De Smet et al., 2008).
The next step in the development of learning models in higher education is the application of wearable computing technology. Wearable computing technology provides a higher level of synchronization with the user and their needs, and it does not requires from user to interrupts his task during process of collection and providing data. During last ten years it is being gradually introduced in education, which is the subject of this paper.

Historically, a wearable computing concept as an idea of a portable device that will provide useful information to a user is much older than it looks. The first mechanical inventions that can be carried by user are considered to be the beginning of the wearable computing idea. The precursor of the concept is a pocket watch founded in 1510. by Peter Henlein in Nuremberg ("The history of wearable Computing"). One of the next interesting steps towards today concept of wearable computing is Vannevar Bush "Memex" desribed in article "As We May Think " in 1945. Although it is not constitute as wearable technology, it is used to increase user's memory. Modern concept of wearable computing is also based on this idea. "Memex" is a private file or library that should contain the records, books, correspondence, and based on its flexibility provides easy content accessibility, and serves as a user memory supplement (Bush, 1945). In the modern sense, wearable computing has been used for the first time, for the prediction of the outcome of roulette, by Ed Thorp and Claude Shannon's in the year 1966. The wearable computing device made for this purpose was worn in a shoe (Miller, 2012 ; "Wearable Computing").
In the 21st century, the concept of wearable computing is far more complex. Since first pocket watch and "Memex", the wearable computing concept is being developed as a technology that should be able to swimmingly help user in fulfilling various tasks. It is not enough that the device is portable, easy to use and provides information on the complex demands placed by the user at any time. It is necessary that it simultaneously and continuously provides information to the user through the process of feedback without disturbing user during his task fulfillment. The emphasis is on a greater synchronization that in the future should be complete. In 1981. The Steve Mann designed a backpack based on wearable multimedia computing system. Part of this technology is the display, which is worn on the head and covers one eye. The display supports text, graphics and audio. The concept allows the user to work with variety of computer applications while on the move performing other activities. Later, 1999th Mann has created EyeTap digital eyeglasses that collect video data from the surrounding, then sends data to a computer which processes it and delivers back to the glasses in such a way that real picture is replaced with processed one. It is the beginning of creating so-called AR (augmentative reality) known as enlarged reality. Mann has continued to refine the prototype of the glasses with the help of sophisticated new technologies that have since become available ("Wearable computing"). In 2014. this idea is modified and commercialized under the name Google Glass.

Defining the wearable computing concept:
"Wearable computing is the study or practice of inventing, designing, building, or using miniature body-borne computational and sensory devices. Wearable computers may be worn under, over, or in clothing, or may also be themselves clothes" (Mann, 1996).

Mann later expands his definition of wearable computing, and binds it with concept humanistic intelligence. Humanistic Intelligence is an inseparable intertwining of computers and humans. Wearable computing is the embodiment of humanistic intelligence and comprises three components: stability, increase and mediation (Herzog & Witt, 2007). Further, one of the founders of the first International Conference of wearable computing called the International Symposium of Wearable Computing is Thad Starner also believes that wearable computing is a term to describe a system that is able to be at all times available to user with use of feedback loop. Specifically, he believes that wearable computing should be able to "observe and model the user's environment and the user's physical and mental condition (Herzog & Witt, 2007)". Definition of wearable computing is subjected to changes in accordance with the development of technology. To better understand the concept it is necessary to determine the elements that underlie this technology as follows (Herzog & Witt, 2007):

- **The operating system is constant**- system has a role of secondary support that is always available for providing useful functions to the user.
- **Seamless integration with environment**- system in not an obstacle and does not interfere with the user as he performs other physical tasks.
- **Context awareness**- system is sensitive to changes in the environment and the changes related to user.

- **Flexibility**- during application operation system can automatically adopt interaction style in order to reduce mental effort of the user.

3. REVIEW OF WEARABLE COMPUTING IN EDUCATION

Wearable computing technology is entering an era of commercialization, but still has not become an inseparable part of higher education. Wearable computing in education is mostly used in small temporary research groups. This technology is still away from the usual learning applications, such as desktop computing. According with specified, this part of the paper will provide a brief overview of the current wearable computing use in education. Use can be for learning about new technologies, manipulating campus environment or as a learning tool instead of classic learning materials like books and desktop computers. There are cases that can even be used as a aid for students with disabilities.

3.1 Wearable computing for learning technical sciences

Most famous example for learning new technologies is use of Lily Pad Arduino in education. Lily Pad Arduino is a wearable computing tool introduced into the market in the period of 2007-2009 year. It is based on microcontroller panel (ATmega168V ATmega328V I) which can be sewn to different textile materials. This tool was designed by Leach Beucheley and Spark Fun Electric. Range of products are wide: heat sensors, light sensors, MP3 , battery, LED White, accelerometer and more, and they can measure different variables. while connected with Arduino Software to a computer. This way, user gets all the information on collected data trough Lily Pad system (official Arduino Website). Leach Bulechley and colleagues conducted an experimental workshop based on Lily Pad tool. The idea was to implement a process of gaining knowledge of the electronic, programming and computer-based e-textile technology as part of wearable computing technology in workshop conducted at the high school population. Although, the authors believe that Lily Pad can be used in university education programs too. The paper disclosed the observation that the female population has lesser tendency to choose computer science programs. This kind of creative teaching in secondary schools can increase the number of women who will choose to study computer science at faculty (Buechley et al., 2008).

Similar example is Grace Nagai's work in 2010. Nagai and associates conducted a study where the wearable computing technologies are used for teaching robotics. Also, the practical work is carried out on the secondary school students, but the authors at the very beginning as well in the conclusion argues that this program is suitable for the use in higher education. Platform is named TeeBoard. As in the case of Lily Pad technology it represents a synergy of textiles and electronic components. The difference from the Lily Pad concept is in programming language, which is in this case adapted for users with no previous programming experience and knowledge of the C language. For that purpose Brick Layer graphical text-based program was created in Java Script that can be run by Web browser. The student do not types commands in C language, but use descriptive predefined structure called "blocks" or "bricks" that uses graphic text logical unit. User arranges "blocks" on a computer in that manner that they represents command path for wearable computer sensors on T-shirt (Nagai et al., 2010). Educational benefits from this program are the same as in the previous example.

3.2 Wearable computing for automatization of classrooms and campus environment

Another case of wearable computing application is done by Ho Park (2008) and associates from the Korean Institute for Advanced Science and Technology is development of advanced ubiquitous environment under the campus environment. This concept named U-TOPIA use different technologies: hardware/software, user interface, communication technology, and UFC wearable computer. The use is manipulation of environment like turn on/off devices and record scene. Interface called i-Trow was developed, which is based on the wireless device for recognizing gestures. In a separate control room devices that can be manipulated through this concept were set up. The idea is that individual can use wearable technology and wireless communication to assign commands to different intelligent devices. To make this idea come to life it has been developed an UFC wearable computer whose main characteristics are "modularity and sensitivity". UFC wearable computer designed to look like addition to clothes - buttons, necklaces, Zig Bee earrings (earrings with Zig Bee transceiver) was connected to the devices trough standard USB protocol. Another essential part of this platform is a wireless ring-shaped device for gesture and movement recognition.
This way students can use the wearable computing sensors to turn on and off music, amplified and mute music, turn off and on printer, watch pictures, send and delete files (Ho Park et al., 2008).

Cooter Willis and Sumi Helal are creators of model intended for blind users within the campus environment. This model does not cover learning process. It is merely a tool for the blind users in educational institutions.

The concept was created on the idea of the need to facilitate the movement of persons with visual impairments. The technology is based on RFID (Radio Frequency Identification) Information Grid in the framework of wearable computing model.
System used to notify the user about the location and distance of objects is RIFD tag placed on all larger objects in the environment as well as the doors and hallway so the better information could be transmitted to the user. NAVCOM belt containing Devantech SRF08 Range Finder was used as wearable computing element. This Range Finder can read the object distance from 3 cm to 6 m, with the ability to detect the distance of up to 16 objects. The above mentioned technologies can communicate with mobile phones over Bluetooth SPP connection. This concept should facilitate the mobility of blind students across campus (Willis & Helal).

3.3 Wearable computing as a learning tool

For the benefit of this paper, Wei Hsun Lee's and Chieh Kuo's work will be introduced as well. They propose the use NFC tags (Near Field Communication tags) as a ubiquitous platform for interactive learning. The platform supports NFC reading model, P2P (Peer-to-Peer) model and wireless communications. They are also supported by the NFC phones that can identify each NFC tag individually by its ID code. This model is proposed for use in education. Idea is providing simultaneous answers to questions from the professor at the end of the lecture, in order to determine how much students understand the lecture. The concept is programming NFC tags in responding manner A / B / C / D so students can gave answer to the professor questions using tags. Answers are given with click on tags, then sent via NFC phones and delivered with the help of Bluetooth to Notebook of professor. Thus, the results of the collected answers are given in real time by all students and they are shown up automatically on the professor Notebook screen. This way the teacher is very quickly able to assess how much students understand his lecture (Lee & Kuo, 2014).

Wearable computing can be used as well, for learning to play piano. PianoTouch system is Wearable Haptic Piano Instruction System that is used for passive learning. Wearable computing gloves with vibration motor on fingers can simulate movement needed for playing compositions. Laptop. MP3 player or mobile phone can communicate via Bluetooth with PianoTuch and control it by producing music output. Vibration on fingers that are coming from PianoTuch gloves indicate which finger is needed for playing note (Huang et al.,2008). The model proved to be very effective.

In order to a certain technology become an integral part of daily life it is necessary to become available for the masses, and easily applicable. As such wearable computing technology is not designed to be exclusively used at the university learning technology courses, but also to "serve the people and facilitate tasks (Duval et al., 2010)" in a much wider use. One of the conditions for its wide range of applications is to be accepted by users (Bergmann & McGregor, 2011). This is because it is expected from wearable computing technology to become an integral part of higher education in the future, as desktop computing is today. By far the greatest degree of commercialization this technology experienced is in medical and Fitness use.
The concept of wearable computing for the general population was successfully introduced by the company Nike. Product Nike Shoes Bluetooth, appeared on the market in 2012. Nike Shoes Bluetooth link Bluetooth technology with iPhone and iPhod Tuch trough applications to provide an overview of variables: such as strength, speed, number of exercises . ("Nike makes Bluetooth Smart sensors cool and fun"; "Nike Smart Shoes Communicate via Bluetooth"). Nike has introduced wearable computing technology to the general population and thus opens the possibility of using the same in the different segments of everyday life.
During last two years Smart Watches have been emerged on market. Smart Watches can use daily application such as weather forecast and news, remote applications like camera and thermostat, fitness applications, games and tools applications for measurements and calculations. Most of the watches allow viewing of messages, e-mail, and can be sync with Facebook and Twitter. The user can receive calls or dial the number for the remote connection and wireless technology associated with a mobile phone.
One more useful example of commercialization of wearable computing is application of wireless sensor networks ad wearable computing technology in medicine. Monitoring vital signs of patients using this technology becomes significant practice in medicine science. These examples point to the gradual commercialization of the latest technological achievements in different spheres of life. Education is only one of the segments in which these technologies with modification and adjustment may be applied.

4. APPLICATION MODEL FOR SMART GLASSES AND WATCHES IN E-LEARNING

Google Glass is currently the most interesting wearable computing technology available in the market and is designed for commercial purposes. It is the type of smart glasses which allows the user to input voice commands so glasses can capture what the user sees. Therefore they support commands without hands, and in real time share what the user sees. It has option to show the direction of movement if the user is lost, to answer questions and translate voice of user to foreign language (Google Glass website). The initial idea

is that the Google Glass can be use in educational institutions. In 2013. Forbes published an article in which Dr. Grossmann is proposing the application of Google Glass for medical student education.
The idea is based on consultations in real time where the student may request and receive instructions via glasses thanks to the transmission of visual and audio data. This can lead to serious consultation during surgery. To support his idea Dr. Grossmann made video footage showing the consultations with the student via Google Glass during the student surgical exercise on manikin (Nosta, 2013). Models that are proposed in this paper emphasize the usefulness of wearable computing smart glasses technology as a learning tool that should provide better and faster communication, exchange of data and knowledge in educational environment.

First model that is proposed in this paper is based on some features of Google Glass and possibilities for further modification. Some of the faculties such as Faculty of Biology, Faculty of Veterinary and Medicine, Department of Physical Teaching, Faculty of Pharmacy, Faculty of Medicine within their courses required field learning. At the Faculty of Biology and Faculty of Pharmacy, students do field collecting of plant samples. For them this model considers the possibility that smart glasses can provide in field learning process.. Google Glass allows connection with applications for mobile phones which are supported with GPS technologies. GPS and applications based on it can be used for its precision timing capability and position information. GPS option in conjunction with the transfer of data in real time with Google Glass should provide information about student's position on the field, so professor can easily form task groups for field learning. In accordance, it is possible for professor to simultaneously run multiple groups. GPS allows tracking of student's location and movement. Google Glass feature that supports text and audio setup further allow quick tasks and instructions providing. Mixing it with already mentioned idea of eye movement tracker it can easily provide readable information for student while he is moving. This model enables different groups setting at different locations at the same time. This would be feasible only if all the students and professor have Google Glass to work with. Each student would be capable to get instructions on his smart glasses and to ask additional questions if it is needed. This way real time communication allows the teacher to give useful advices while the student performs the collection of study materials from nature that are required for different works/tasks. With already mentioned option of asking questions and getting responses via glasses, thanks to the Internet and Wi-Fi, use of this model can further reduce the need for the professor presence on the field. Each time a student collect some materials from nature with the simple question asking can get basic information about the same material from the Internet on Google Glass. This way, instead sitting in a classroom and learning from books smart glasses allow students to learn in fare more interesting manner trough synergy of field learning, tutoring and text based information, all at the same time using modern technology. Another useful way of using Google Glass would be a simultaneous recording of certain material that the student sees and explanations given by the teacher regarding the same material. In this way the student is able to review the recorded lectures later, in order to better prepare for the exam.

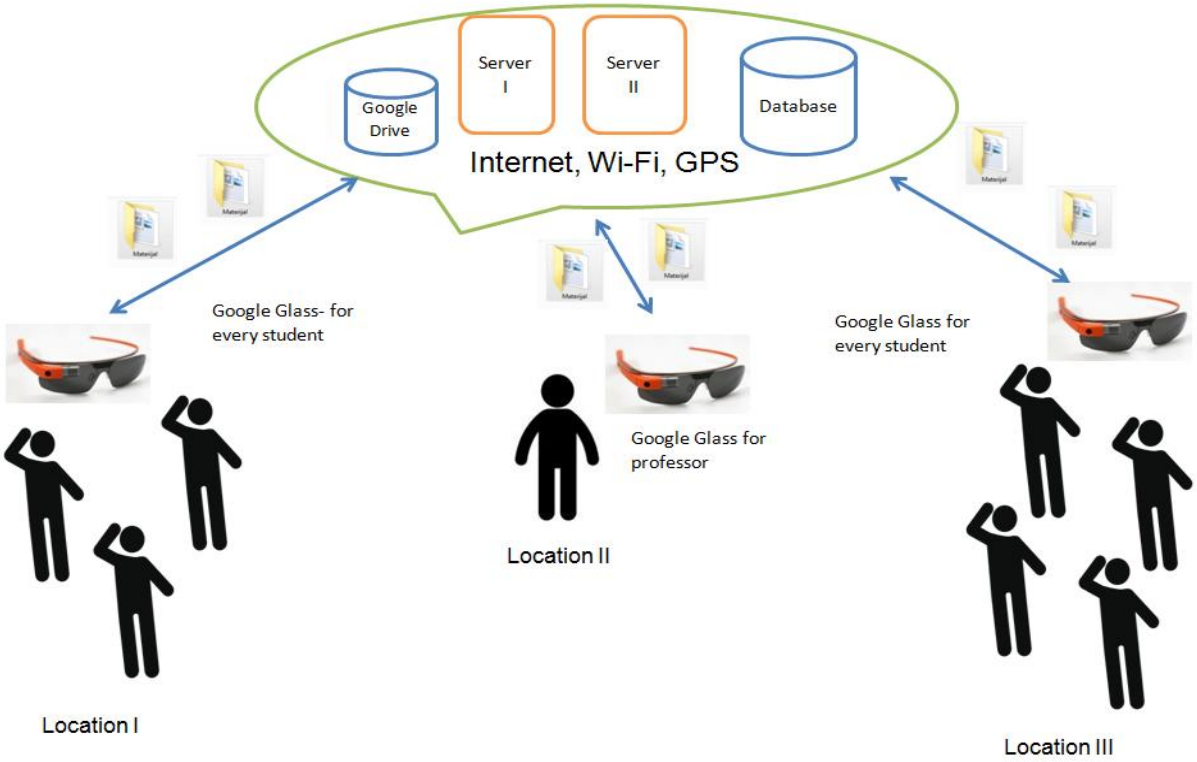

Figure 1: Communication between professor and students on various locations

Learning can be improved by fare trough motivating students to make their own scripts, from which they will later learn. Camera on Goggle Glass allows students to take pictures or record a particular material in real time. Information collected this way can be stored in a database that was created specifically for this purpose. Continue through questioning Google Glass (which has already been mentioned) a student can take information that considers most relevant, pare it with a particular image and store it in the script that is resembles to data storage. Student can manipulate collected information in the way that is most suited for him and for later learning. In the future it is expected that technology will recognize every material trough shapes and colors recognition programs. Today, recognition technology is primarily used to identify human faces (Hsu et al., 2002; Wang & Tan, 2002). These systems are expensive and complex. 2D Gabor, RBG color model SPD and other models that support this technology can be modified and applied in identification of plants and animals with smart glasses so that students would be able to see, take visual record and simultaneously recognize specific plants in real time, tanks to recognition program and Internet. Basically, students would get an answer about the plant/animal or some material trough recognition program and Internet on their smart glasses. If this application comes to life it would be indeed the application of augmented reality. As we can see Google Glass can be modified and used in a far more complex manner then they are used at the moment, and that applies even if we do not add any new features and performances.

Second model is based on the combination of Google Glass with Smart Watches and NFC tags used in classrooms. Faculty can allocate the necessary funding for certain courses and endure students with Smart Watches for personal use. These watches should facilitate communication with teachers so that students will be provided with working material and teaching schedule on the Smart Watches. Updating information on them will be enabled through NFC tag that is placed on all tables within the classroom or amphitheater where lectures and exercises are held. By leaning Smart Watch to a NFC tag automatically via Wi-Fi technology materials are updated as well as class schedules. NFC tag is associated with database of a certain course which holds and preserves data in the Cloud environment of the Faculty. Model diagram provides an example of Cloud environment of the Faculty that is base for communication with students. It provides all the necessary information and data for the teaching models of e-learning.

Communication with students can be improved with NFC tag and Smart Watch. All information would be provided to students using NFC tags and Wi - Fi technology for updating data on student's Smart Watches. The teaching team is the one who is responsible to create the necessary data and input it to the Cloud environment. It is understood that the Faculty has its own web site for sharing information as well. First, professors need to prepare the data for Interface from which website is going to be updated with fresh data. After passing the data into the appropriate form it is ready for downloading over the NFC tag. Idea is to allow all students with Smart Watches to easily and simply, in the shortest possible time interval come in possession with working material immediately after the lecture. NFC tag can be programmed to recognize the ID of each Smart Watch and thus can be used for the keeping evidence of student's presence at lectures and exercises. Data on keeping presence evidence can be storage also in Cloud space database of Faculty. Model also assumes that the students have a Google Glass that can be connected to their Smart Phones.

With modification of Google Glass and installing sensors to recognize the device ID similar as in NFC tag, it would be possible to achieve communication between the Smart Phone and Google Glass. Smart Watches have touchpad. After connecting the devices via Wi-Fi networks, using a touchpad screen student can issue a command to transfer the material from Smart Phone to Google Glasses. Also, in order not to interfere with another student task one can use touchpad on Smart Watch for commanding Google Glass what text student wants to follow up and read at any given moment on a screen of Google Glass. The final process of communication is between Google Glass and Google Drive in Cloud environment. Google Drive allows storage of documents in Cloud environment which reduces the memory usage of the Google Glass and the student is able to access recorded documents anytime and anywhere if there is a Wi-Fi network. This model must be supported by 3G and Wi-Fi communication.
Next graphic represent communication flow between students and professor using Google Glass.

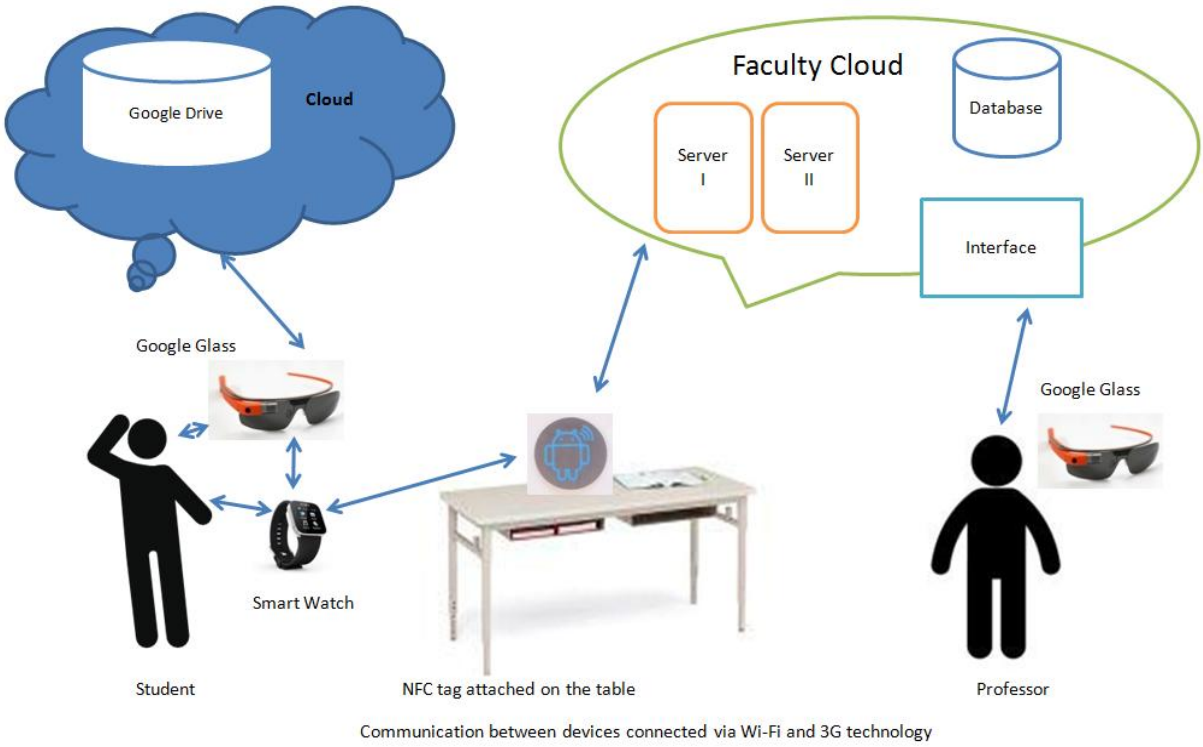

Figure 2: Information flow via Google Glass in classroom

6. CONCLUSION

Wearable computing technology is a concept that is not fully reached its potential in any segment and especially in education use. At this point some of the essential characteristics like context awareness, flexibility and Augmentative Reality are not fully met. As far as its use in education there in not enough papers with implementation models so in that field there is a lot of free space for research and for proposing something new. Models presented in this paper are not perfect but can be god “milestone” for future research. There are some good sides and bad sides of these models. First of all models we gave are intended to lower barrier between old educational systems and new technologies. Further, using wearable computing in education can really help to create even better communication among students and professors and it can be the key to create new successful generations. We live in the time of fast information so we need to provide adequate access to it in educational environment as well. The first model emphasize to applicability of the wearable computing at different locations at the same time. Second model more highlights the need for faster information flow. The good side of second model is uniformity of the process of obtaining information which can help students and professors because there is no much space for incomplete information awareness and communication loops. Represented models are based on idea of using wearable computing for all students not only for the one with technical knowledge and programs. Wearable computing should allow easier and faster communication both between teachers and students and among students as well.

Bad side of these models is time that is needed to make them work. Further, students and professors are needed to be trained to use wearable computing technology. From professors is expected to update their materials on time without delay. Face to face communication is minimized and it can be negative in psychological manner. In larger student groups there can be cheating with the registration of present students. Professors should after registration is done by students count number of students in classroom and number on registered Smart Phones and then compare obtained information. The good side of this model is idea of pushing wearable computing technologies in educational purpose so the information flaw is better and the productivity is higher in all faculty activities. Regarding to all, proposed models need to be further developed in accordance with the available technology and knowledge.

6. REFERENCES

Arduino Website, Retrieved at: http://arduino.cc/enMain/arduinoBoardLilyPad

Bergmann, J. H. M., &McGregor, A. H. (2011). Body-Worn Sensir Design: What Do Patients And Clinicians Whant?, Annas of Biomed. Eng., vol 39, pp.2299-2312

Bonk, C. J., & Graham, C. R., (2006). Handbook of blended learning: Global Perspective, chapter 1.1. Blended learning system: definition current trends and future directions, Pfeiffer, an Imprit of Wiley 989, Market Street San Francisco

Buechley, L., Eisenberg, M., Catchen, J., &Crockett, (2008, April). The LilyPad Arduino: Using Computational Textiles to Investegate Engagemet, Aestetics, and Diversity in Computer Science Education, In Proceedings of the SIGCHI conference on Human factors in computing systems (CHO), Florence, Italy

Bush, V., (1945, July), As we may think, The Atlantica Monthly, pp.6-7, Retrieved from http://web.mit.edu/STS/www/PDFs/think.pdf

Desktop environment, Retrieved at http://en.wikipedia.org/wiki/Desktop_environment

De Smet, M., Keer, H. V., Valcke, M., (2008, January). Blending asynchronous discussion groups and peer tutoring in higher education: An exploratory study of online peer tutoring behaviour, Computer & Education, vol. 50, issue 1, pp. 207-223

Duval, S., Hoareau, C. & Hashizume, H., (2010), Smart Clothing Technology and Applications, chapter 7, pp. 153-187

Google Glass website, Retrieved at: http://www.google.com/glass/start/what-it-does/

Hezgorg, O., & Witt, H., (2007). User Interface for Wearable Computers, Dissertation University Bremen, pt. 13-14

Hsu, R.-L., Abdel-Mottaleb, M., & Jain, A. K., (2002, May). Face detection in colour images, Pattern Analysis and Machine Intelligence, IEE Transactions, vol. 24, no. 5, pp. 696-706

Huang, K., Yi-Luen Do, E., Starner, T., (2008), Piano Touch: A Wearable Haptic Piano Instruction System For Passive Learning of Piano Skills, Wearable Computers, 2008. ISWC 2008. 12th IEEE International Symposium

Lee, W. H., & Kuo, M. C., (2014, January). An NFC E-Learning Platform for Interactive and Ubiquitous Learning, 2014 International Conference on Education Reform and Modern Management (ERMM 2014), Phuket, Thailand

Miller, P., (2012, June). Project Glass and the epic history of wearable computers, The Verge, Retrieved at http://www.theverge.com/2012/6/26/2986317/google-project-glass-wearable-computers-disappoint-me

Mann, S., (1996, August). Smart clothing: the shift to wearable computing, Communications of the ACM, vo. 39., issue 8, pp. 23-24

Ngai, G., Chan, S. C. F., Cheung, J. C. Y., & Lau, W. W. Y., (2010, January-March). Deploying a Wearable Computing Platform for Computing Education, IEEE Transaction on Learning Technologies, vol. 3, no.1

Nike makes Bluetooth Smart sensor cool and fun (2012, June 29), by Bluetooth SIG, Retrived at http://blog.bluetooth.com/nike-makes-bluetooth-smart-sensors-cool-and-fun/

Nosta, J., (2013, June 27). Forbes website, How Google Glass Is Changing Medical Education, Retrieved at http://www.forbes.com

Park, K. H., Lee, J., Yoo, J.-W., Lim, S.-H., Park, K.-W., Choi, H.-J. & Wohn, K., (2008). U-TOPIA: Campus-wide Advanced Ubiquitous Computing Enviroment, Communications in Computer and Information Science, vol. 11, pp. 183-193

Peter, C., Kreiner, A., Schröter, M., Bieber, G., Waterworth, J., (2012, June). The AGNES System for Ambient Social Interactions, The 5th ACM International Conference on Pervasive Technologies Related to Assistive Environments, Petra, Crate, Greece

Singh, H., (2003, November-December). Building Effective Blended learning Programs, Issue of Educational Technology, vol. 43, no. 6, pp. 51-54

The history of wearable computing, Retrieved at http://www.cubeos.org/lecture/W/In_2.pdf

Wearable computing, chapter: History of Wearable Computing, International Design Fondation, Retrieved at http://www.interactiondesign.org/encyclopedia

Weiser, M., (1991, September). The Computer for the 21st Century, Scientific America, vol. 265, no. 3, pp. 94-104

Willis, S., & Helal, S., RFID Informational Grid and Wearable Computing Solution to the Problem of Wayfinding for the Blind user in Campus Environment, Source: Helal, Abdelsalam- Department of Computer and Information Science and Engineering, University of Florida, Retrieved at http://www.icta.ufl.edu/publications.htm

Yahaya, S., Ahmad, E. A., & Jalil K. A., (2010). International Jurnal of Education and Development using Information and Comunication Technolohy (IJDICT), vol. 6 Issue 1, pp. 117-127

IMPROVING OF THE QUALITY AND RELIABILITY IN THE DEVELOPMENET OF THE SOFTWARE SOLUTIONS

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Abstract: *The software engineering is aimed to finding renewable, anticipated processes or methodologies of the software solutions. The methodological proceedings improve the quality and the reliability level of software, whereat all quality factors are grouped in the unitary paradigm, which determine software solutions of the modern software development, and they are oriented to reusable assets.*

Keywords*: the quality and reliability of the software, object oriented programming, component programming, reusability assets.*

1. INTRODUCTION

Modern software engineering deals with the process of software development, with theoretical knowledge, practical procedures and proper conducting of development activities. Software engineering passes through a large number of researching and practical phases. The quality of a software product is evaluated and estimated many times, whereat the three most important aspects are: the quality of the software according to user's perception, the quality of the software process production and the quality in the frame of business environment where the software will be used, whereat the software products will be estimated, the maintenance and developing methods. Generally, the software quality is estimated only by mathematical models, which include defects measuring in the programmed code, the number of dismissals (termination of performance or program failures) the time required for software development, with reference to finding and fixing errors in the software code.

2. COMPONENT AS A BASIS OBJECT-ORIENTED (OO) PROGRAMMING

The object oriented approach to the development deals with objects as independent and autonomous units, in which the whole partially participate in making software. Formally the objects make components, which contain single solutions, in building up complex and demanding Software. The basic approach of this development is to select, configure, to specialize and to figure a new software program which is being built. The components are very dependant on their size, complexity, functional and technical possibilities. OO programming has raised the quality of software solutions on a higher level and it contributes to formalize the develop software for multiple purposes. OO software development is about methodological, modern and flexible technology that provides solutions to create a better quality of software solutions and software development too. Only the OO programming provides tools and techniques of multi-functional software solutions (Reusability assets-R) i e components that depend of precisely defined methodological activities: production methods, R management, infrastructure, placement and using of R values.

The quality criteria are numerous, but generally they are divided into: internal and external criteria. External criteria (speed of software performance, simplicity of appliance, interface and functionality of software solutions) are usually in the interest of the final users. The interest of professional programmers is based on internal quality criteria, such as procedures in the implementation and distribution (reusability, scalability and robustness of software components, which are independent software units). The quality of external criteria is based on the quality of internal criteria. ''The ability of an program unit (program, class, subprogram, method) to work out according to its specification, whereat the specification means the precise description of what the program unit needs to do, it's called ''the correctness''[A], which is the most important quality criterion of OO engineering.

3. IMPROVING OF SOFTWARE QUALITY

Improving of software quality (Software Quality Assurance SQA) is a multidimensional concept. It requires measurement of many parameters in determining of potential targets and limits of the software quality. It is particularly complex to specify which parameters have to be measured and to provide testing of software system according to the specified outputs of software quality all of processes during development or project documentationfor supporting. It is necessary to specify all the measurement parametersand provide testing of a software system according to the specified outputs of software quality.

The research quality range can be extended to different aspects of business skills, where the software is integral part. Accordingly, we assume that the technical improvement of business and working environment reflects automatically the business value.

In this respect, setting the software features standards, to follow it, analyze and specify the target to achieve the specified outputs, are part of the practice software standardization. Some of the standards in the frame of international defined(International Organization for Standardization-ISO) as ISO 9000[B](Information Technology) or JUS/ISO 12207[C](Software life cycle processes) then (International Electro Technical Commission-IEC[D]). ISO/IEC 9126 international standard of the software quality is divided into four parts (ISO-9126[E]) which analyzes and defines:

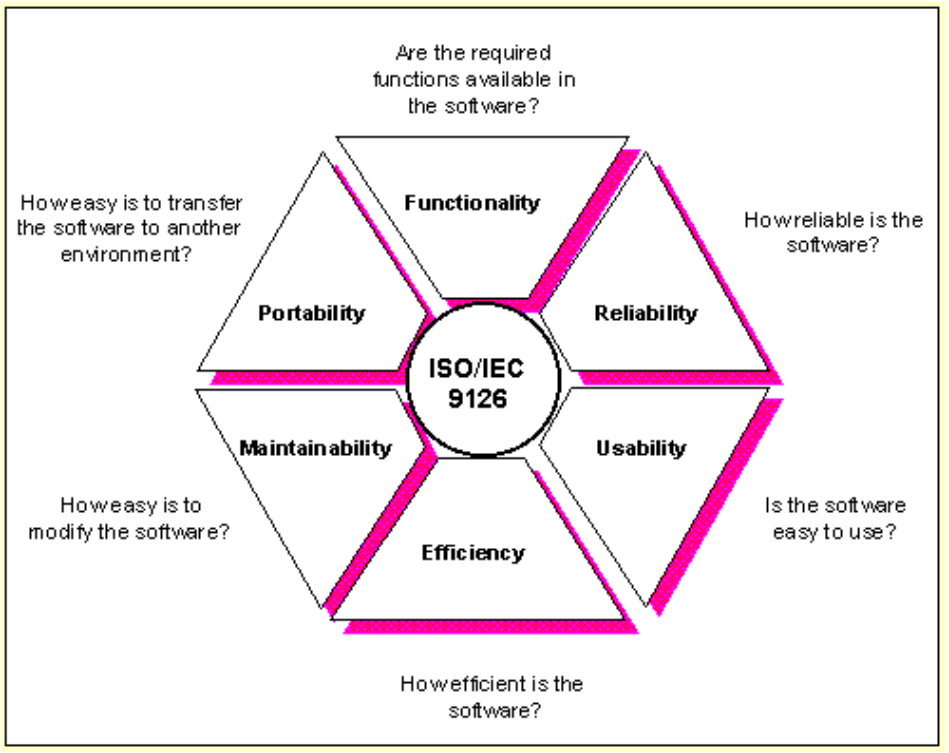

Figure 1:ISO9126software qualitymodel[F]

- ISO/IEC 9123 1 quality model
- ISO/IEC 9126 2 external software metrics
- ISO/IEC 9126 3 internal software metrics
- ISO/IEC 91264 quality in use metrics

According to the quality model ISO/IEC 9126[G] each subfeature affects on one basic feature on a higher level.

The evaluation of software quality should be specified on the standardized features, which ISO/IEC 9126-1 defines in the six most important attributes of a **good software system**:

1. Functionality
2. Reliability
3. Usability
4. Efficiency
5. Maintenance
6. Portability

Each attribute has a set of elements that can be measured using internal or external software metrics. To evaluate software products, primarily means to assess its reliability, which is reflected in the two most important factors: complexity and size of the program. The typical variables in which the values can be readout are:

- Total number of errors
- Length of program- thousands of code lines (KLOC)[H]
- Thousands of non comment source statements (KNCSS)
- Number of errors in the date inputs
- Number of different operators (keywords)
- Number of different operands (data inputs)

The complexity of programming task slows down its development and maintenance also. The natural complexity of the task may be very different from the evident complexity of developed program for this task. Software is a ''discrete'' system and it is essentially the cause of its complexity. The software product is measured in metrics from different aspects, and it precisespecific actions and realistic information in:

- Preparing of the specification of contract obligations
- Checking of software specifications
- Maintenance and costs checking
- Improving of productivity
- Improving the quality
- Reliability increase
- Basis defining for further predictions
- Requirements for new software tools and additional training.

The complexity and the ''discretion'' of the software system sometimes creates a confusing situation by using the terms software measurement and software measurement and software metrics. We would like to say that the software metrics involves quantitative measures derived from attributes in the software cycle, in mechanical or algorithmic way, so it doesn't depend on device which is measured on the quality of software, whereby it can be: a human, hardware, software or any similar combination. Measuring of software products provides:

- Objectivity, reliability, security, accuracy, suitability, uniformity, formulary process and process of logical thinking
- And not at all measuring by intuition.

The most prominent objective-formal attitude of software development is represented in ''Program-based components''. (Component-oriented programming-COP)[I]Components programming enables unified implementation, software development methodologies, but it is not always completely. The development of the internal part of components is similar to the development of other types of software (OO, structural etc). On the other side, the development of the external part of components is still relatively unexplored, and there are no excellent solutions for some component features:

- Define the connection between the components
- Distribution (clustering) components of the physical parts of the system and
- Time independence of running components (how to continue the performance of distributed applications if a component isn't available).

4. THE METHODOLOGICAL FRAMES WHICH JUSTIFY THE PROGRAM UTILITY BASED ON COMPONENTS

Building of methodological frames and models that prove the improvement of software solutions can be described as a difficult task, because it isn't included all of factors which can be measurable. Which tasks in development or maintenance will be planned, and how it will be implemented, it is estimated in costs and benefits analysis.(cost/benefitJ). This model takes into consideration the positive and negative factors that get into the analysis of total costs and benefits, and that indicates if the planned action is recommended. The costs/benefits analysis is carried out with financial support. If we want to include the intangible items in the analysis, then we have to give a valuation for the same, you will inevitably include the subjective factors in the measuring process. Yet, in accordance with all aspects of measurements and assessment, cost/benefit analysis is the best technique in the process of deciding if the R is deserved investment.

R metrics, define measurable categories, valuation software products, with its indicators are reflected in continues monitoring of cost/benefit connections, during the development and maintenance of software systems. The metrics assess the segments in which the R software shows a positive result, as evidenced by a group of 6 metrics:

- The quality, productivity and metrics of time-to-market
- R metrics economy
- R metric library
- R metric products
- Re-use of the metric values

The primary results such as quality, productivity and time coming out on market are used as input parameters for the economic model of software reuses. All other metrics contribute to the primary.

5. METRICS OF REUSED CURRENT VALUE

The reused software is proved by metrics of reused current value and R metrics. The formula realizations of R metrics define measuring of the following parameters:

A. Metric size: measuring the size of R values
   Measurement: KNCSS values R
   Benefits: provides useful measure of capacity in planning R
B. Number of R for each value:
   Metrics: Number R in relation to, the time until
   Benefits: Measuring the frequency of R values. The low frequency may indicate that the required re-engineering values and the efforts should be directed at the reusable R values, and the functions that they perform.
C. R Metrics:
   Metrics :Measurement of re-utilization of value based on fundamental R characteristics. Such marks can be subjective appraisals by user (excellent, good, average, meager, poor), while there is a way to get R metrics to be evaluated by automated tools.
   Benefits: The characteristics are identified which creator of R values in particular way emphasizes to fulfill the needs of users.

The measurements of the R size can be numerous. It is listed six models that define R metrics are sufficient to demonstrate the advantages of software built on R values. The methodology defines accurately and thoroughly all steps of a complex research of this type known by the name ''the goal questions-metrics''. This method is basically every metric and the research always begins and gradually leads to pre-approved methodology steps of this method.

$$\textbf{Quality R} = \frac{\text{(The number of errors and thefailureofthe program)}}{\text{(KNCSS thenew software) or (KNCSS inR-values)}}$$

R metrics defined measures the concentration of defects in the application program:

1. It is compared the concentration of errors in R values in the new software, whereat the better quality on a higher level of participation in the new software program.
2. It is determined the level of concentration errors before and after their integration of R values in the project of development, taking into account the errors appear additionally due to the integration of R values in the new product.

$$\textbf{Quality R=} \frac{\text{(The number of errors and thefailureofthe program)}}{\text{(KNCSS in softwarewithoutR) or the(in the software ofKNCSSR)}}$$

Figure 2: Formula of the new program quality with or without the R value[K]

Preponderance of errors significantly reduces the quality and reliability of software. The sharing of R values and its integration into new software products, from technical point of view, requires an analysis or other additional parameters through the following information:

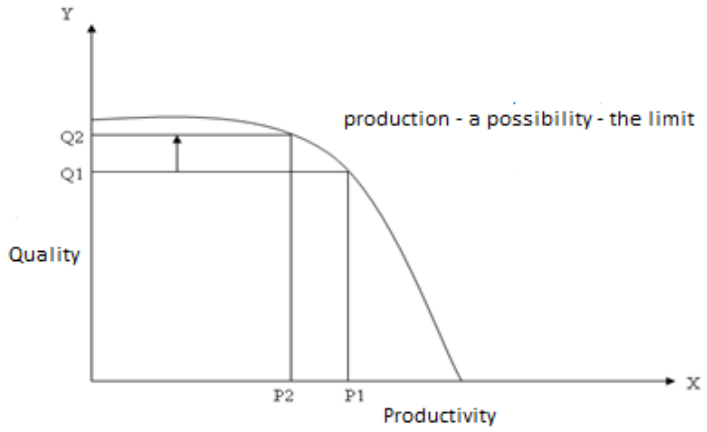

Figure 3: Mutual exclusionbetweenquality and productivity[L]

- Functionality- the area in which the program fulfills the user's requirements. R components can quickly create a prototype that will allow changes to the functionality of future decisions on the fly, during the current development.
- Accuracy- the level in which the software is released from extra efforts of designing and coding errors because it is constantly tested and reused.
- Reliability- the degree or reliability and accurate performance of certain functions with minimum glitches.
- Performance- the successful implementation of R program as an adequate response on time. The maintenance ability performance is under various conditions for a specified time.
- Usability- the application software is friendly to users, easy to use and learn, the user procedures are fast executed and it is easy to prepare and to interpret the input and output parameters.
- Localization- R values have the foreseen functionality for certain volume of business, but in the specific locations of application software emerging the requirements may be modified, where the necessity appears for regional users.
- Support- of maintainability R software. The engineers creators of R value takes over and the process of their maintenance. Under these conditions, the cost decreases per unit of product.
- Flexibility- R software provides the ability to modify the system requirements. Only changing parameters of the R component, is sufficient to modify the output values of R.
- Integrity- reflects controlled an authorized access to software or data.
- Testing- testing to fulfill the requirements of the program proves the achievement of the planned functionality.
- Portability- meet requirements of transfer programs from one hardware configuration or operating system to another or the ability to transfer between different working environments.
- Strong operational R software raises the level of interoperability of software, because the components of the re-handling routines are used by other systems. Therefore, the time and effort which are invested in the development and debugging of the original components of individual modules, which are used many times, und it is ultimately worth. The cost is amortized on a large number of component usages, which indicates the viability of the usage.

Comparison between quality and productivity provides a choice of outputs and inputs. The output is limited by comparison of these two parameters. The production graph is limited with labor, time, and capital, where input produces alternative exits. ''Curve- production-possibility-boundary'' as it is shown in the chart tells about the production, which gives a choice of thresholds of productivity or quality, which is mutually exclusive to a certain point. If we illustrate by the following picture, we can say that the effort involved in achieving the quality product Q1, entails a certain level of productivity P1. However if you would like to make some mistakes and weaknesses, and raise the level of quality in Q2, it requires the additional labor costs and time, which would otherwise bring down the level of productivity in P2. The company management according to offered parameters should decide which threshold wants to implement, higher productivity, lower productivity or vice versa R components dampen the benefits of raising productivity and quality of new software products but sometimes priorities need to be defined.

6. RELIAIBLITY IN SOFTWARE DEVELOPMENT

The methodology which estimates the **quality** of its **software** processes tries to raise the quality which also affects the raising of **reliability** of **software**.By analyzing the factors, it helps to improve the quality of the end-products usability. The equation measures these factors.

The semantic meanings of the terms are:

C_d - price debugging
t - estimated lifetime of the software product
f - relative frequency with which the components are executed
E - tf - number of repeating the code that will be executed
p - assumption that the component contains an error code
r – fp - reliability or assumption of errors causing product
c_f - price for code of broken code components
K- 1000 fold passage through software
(Note: all formulas are the references^{M})

It should be determine breaking points that represents the value of going through the lines of program code for debugging, is equal to the expected cost due to defects or errors or when the component code uses only one product:

$$C_d = Epc_f$$

If the component code is potentially multiple times in the N product, then the total number of performance components was:

$$E_{total} = \sum_{i=1}^{N} E_i$$

Thus, the breakpoint when the component code used in the N product is:

$$C_d N = E_{total}\ pc_f$$

Because the Etotal > E to be exactly Cd N ≥ Cd. More pieces of code are executed, the higher cost of lurking bugs in the code that can be justified, until they are amortized in a number of use. R cannot afford more debugging to reduce P ie assumption is that the component contains an error, which improves r ie reliability of a software product.

1. If we assume that we have a software component that is reusable, we can perform analysis of quality and reliability, according to the proposed methodology.

c_f = 80€.
E= 10.000 performance
P= 0,001 presumption that contains an error

Then C_d = Epc_f
= 10.000 x 0,001 x 80€
= **800€**
price debugging components

(Reliability) R =fp=10,000*0.001= 10is the number ofthe assumptionsthatthe component codecontains an errorafter10,000repetitions:

80 € /10possible numberof detectederrors=8 €, which is the pricefordebugginga single passthroughthe codecomponents.

If the cost of the development program lines of code is ie components that may contains an error, € 80, with 10.000 replications discover 10 possible errors, then the reliability is extremely high after the passage of 10.000 lines of code in the program. Price for each debugging is 8 €. The more debugging or going through lines of code, the less opportunity for error and greater reliability software solutions(R), which is seen in the following formula:

R = fp = 1.000 * 0.001 times passes assumption errors = 1
R = fp = 10,000 times passes * 0.0001 assumption errors= 1

2. On the basis of these analyzes, we make a conclusion, that the cost fo 8 € to pass through a single component should not be justified. On the other hand, if the software component of the real potential for R (re-use) of three products where a component is executed 10H, 20H and 30H times, recognizing that cf=80 € and P= 0.001 then:

Er = Epi = 10H + 20H + 30H = 60H
C_d (3) = 60H x 0,001 x 80€ = €4.8H
Epc_f = 60.000 x 0,001 x 80€= **4.800€**

Reliability R = fp = 60,000 * 0.001 = 60 is the number of assumptions, it is possible to detect an error in the code components after 60,000 repetitions, 80 € / 60 = 1,33 €, which is the price for debugging a single pass through the code.

The mathematical expression confirms that the 6-fold increase of debugging is a reasonable cost price, which is given 6 times repeatedly, passing through the component code, and it don't increase the reliability of software. If the € 80 cost component code is, and we assume that there are mistakes, and we have calculated that the assumptions of possible 10 errors in the code after 10.000 repetitions 8€ is a price for each pass through the code during debugging. However, if the same code is used in three organizations, and each has 10.000, 20.000, 30.000 passing through the same code, so debugging is 6 times increased, in which case the value of 1.33 €is an extremely low cost per debugging passing through the code.

5. CONCLUSION

The scope of the research quality of the software system business is the legal capacity, whereat the quality depends on the products and services which are provided by complex business systems, where software is an integral part. Therefore, improving the technical quality of software operating environment, reflects the business value of complex business systems.

With this methodology it is estimated the quality of software by their actions and it tries to raise not only the quality but also the level of reliability of the software. Analyzing the factors of improving the quality in the most rational and efficient war, it is amortized the R component, which participates in the development of software applications, which increases the quality and reliability of the final product of their used time and the effort in developing and debugging the original reusable components is shortened and it is multiplied in its use, since the manifold usage justifies the time spent for building, debugging and testing of components because the components are already prepared as a partial software solutions. The rational use of your time gives a space to perform quality, reliable and comprehensive analysis, which usually requires more resources and time and expert, which affect the proper development of the project tasks. The quality and reliability in the development of software solutions assimilated paradigm Reusable Assets-Component Software Development.

REFERENCES

[A] Aleksandar D. Kupusinac, Dušan T. Malbaški (2008) „Fairnesssubclasses" . Retrived from http://2008.telfor.rs/files/radovi/09_06.pdf

[B] International Organization for Standardization (2009) Selection and use of the ISO 9000 family of standards. Contains some of ISO's best known standards. Retrived from http://www.iso.org/iso/home/standards/management-standards/iso_9000.htm

[C] Raghu Singh, Federal Aviation Administration Washington, DC, USA. INTERNATIONAL STANDARD ISO/IEC 12207 SOFTWARE LIFE CYCLE PROCESSES. Retrived from http://www.abelia.com/docs/12207cpt.pdf

12207-2008 - ISO/IEC/IEEE Standard for Systems and Software Engineering - Software Life Cycle Processes. Retrived from http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?tp=&isnumber=4475825&arnumber=4475826&punumber=4475822

[D] ISO/IEC joint technical committee 1 – JTC 1 Information technology standards (2012) The force multiplier for ICT innovation. Retrived from http://www.iec.ch/about/brochures/pdf/technology/ict_innovation.pdf

and International Electrotechnical Commission. Retrived from http://www.iec.ch/
[E]ISO 9126 Software Quality Characteristics. An overview of the ISO 9126-1 software quality model definition, with an explanation of the major characteristics. Retrived from http://www.sqa.net/iso9126.html
[F]ISO/IEC 9126 Information technology: The standard of reference (1991) Quality characteristics and guidelines for their use. Software Product Evaluation. Retrived from http://www.cse.dcu.ie/essiscope/sm2/9126ref.html
[G]Sonu Mittal, Pradeep Kumar Bhatia(2013) Software Component Quality Models from ISO 9126 Perspective: A Review. IJMRS's International Journal of Engineering Sciences. Retrived from http://www.researchgate.net/publication/253341676_Software_Component_Quality_Models_from_ISO_9126_Perspective_A_Review
[H]Ben Chelf (2012) Measuring software quality. A Study of Open Source Software. Chief Technology Officer Coverity, Inc.
Retrivedfrom http://www.coverity.com/library/pdf/open_source_quality_report.pdf
KLOC (thousands of lines of code) (2011). Retrived from http://whatis.techtarget.com/definition/KLOC-thousands-of-lines-of-code
or eLOC – Effective Lines of Code Metric. Source Code Size Metrics.
Retrived from http://msquaredtechnologies.com/m2rsm/docs/rsm_metrics_narration.htm
[I]ANDY JU AN WANG, KAI QIAN (2005) COMPONENT-ORIENTED PROGRAMMING. Southern Polytechnic State University
Marietta, Georgia
[J]Wayne.C. Lim (1998) Managing Software Reuse. A Cost Justification Model for Software Reuse. Hewlett-Packard of California. page 101
[K]Wayne.C. Lim (1998) Managing Software Reuse. Formulas are derived using the interpretation software quality. Hewlett-Packard of California. page 102
[L]Wayne.C. Lim (1998) Managing Software Reuse. Prentice Hall PTR in 1998. Hewlett-Packard of California. page 109
[M]Wayne.C. Lim (1998) Managing Software Reuse. Prentice Hall PTR in 1998. Whatever. Hewlett-Packard of California. page 105

By Ivar Jacobson, M. Griss, P. Jonsson (1997) Software Reuse: Architecture, Process and Organization for Business Success
International Organization for Standardization (2009) Selection and use of the ISO 9000 family of standards
Wayne.C. Lim (1998) Managing Software Reuse. Formulas are derived using the interpretation software quality. Hewlett-Packard of California
Hongji Yang (De Montfort University, UK) and Xiaodong Liu (Edinburgh Napier University, UK) (2012) Software Reuse in the Emerging Cloud Computing Era

SOFTWARE SOLUTION FOR THE PRODUCTION QUALITY MONITORING

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Abstract: *This paper presents the main elements of the development of a software solution for monitoring the quality of production during the execution of the production cycle. Controlling elements are based on the tracking malfunctions which can be seen at the assembly of the final product. The specificity of the present software solution represents the monitoring of workers and supervisors in the analysis of production quality. Monitoring the quality of production during the execution of the production cycle has a wide range of implications for the organizational elements of the company and production planning. Analysis of malfunctions during the assembly of the final product significantly improves the quality of production, shortening of the production cycle, as well as a more efficient choice of suppliers and elements for installation. The software solution presented in this paper is designed in such a way that it can be universally applicable to all forms of industrial production at the assembly of the final product.*

Keywords*: Software Development, Information Technology, Quality Control, Production Cycle, Production Analysis*

1. INTRODUCTION

Analysis of production quality is one of the most important elements of industrial production. Quality creates one of crucial factors in the placement of the final product. However, analysis of the actual quality and identified defects during production significantly affect other business segments. A large number of identified deficiencies in terms of poor installation inevitably implies a number of organizational and technical measures in terms of the improvement of the production process. Reduction of certain defects during production affects the shortening production cycles due to eliminating the need for subsequent finalization of the finished product. Also, the improvement in the production process results in adequate production planning, management of human and material resources, as well as achieving financial effects.

Considering the importance of achieving quality production, to this issue is given great importance. Mitra (2012) this issue of improves by a statistical approach to the analysis of quality. Modern methods of quality control include numerous methodologies (Wadsworth et al., 2002, Besterfield, 2004, Christensen et al., 2007).

The analysis of production quality a number of authors highlights with the different approaches, introducing new improvements in this area:

- Various quality techniques for manufacturing (Reece, 2007)
- Implementation of quality control stations (Shetwan et al., 2011)
- A modeling approach for quality control (Weiss, 2013)
- Quality control model based on danger theory (Zhang et al., 2009)
- Implementation of n-line quality control (Pan et al. 2009)
- Implementation of intelligent quality control system (Zhao et al. 2009)

An essential element of improving production quality control is the implementation of information technology. In this sense Demant et al. (2012) highlight opportunities of visual quality control in manufacturing. Chen et al. (2010) accent of consideration set to the application of data mining technology in the analysis of quality control. Certainly one of the most important elements of the application of information technology refers to the automation of certain segments of quality control in manufacturing (Maki & Teranishi, 2001).

Software solution which is presented in this paper is a computer support for monitoring and analysis of quality of products at their final assembly, as well as individual components of the installation. The specificity of this approach is based on recording of product quality and registration of certain defects during the manufacturing process. In addition to timely response, in terms of subsequent finalization of finished products and elimination of identified deficiencies, this approach also aims to analyze the production process and improve organizational and technological elements of production.

2. REVIEW OF THE SOFTWARE SOLUTION

The basic elements of a database of the considered software solution are based on records of individual malfunctions, control elements, as well as information about workers and supervisors who participate in the monitoring of the quality of production. Figure 1 shows the Codebook of workers and supervisors with their basic data, which is one of the original table for the analysis of the results of the monitoring of quality control application. The structure of the code list table is based only on basic data on workers and controls, directly relevant to the activity of monitoring the quality of installation. Through the relational model, these basic data can be linked to other tables in the database of integral information system and thus obtain other information about the workers and supervisors who participate in this activity. Registration number of workers is the unique identification number of workers or supervisors in the entire enterprise information system and the primary key of the table in the function of connecting with other database tables. Seal number of workers or supervisors means the identification number of workers at the check list in monitoring of quality. The table includes the number of working days for monitoring quality control as well as required field which defines the worker or supervisor.

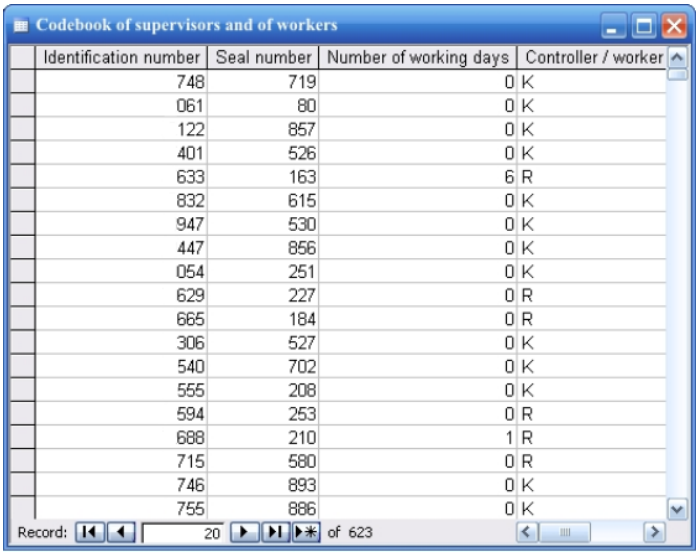

Figure 1: Codebook of supervisors and of workers

Table with control elements is a database table for quality analysis of installation. In addition to the primary key which uniquely marks individual pre-defined control elements. The specificity of records makes points of workers and supervisors for indicating the importance of individual malfunctions. The table contains predefined values for expressing the importance of identified eventual malfunctions over individual elements of the control. Figure 2 summarizes the structure of this table.

Figure 2: The table of control elements

The table Irregularities is the most important table in the database intended for monitoring the quality control of installation, Figure 3. In the table records are kept on concrete individual control elements which represent sub-assemblies in which the specific defect was observed. Basic data which constitute record of individual malfunctions are, in addition to the elements of control and identified malfunctions, the identification number of each product, the date of inspection and the number of seals of workers or supervisors. Data is automatically joined values of some important malfunctions in the Table of control elements.

Malfunctions

Number of product	Date of Inspection	Element of Control	Malfunction	Number of worker seals	Number of controller seals	Workers points	Controller points
7555835	5/9/1998	Corrector	Leakage	59	134	0	0
7555835	5/9/1998	Corrector	Leakage	15	134	0	0
7555735	5/9/1998	Sunshade	Bad installation	229	884	1	1
7555735	5/9/1998	Basis of clutches	Adjusting	105	672	3	3
7555735	5/9/1998	Basis of clutches	Adjusting	19	672	3	3
7551751	5/11/1998	Corrector	Harsh work	59	134	0	0
7551751	5/11/1998	Conductor	Poor performance	105	672	0	0
7551751	5/11/1998	Conductor	Poor performance	19	672	0	0
7551751	5/11/1998	Filling with oil	Inadequate level	153		3	3
7551597	5/11/1998	Dashboard	Deformation	28	184	0	0
7551597	5/11/1998	Floor mat	Bad installation	115	884	1	0
7551597	5/11/1998	Floor mat	Bad installation	28	884	1	1
7555837	5/9/1998	Glass lifters	Harsh work	25	884	3	3
7555837	5/9/1998	Corrector	Leakage	15	134	0	0
7555837	5/9/1998	Conductor	Poor performance	105	672	0	0
7555837	5/9/1998	Conductor	Poor performance	19	672	0	0
7555837	5/9/1998	Basis of clutches	Adjusting	105	672	3	3
7555837	5/9/1998	Basis of clutches	Adjusting	19	672	3	3
7555837	5/9/1998	Floor mat	Bad installation	255	884	1	0

Record: 20 of 294

Figure 3: The table of data on individually identified defects

Based on previously entered data, the software solutions enable creation of a number of reports, by which in different aspects can analyze required information on quality control. Figure 4 shows a report of improprieties with other related data, grouped for specific final products. This allows the analysis of all malfunctions identified over certain products. Additionally, of great importance are the reports by which the observed malfunctions are grouped according to individual elements of control. This analysis is carried out on certain sub-assemblies with the associated disadvantages. This analysis affects the selection of individual components and determination to a particular supplier in terms of quality. A large number of malfunctions, which indicate poor installation, implies different measures for improving individual operations of installing, to the structural and technological improvements.

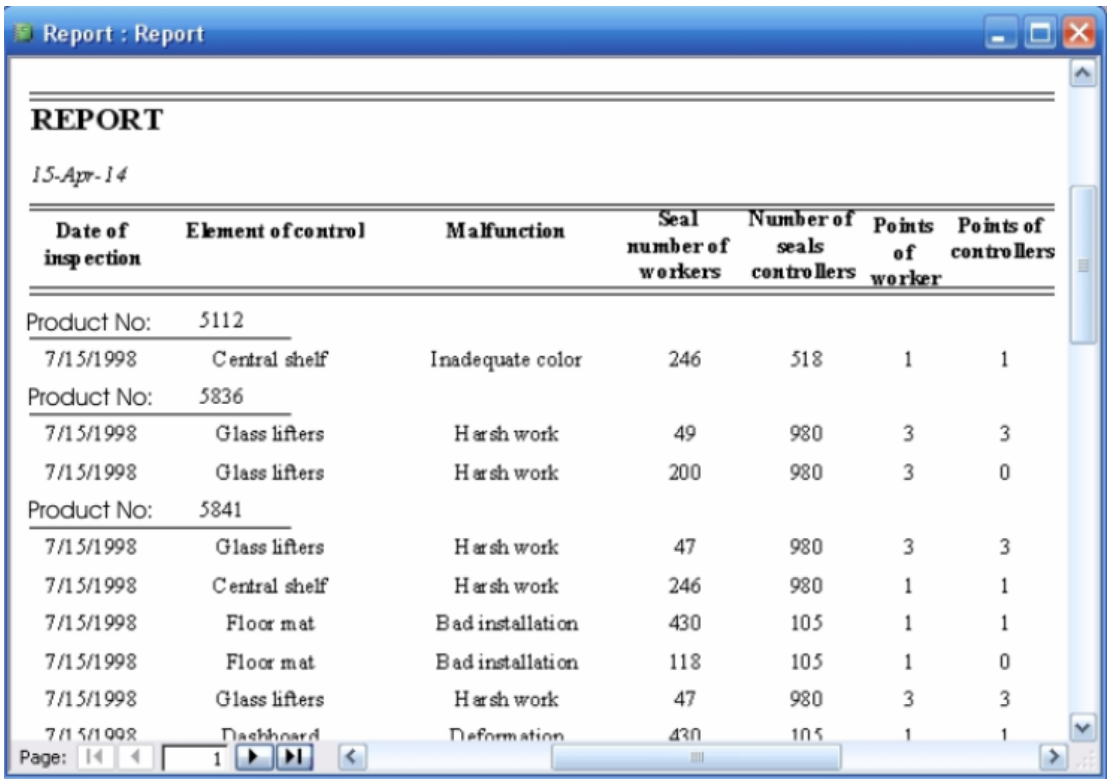

Figure 4: A report on irregularities grouped for specific final products

When considering the quality control of the presented software solution, accent is placed on the statements relating to the monitoring of work of the supervisors and workers in the process of monitoring and failure analysis. Figure 5 shows the data report only about the controls in this activity. Based on the number of seals, controllers obtained automatically, through the rest of the most important information, information about the controls, by establishing relational links with the table codebooks of controllers. Reports are formed grouped for individual controllers, where the information relates to a summary presentation of the acquired points of controllers, regarding the importance of identified malfunctions. In purpose of analysis the controller operation, an important information is a summary presented number of working days for control on this activity and achieved points in relation to the number of working days. In this way can be evaluated the work of controllers and their contribution to the detection of deficiencies in the quality control of production. Based on the displayed personal identification number of the controller, by establishing relational links to other tables of the integrated information system, it is possible to obtain all other necessary information about them. In the same way enables creating reports about the workers, by which can be evaluated their work in the quality control activities., Figure 6.

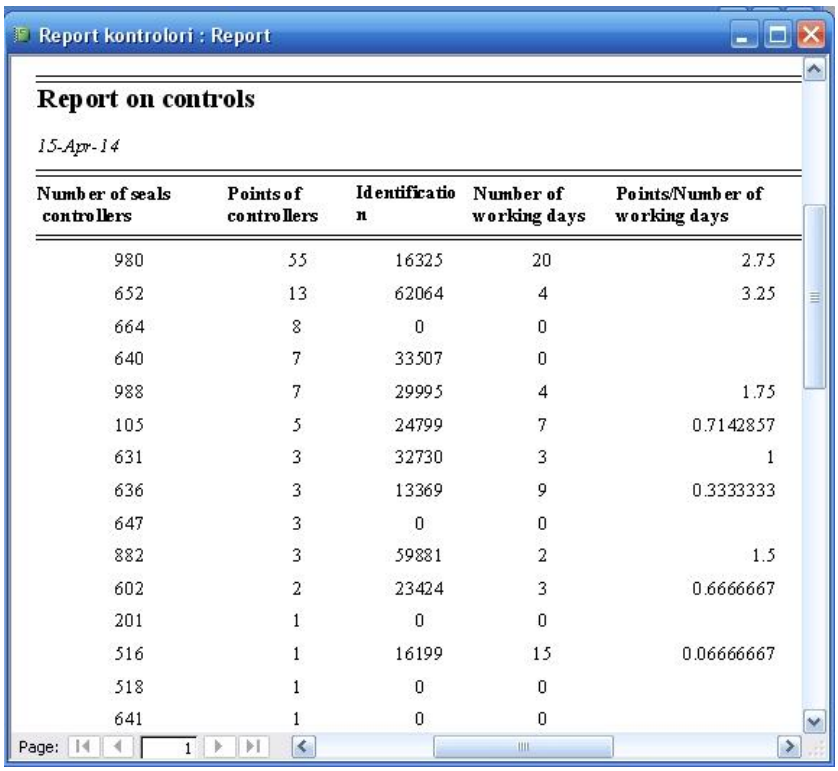

Figure 5: Report about the controls

Automatization of the report creation about the controls is performed by placing a query over tables of the relational database. The following listing is an appropriate program for the creation of this report, created with SQL (Structured Query Language) language, the universal language for accessing relational databases:

INSERT INTO [REPORT controllers] (NoSealController, SumOfPointsController) SELECT DISTINCTROW REPORT.NoSealController, Sum(REPORT.PointsController) AS SumOfPointsController FROM REPORT GROUP BY REPORT.NoSealController ORDER BY Sum(REPORT.PointsController) DESC;
UPDATE DISTINCTROW [REPORT controllers] INNER JOIN [CODEBOOKS CONTROLLER I WORKERS] ON [REPORT controllers].NoSealController = [CODEBOOKS CONTROLLER I WORKERS].NoSeal SET [REPORT controllers].IdentificationNo = [CODEBOOKS CONTROLLER I WORKERS]![IdentificationNo], [REPORT controllers].NoWorkingDays = [CODEBOOKS CONTROLLER I WORKERS]![NoWorkingDays]
WHERE ((([CODEBOOKS CONTROLLER I WORKERS].KontrolorWorker)="K"));

In addition to previous report which has a general character, one of the most important analysis refers to the work of supervisors or workers on a monthly basis or within a specified period, Figure 7. By this is perceived detailed and summary results of the work, in order to establish stimulating measures and rewards according to the effect of operation. In addition to data on observed irregularities in certain elements of control, in this sense are of importance and generated summary points that describe the overall significance of results. The programming code for creating this report is presented in the following listing:

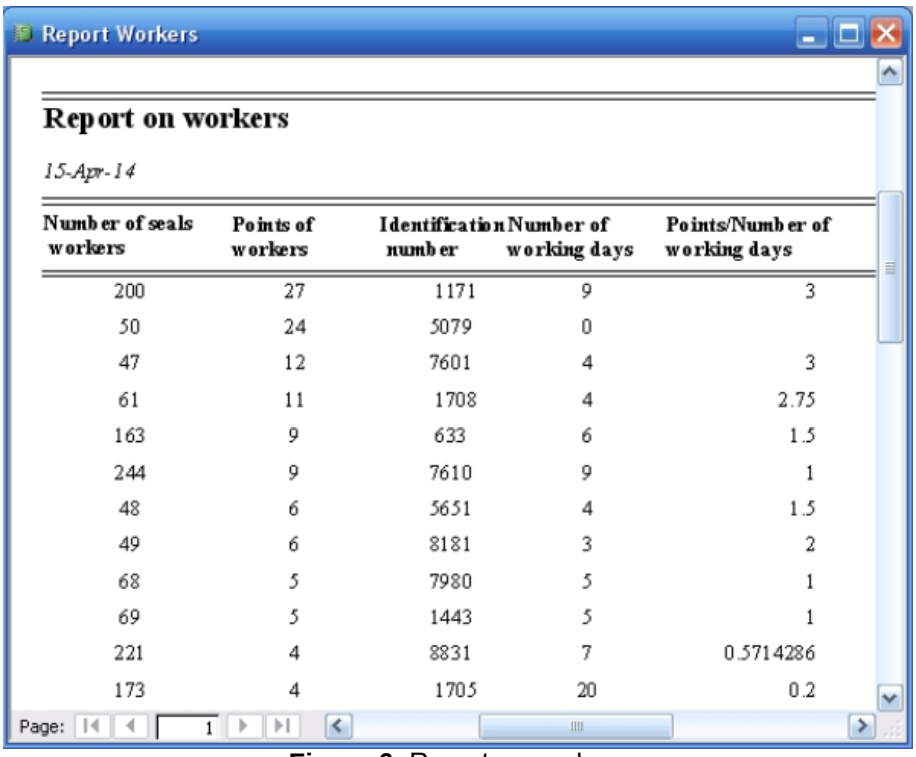

Figure 6: Report on workers

INSERT INTO REPORT (NoProduct, DateInspections, ElementControl, Malfunction, NoSealWORKERS, NoSealController, PointsWORKERS, PointsController)
SELECT DISTINCTROW MALFUNCTIONI.NoProduct, MALFUNCTIONI.DateInspections, MALFUNCTIONI.ElementControl, MALFUNCTIONI.Malfunction, MALFUNCTIONI.NoSealaWORKERS, MALFUNCTIONI.NoSealaController, MALFUNCTIONI.PointsWORKERS, MALFUNCTIONI.PointsController FROM MALFUNCTIONI WHERE (((MALFUNCTIONI.DateInspections)>=[SIGN INITIAL DATE] And (MALFUNCTIONI.DateInspections)<=[SIGN FINAL DATE]));

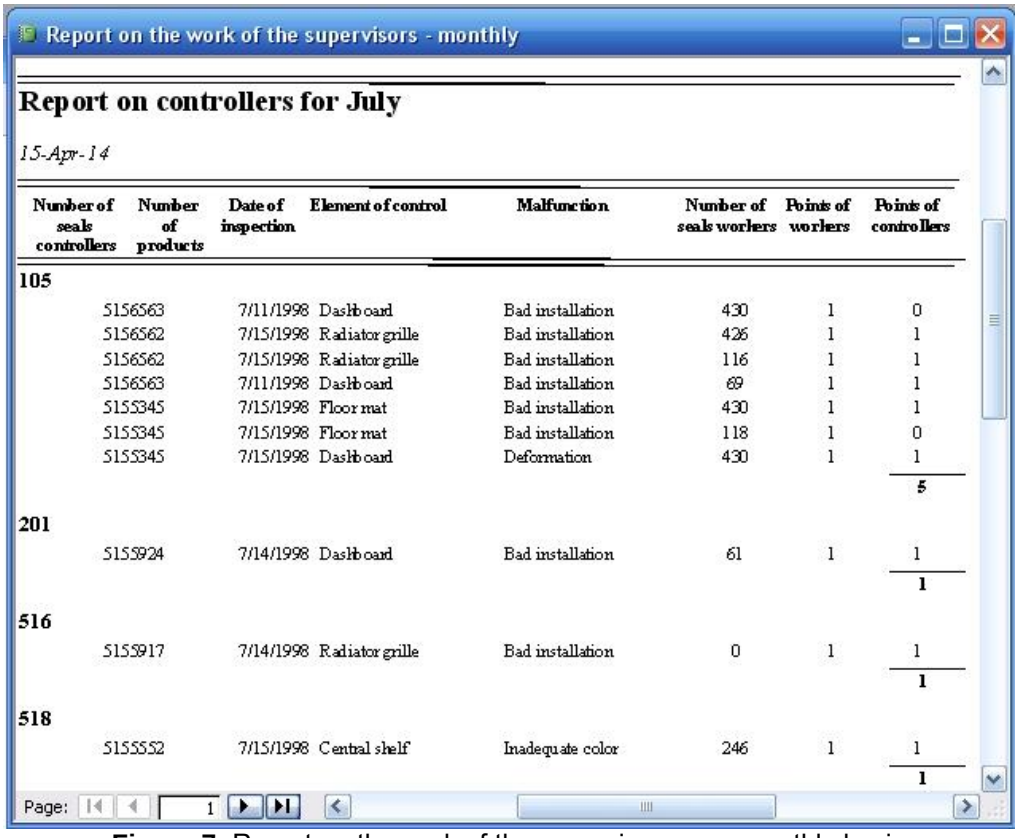

Figure 7: Report on the work of the supervisors on a monthly basis

3. CONCLUSION

In this paper are presented basic elements in the development of a software solution, which enables computer support for recording and analysis of malfunctions of finished products. The most important elements of the considered solution are presented . Discussed computer support is created using MS Access software tool, which is one of the most suitable tool for this purpose. The reasons for this can be seen in the speed of development of software support in all areas: creating a database, automation of calculation and analysis of data by setting the query, formation of different satisfactory reports for business purposes.

In addition to monitoring the quality of the product and identified malfunctions, the prezented software solution enables the analysis and evaluation of supervisors and workers in the quality control process. Evaluation of the work is provided in general terms and in a period of time, such as monthly. In this sense there is a possibility of evaluating and rewarding work by performance and by the importance of the identified irregularities in the quality control.

By predefined codebooks of supervisors and workers, as well as with a table of elements of control, it is enabled automatical creation of reports, with all necessary information, based on the entered elements of control and malfunctions, identified during the production process. Database tables, formed for the purpose of this software solutionis, is possible to link with other databases of the integral enterprise information system by a relational model, in order to obtain a large number of other reports. In this sense, the presented solution is not an isolated segment, but part of the overall information system.

An important feature of the displayed solution is a logical overall structure, in terms of its universal applicability in all industrial company, with the characteristic of the assembly of the final product. The greatest significance for the application of the considered software solution can have in case of execution of complex products with a large number of parts. In this sense, the solution may represent a conceptual basis for the development of own computer support in the individual industrial production.

ACKNOWLEDGEMENTS

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REFERENCES

Besterfield D. H. (2004). Quality Control, Delhi, India: Pearson Education.

Chen R. S., Chen Y. C., & Chen C. C. (2010). Using data mining technology to deign an quality control system for manufacturing industry, ECS'10/ECCTD'10/ECCOM'10/ECCS'10 Proceedings of the European conference of systems, and European conference of circuits technology and devices, and European conference of communications, and European conference on Computer science, Stevens Point, Wisconsin, USA: World Scientific and Engineering Academy and Society (WSEAS), 272-276.

Christensen E. H., Coombes-Betz K. M., & Stein M. S. (2007). The certified quality process analyst handbook, Milwaukee, Wis. : ASQ Quality Press.

Demant C., Streicher-Abel B., & Waszkewitz P. (2012). Industrial Image Processing: Visual Quality Control in Manufacturing, Berlin: Springer Publishing Company.

Maki H., & Teranishi Y. (2001). Development of Automated Data Mining System for Quality Control in Manufacturing, DaWaK '01 Proceedings of the Third International Conference on Data Warehousing and Knowledge Discovery, London, UK: Springer-Verlag, 93-100.

Mitra A. (2008). Fundamentals of Quality Control and Improvement, Hoboken, New Jersey: John Wiley & Sons.

Pan J. C. H., & Tai D. H. (2009). Implementing virtual metrology for in-line quality control in semiconductor manufacturing, International Journal of Systems Science, 40(6), 461-470.

Reece J. (2007). Measurement, Analysis, and Control Using Jmp: Quality Techniques for Manufacturing, Cary, N.C.: SAS Publishing.

Shetwan A. G., Vitanov V. I., & Tjahjono B. (2011). Survey: Allocation of quality control stations in multistage manufacturing systems, Computers and Industrial Engineering, 60(4), 473-484.

Wadsworth H. M., Stephens K. S., & Godfrey A. B. (2002). Modern Methods for Quality Control and Improvement, New York: Wiley.

Weiss S. M., Dhurandhar A., & Baseman R. J. (2013). Improving quality control by early prediction of manufacturing outcomes, KDD '13 Proceedings of the 19th ACM SIGKDD international conference on Knowledge discovery and data mining, New York, USA: ACM, 1258-1266.

Zhang G., Zeng H., Wang G., & Huang G. (2009). Quality Control Model for Complex Manufacturing System Based on Danger Theory of Biological Immune System, ICMTMA '09 Proceedings of the 2009 International Conference on Measuring Technology and Mechatronics Automation - Volume 03, Washington, DC, USA: IEEE Computer Society, 265-268.

Zhao X., Ma Y. B., Cai R., Bai X. L., & Ning L. Y. (2009).Research and Application of Intelligent Quality Control System Based on FMEA Repository, ITCS '09 Proceedings of the 2009 International Conference on Information Technology and Computer Science - Volume 02, Washington, DC, USA: IEEE Computer Society, 514-517

DEVELOPING JOOMLA COMPONENT FOR THE VOTING SYSTEM BASED ON COMPARATIVE ANALYSIS

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Abstract: *Ideas on the theory of voting have been adopted in number of recent online applications. Web search engines and recommendation systems use various voting methods for ranking results. The paper addresses a problem of implementing different types of voting systems, along with their definition and history. It points out the necessity of comparing them in order to complement different types and to suggest their improvement. Special attention is dedicated to the comparative analysis of voting systems, and applying Single-winner system of voting to Joomla component. Joomla component "Music recommendation" is developed.*

Keywords*: Voting system, Single-winner, Joomla component, Music recommendation, Model-View Controller.*

1. INTRODUCTION

Ideas on the theory of voting have been adopted in number of recent online applications. Recommendation systems have proven to be valuable tool for online users to cope with the information overload and to provide useful suggestions related to various decision-making processes (Ricci et.al, 2011). Various voting methods for ranking results have been proposed and many of them have been successfully deployed in the business and academic applications.

However, there are a lot of concerns in regard to adaption and design of learning mechanisms and algorithms for review ranking. Therefore, this research will be addressing this issue. Paper goal is to provide an insight into different types of voting systems, along with their definition and history. Special attention is dedicated to the comparative analysis of voting systems, and applying Single-winner system of voting to Joomla component. The growing attention on modeling in software development has subsequently brought the design of components in forefront. The specification and design of the component is strongly related to its availability and usability. Model-View-Controller (MVC) software architecture is recognized as the most used and accepted approach for designing a component (Bose, 2010).

First, literature overview presents the scope of the work done in defining different types of voting systems and Component-based software development approach. UML class diagram and process workflow of "Music recommendation" voting is given in section 4. Section 5 examines existing voting systems in order to define appropriate voting mechanism for "Music recommendation" component. In conclusion, we discuss research outcomes and ideas for future work.

2. VOTING SYSTEMS

Voting system or electoral system represents the way by which voters choose between given options in elections or on political referendums. The system sets the rules for achieving valid voting credential, as well as rules for aggregating votes in final results.

Common voting systems are: majority rule, proportional representation or plurality voting with many variations, such as first past the post or preferential voting (Rivest and Shen, 2010). Social choice theory or theory of voting represents a mathematical theory for formal analysis of combining individual opinions, preferences and interests to reach collective decision. From a standpoint of majority rule voting system, those who aren't familiar with voting theory are usually surprised that another voting system exists and that there are differences in meaning to be supported by majority. Therefore, majority rule voting can sometimes get the results that majority does not support. If there were only two options on each election, a winner would be chosen only by majority rules voting. However, if there were three or more options, it might happen that none of them get the majority votes of most or least liked. A simple choice does not allow voters to express

their order of preference and their feelings towards certain options. Different voting systems may give very different results, particularly in situations where the majority does not clearly specify their preferences.
Voting system determines a form of voting ballot, a set of legal votes, counting method and an algorithm for determining the results. Based on an algorithm, voting systems are divided into two general types: Single-winner and Multiple-winner voting systems (Nurmi, 2010). Moreover, the voting system may also specify how voting power is distributed among voters and distribution of voters in the subgroup whose votes are counted independently.

Conduct of elections in practice is not considered as a part of the voting system. It does not specify whether the ballot is in the form of plain paper, cards ticking or on a computer screen. A voting system also does not determine whether and how votes are kept confidential, the way to check whether the votes were counted correctly or who is allowed to vote.

3. COMPARATIVE ANALYSIS OF VOTING SYSTEMS

According to the algorithms for determining the results, voting systems are divided into: Single-winner and Multiple-winner voting systems. Scope of our work is in Single-winner voting system and it is applied in developed Joomla component.

Based on the voting method, Single-winner voting systems are divided into:

1. One vote or Sequential voting systems

In these systems voters vote for only one candidate and it is distinguished from the voting system applied in Joomla component “Music recommendations”. In the game each participant must vote for all recommended songs, not just for one. The best known Sequential voting systems are: Majority, Approval, Runoff and Random ballot voting system (Johnson, 2005).

Under the Majority system, a candidate must receive an absolute majority of votes to be a winner. This system encourages tactical voting and voters are pressured to vote for one of the two candidates with the highest chance of winning, because a vote for any other candidate is most likely wasted vote with no impact on the final result. Its implementation would be very simple, but it is not appropriate for the application where wasted votes should not appear. Approving voting system is similar to a Majority system. Voters can vote for as many candidates as they wish and the candidate with the most votes wins. It is simple and more flexible for voters. However, it is not used for the application because voter must give points to each song. In a Runoff voting, a candidate wins in the first round if obtains an absolute majority of the votes. Otherwise, a second round is held between the two candidates with most first-round votes and the winner is the candidate with best score from the second round. The last type of Sequential voting system is a Random ballot. In this system, a winner is chosen by random selection of a ballot. The use of a random ballot voting wouldn‟t make any sense, because it wouldn‟t depend on voters‟ preferences.

2. Ranked voting systems

Ranked voting system allows voters to rank candidates in order of preference. Ranking voting systems are divided into: Borda count, Bucklin, Instant-runoff, Condorcet, Coombs, Supplementary and Position voting system. These systems are the most similar to the voting system of the component “Music recommendations”.

Under the Instant-runoff system, voters rank candidate by giving mark „1‟ to the most preferred candidate, mark „2‟ to the second-most preferred and so forth in ascending order, while the order in “Music recommendations” voting system depends on the total number of candidates. The ordering process in Instant-runoff system is simpler for voters and also for implementation. The winner is a candidate who receives over 50 percent of the first preference votes. Otherwise, the candidate with the fewest first preference votes is eliminated and the points of eliminated candidate are assigned to the remaining candidates, who are ranked next in order of preference. The process flow is repeated until one candidate wins by gaining more than half the votes (Gehring, 2007). The processes of eliminating the candidates and assigning their points to the remaining candidates are not suitable for “Music recommendations” voting system. In “Music recommendations” system, it is necessary to assign the total number of points by all participants to each song.

Borda count is the most similar voting system to the “Music recommendations” voting. Voters rank candidates in order of preference, by giving a certain number of points which depends on the number of candidates. The candidate with most points is the winner. The only difference between Borda count and “Music recommendations” voting is used series of points.

Condorcet methods use pairwise counting and compare candidates one-on-one. The winner is the candidate whom voters prefer to each other candidate (Johnson, 2005). This method is implemented in “Music recommendations” voting in case where two or more songs have the same total number of points. The final rank is determined by Condorcet method in the aggregate ranking. The pairwise counts can be displayed in matrix. Under the Supplementary voting system, voters express only a first and second choice of candidate. If no one receives an absolute majority of first choice votes, all candidates are eliminated except the two leading candidates. The system is not suitable for “Music recommendations” voting, because in the second round the votes of eliminated candidates are transferred to the candidate of voters‟ next preference. On the other hand, Bucklin voting allows ranking the candidates in order of preference. If one candidate has a majority of first preference votes, the candidate wins. Otherwise, the second choices are added and this cumulative method is not suitable for “Music recommendations” system, since the winner is the candidate with the most points added.

3. Rated voting systems

Under those systems, voters give grades to each candidate from specific series of points. They are divided into: Range voting systems and Majority judgment (LeDuc, 2002). In Range voting system, the ranking ballot is used and voters rank each candidate with a number from defined series. The candidate with the highest sum wins. This method increases the level of tactical voting. Majority judgment system allows voters to judge each candidate and method of six grading levels is suggest, from “excellent” to “rejected”. The median grade for each candidate is calculated and the candidate with the highest median grade wins. The difference between Range and Majority judgment voting is in calculation of highest score.

4. DEVELOPING A COMPONENT FOR JOOMLA CMS

Bose (2010) describes Component-based software development (CBD) as approach based on the idea to develop software systems by selecting appropriate off-the-shelf components and then to assemble them with a well-defined software architecture (p.2). Complex software systems are built efficiently using component based approach in a short period of time. It brings the design of the component to the forefront. Model-View-Controller (MVC) software architecture is recognized as the most used and accepted approach for designing a component. This approach divides the component into three functional parts: data access, data presentation and business logic. The changes made in one part do not affect others.

The Model is responsible for data management, i.e. extracting data from database or from other data sources. In developing a component there can be multiple models and each of them can be defined for different data sources. It includes methods of presenting, creating, updating data and others methods related to handling data. The Model is all business logic with no knowledge of the View.

The View is responsible for presenting the data pulled out from the database. In Joomla CMS, it renders a HTML page from data using the general scheme. The View never changes the state of a database and only shows its condition retrieved from the model. Requests for data change are issued by the Controller and the Model executes them. Modules are automatically associated with a view by the Controller. The Controller selects the appropriate model or multiple models based on user requests and forwards requests to the model. It creates the view and ties it to one or more models. The duty of the Controller is to create a view, not to present data.

In Joomla CMS, each part of MVC is represented by an abstract class: JModel, JView and JController (Whitepaper 2011). These classes are in library joomla.application.component. Figure 1 shows the relationship of these classes.

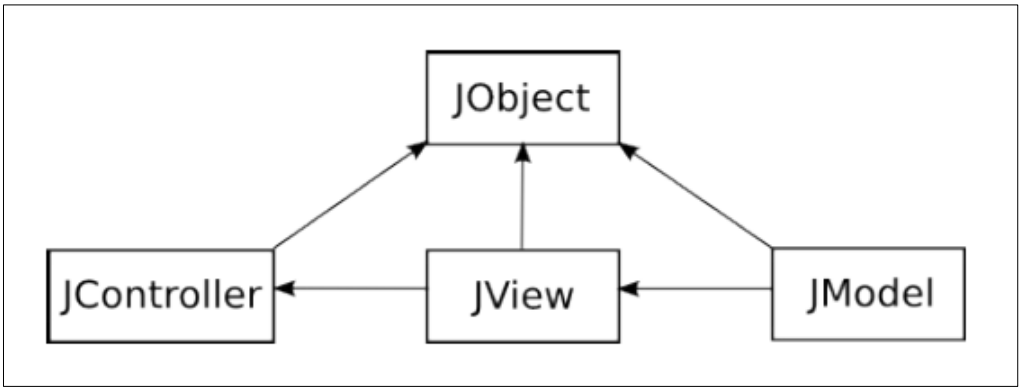

Figure 1: MVC – the relationship of abstract classes

5. DEVELOPING A JOOMLA COMPONENT "MUSIC RECOMMENDATIONS"

5.1 A problem statement

The progress and development trend of Internet communication and the popularization of music websites have encouraged the music fans to seek for more information about music tracks and artists. Music recommendations based on previous searches of every registered user are provided by specific sites, such as YouTube. However, the personal recommendations have significant influence on user online music tracks and artists choices. They affect users' perceptions of trustworthiness. Therefore, "Music recommendations" component was created in autumn 2008 and it reached over 1000 new songs.

In the absence of adequate methods, "Music recommendations" occurred in the form of separate sub form on the main forum. The game take place on a weekly basis and the week is divided into three phases: setting the songs, listening and voting. Two days, Sunday and Monday, are reserved for setting the songs. Each member has an opportunity to recommend a song within these two days on forums" topic created by the administrator. Songs are mostly described by attributes: name of the artist, title of the song, YouTube link and additional information, which is optional and represents members" comment on the song. Listening activity lasts for the rest of the week, accurately until Saturday, the day which is reserved for voting. Each member is required to send their ballots to last week"s winner on Saturday until midnight. Members are voting for each song except their own by specific scoring system, which depends on the number of participants and administrator publish it on the eve of voting. If member forgets to vote or for any other reason doesn"t send his votes, will be disqualified from the current week voting. When all participants vote, last week"s winner adds the points and publishes them on the same topic as song recommendations. In addition to this topic, there are topics on which is possible to comment on the results and the songs. There are also archives of all recommendations, winners and scored.

Increasing demand cause a need for reducing "the human factor" to the smallest possible level, i.e. to create an application for adding the points, creating and closing a voting week, etc. Moreover, number of participants expressed the wish for setting anonymous recommendations which is not allowed on forum. It reduces subjectivity to zero during the voting process.

Therefore, the Joomla component called "Music recommendations" is created as a part of the website with idea to make the game more interesting and user-friendly. Figure 2 illustrates the voting website page of "Music recommendations" component.

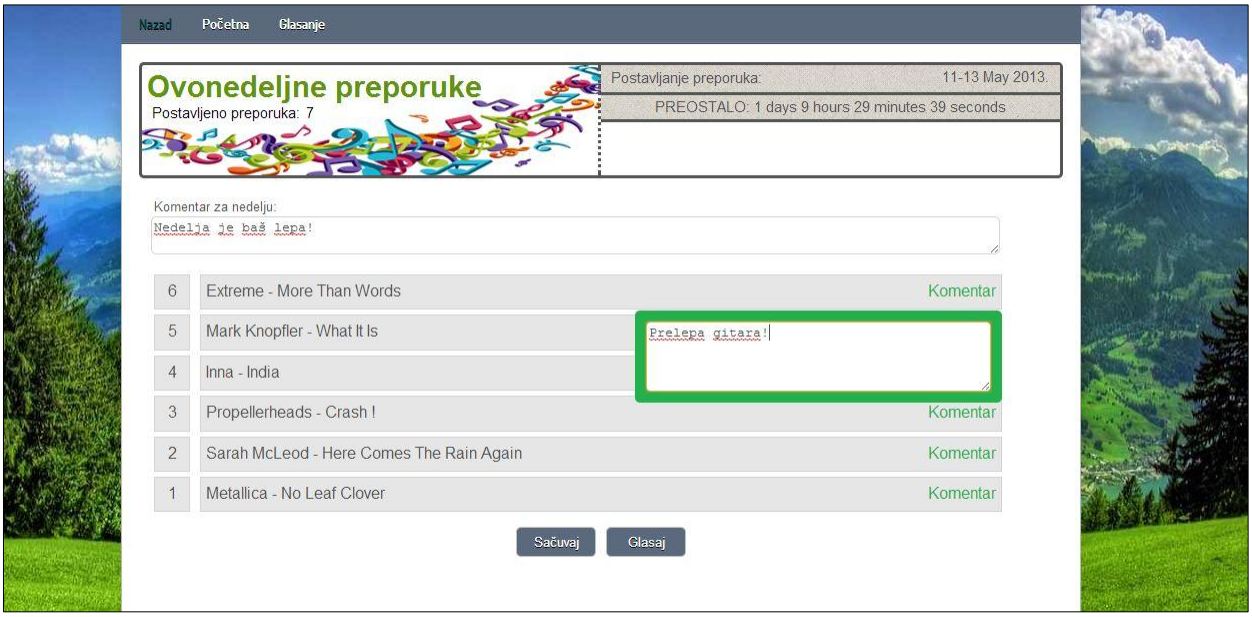

Figure 2: Page for voting

5.2 The component model structure

The organization structure of the model consists of four blocks: current settings, process, history and exit. The model is given in Table 1.

Table 1: The organization structure of the model for "Music recommendations"

Current settings (home) – recommendations set out in the current week
Process (settings, voting, results)
History – results from last week
Exit (back) – exit from "Music recommendations"

"Music recommendations" game takes place on a weekly basis, from Saturday (00:00) up to next Saturday (00:00) and each week represents a process. Two days, Sunday and Monday, are reserved for settings the songs and other days are for voting. Each process is divided into two parts: setting and voting. Thus the week can have two statuses: "setting" and "voting". In first part, participants set songs and review the songs set by other participants. The second part of voting allows the participants to vote for posted songs. If all participants voted before the time for voting expired, weeks" status would become "locked". In this period participants can't set songs. They can only watch the election results from the current week. Results from last weeks are always available in the "History". The process diagram is given in Figure 3.

t1= t3 - Monday (00:00), t2 - Saturday (00:00) (1)

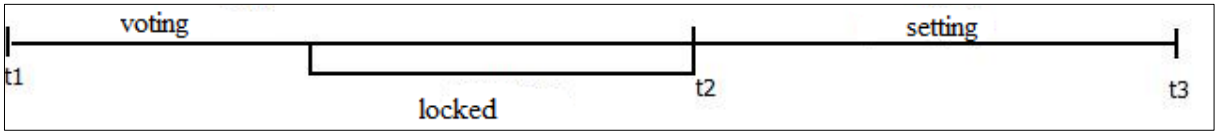

Figure 3: Time intervals of a process

The specification and design of the component is strongly related to its availability and usability. Object-oriented design of the component is illustrated through UML class diagram (Figure 4), as the most important structural model. The objects and information structures used by application, both internally and in communication with users, are described.

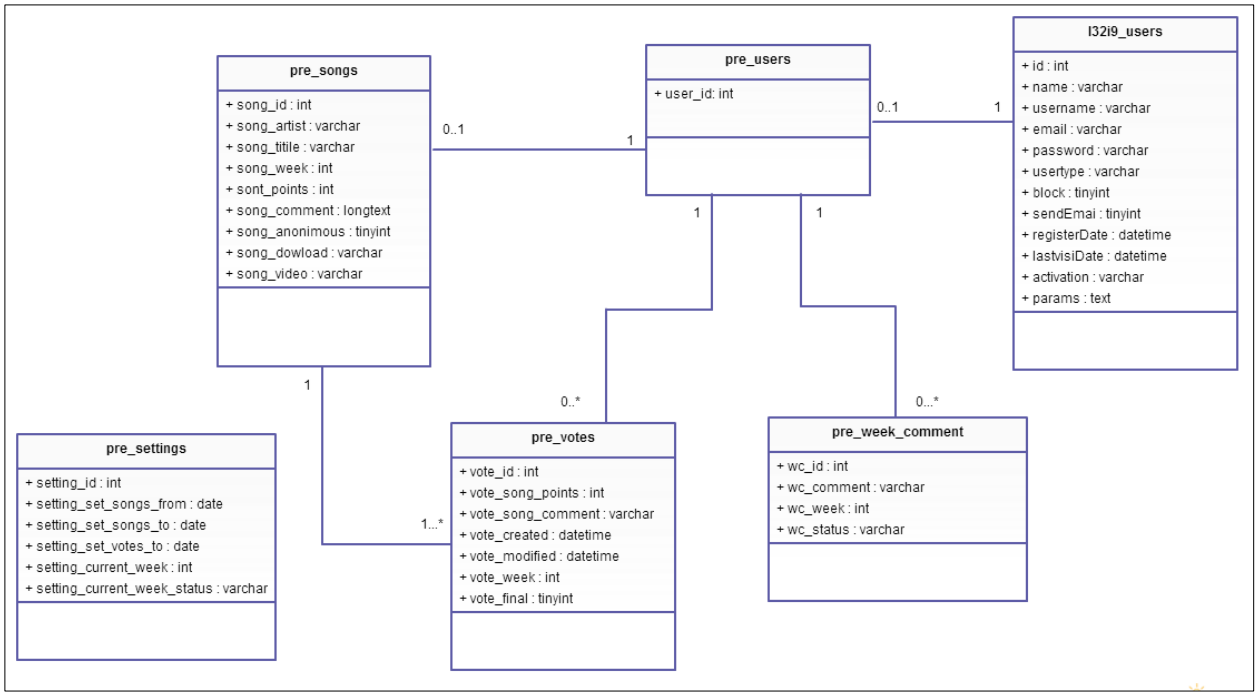

Figure 4: UML class diagram

5.3 Joomla component "Music recommendations" voting system

Creating ballot is the first step in implementing voting system of Joomla component "Music recommendations". The ballot includes all the candidates who are qualified to compete. If member recommends a song to others, member will be eligible to participate as a candidate in voting process. The voters are also the candidates on the ballot.

Moreover, each member who recommends a song can announce whether the previous set songs are known to member. If 30 percent of all participants know the song set by one of the participants, the song has to be replaced by a new one. Otherwise, the member will be disqualified not just as a candidate but also as a voter. The number of voter and candidates is equal, because a member who doesn't recommend a song has no rights to be a voter. After defining the number of candidates and voters, the voting process can be performed. Each voter ranks songs from other participants except their own. Ranking refers to giving points to each song that the other participants set in a particular order, so the most points are given to a song the voter has liked the most and so on. Voter must give points to each song in a way that one value from defined series of points can be applied to only one song. Ratings depend on the number of candidates, i.e. the number of songs that are posted. Rule by which the points are given is represented in Table 2.

Table 2: The ratio of the number of participants and points

Number of participants	Series of points
< 9	1, 2, 3, 4, 5, …
10	10, 8 ,7, 6, 5, 4, 3, 2, 1
11	12, 10, 8 ,7, 6, 5, 4, 3, 2, 1
12	14, 12, 10, 8 ,7, 6, 5, 4, 3, 2, 1
13	14, 12, 10, 9, 8 ,7, 6, 5, 4, 3, 2, 1
14	16, 14, 12, 10, 9, 8 ,7, 6, 5, 4, 3, 2, 1
15	16, 14, 12, 11, 10, 9, 8 ,7, 6, 5, 4, 3, 2, 1
16	18, 16, 14, 12, 11, 10, 9, 8 ,7, 6, 5, 4, 3, 2, 1
17	18, 16, 14, 13, 12, 11, 10, 9, 8 ,7, 6, 5, 4, 3, 2, 1

After the voting, the points that are given to each candidate are calculating. The points are added up and the candidate with highest total number of points wins. Other candidates get their ranking positions in the aggregate ranking list.

If two candidates have the same total number of points, they will be compered in terms of the position they hold in rankings by other voters. The candidate who holds better position in ranking list of one voter gets 1 point. The process continues until positions of candidates are compared in ranking list of all voters, not considering the ranking list of candidates who are compared. The candidate with highest number of points, i.e. who holds the better position in ranking list of other voters, is a winner.

If a voter doesn"t vote, voters" recommended song is automatically disqualified and the position of that song on the aggregate ranking list is taken by a song that was placed underneath.

6. CONCLUSION

There are numerous types of voting systems in use around the world. Different voting systems may give very different results based on rules which enforce how votes are collected, counted and added to get a final result. Moreover, the number of voters can have influence on counting method and an algorithm for determining the results. There is no single voting method that fits all cases. Many of existing voting systems are complementary, with strengths in different areas. It is necessary to understand in-depth the algorithms of different voting systems and choose the right one. Therefore, the special attention is dedicated to the comparative analysis of voting systems. The algorithms of assigning the grades are observed and process flow for determining the winner is briefly described for each best known voting system. Based on in-depth analysis and a problem statement, the appropriate voting system is select for “Music recommendations” website component. The advantages of Ranked voting systems are applied in developing Joomla component “Music recommendations”. Under defined voting system, participants rank the candidates in order of preference, by giving different grades from series of points to each candidate. The total score of each candidate is presented in the aggregate ranking list. In “Music recommendations” system a voter is also a candidate. Voters must rank songs if they want to stay in the game. In this way, system motivates voters to participate in the game.

It is important to emphasize that Single-winner voting system isn"t completely applied in developing Joomla component, only some elements. The main contribution of this work is reflecting through the creation of Joomla component based on Model-View-Controller software architecture with own voting method. UML class diagram of the component is presented. The resulting method and component can be widely accepted and future research intends to explore new improvements of the method and its further implementation.

REFERENCES

Bose, D. (2010). Component based development application in software engineering. Indian statistical institute. pp. 1-25. ArXiv: 1011.2163.

Gehring, M. (2007). Instant- Runoff Voting. Research Department, Minnesota House of Representatives.

Johnson, E. P. (2005). Voting systems. A textbook-style overview.

LeDuc, L. et. al (2002). Comparing Democracies 2: New Challenges in the Study of Elections and Voting. SAGE publications.

Nurmi, H. (2010). Voting systems for Social Choice. Handbook of Group Decision and Negotiation, Advances in Group Decision and Negotiation, Volume 4, e-ISBN: 978-90-481-9097-3, DOI 10.1007/978-90-481-9097-3_11, pp. 167-182.

Ricci et.al (2011). Recommender Systems Handbook. Springer Science. e-ISBN: 978-0-387-85820-3 DOI 10.1007/978-0-387-85820-3.

Rivest E. P. and Shen E. (2010). An Optimal Single-Winner Preferential Voting System Based on Game Theory. In ComSoc, pp. 399-410.

Whitepaper (2011). Creating modules and components for Joomla CMS. Faculty of Organizational Sciences.

PROJECT MANAGEMENT IMPACT DURING ERP SYSTEM IMPLEMENTATION

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Abstract: *This research model was developed through a multidisciplinary combinatory approach, theory of decision-making and project management. In the research, the study of influence of project management during the implementation of ERP solutions in Serbian companies is presented. The development of IS in companies is being researched, the metric of responsibilities on the project is presented, the role of project manager is identified, representing the percentage of companies with established ERP solutions by sector and size and the reasons for implementing SAP ERP solutions in Serbian companies is reviewed. The study systematically presented: a comparative analysis of IS before and after use of ERP solutions, a comparative overview of the new and old system in surveyed Serbian companies, the display module implemented in those companies, the percentage impact of SAP ERP solution implementation in Serbia, the total cost of ERP ownership as a percentage and the cost percentage in surveyed companies.*

Keywords: *ERP system, implementation, information system, enterprise*.

1 INTRODUCTION

In this research paper, based on the systematic study of the relevant literature and research performed in surveyed companies in Serbia, with different type of activities, production processes and the ownership structure, on a representative sample, using the questionnaire, the methodological aspects of the implementation process of ERP system have been researched and evaluated. Eminent authors, (Monk, EF& W Agner, BJ 2006) define ERP as the most important software in the company, which coordinates data / information in all areas of business. ERP solutions help manage business processes through the use of a database and shared management reporting tools. ERP solutions support the efficient functioning of business processes through business operations including sales, marketing, manufacturing, logistics, finance and human resources. Harwood, S. (2004) pointed out that ERP cannot be, in any way, classified as a database with pre-built software.

2 ERP FACTS

ERP solutions enable us to provide automated support for business processes and improved access to information and assistance in the implementation, including process modeling and documentation and tools that support the training and development of ERP solutions, (Denic et al., 2013).

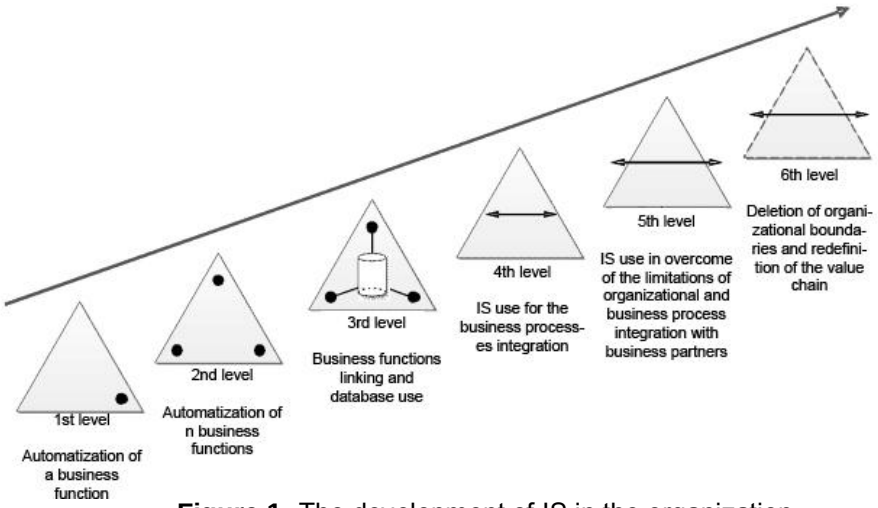

Figure 1: The development of IS in the organization

Source: Boddy D., Boonstra A. & Kennedy G. (2008). Managing information systems– strategy and organization. England etc.: Prentice Hall.

ERP solutions also allow the integration of business processes within and outside the organization, so that the boundaries between organizations disappear by changing their business value. Such systems are called Integrated IS or ERP solutions and their development is presented in the figure 1.

If there is a need to describe the ERP solution from the standpoint of the user, the following can be done: (Hamilton S. 2002).

- the way of making every product and service shall be defined
- the requirements of specific products or specific customer requirements shall be set
- the realistic business plans and proper time delivery of products and services shall be defined
- in order to coordinate activities in the supply chain the schedule shall be used
- the accurate calculation of product costs providing useful information for managers is allowed.

2 PROJECT MANAGEMENT AND ACCOUNTABILITY DURING PROJECT IMPLEMENTATION

The following Table 1 presents Serbian companies, with various types of activities, the production processes and the ownership structure (representative sample), where ERP system was implemented and which participated in the survey and also, the results of research.

Table 1 Companies that participated in the survey

Company Name	Activities of the company	Years In Business	Number of Employees	Web site
Srpska fabrika stakla A.D.	Glass industry	105	870	www.srpskafabrikastakla.com
Swisslion Takovo	Confectionery	17	2762	www.swisslion-takovo.com
Holcim Srbija	Manufacture of cement, aggregates and ready-mixed concrete	135	334	www.holcim.rs
JP PTT Srbija	Postal services, e-commerce, Internet	174	15336	www.posta.rs
Dijamant Zrenjenin	Food industry	76	585	www.dijamant.rs

Source: Research conducted in enterprises in Serbia, 2014.

The following Table 2 presents the results of research related to the review of the reasons for implementing SAP ERP solutions in the above mentioned Serbian companies, which show that every company has its priority reason for the introduction of modern ERP solution, which can be summarized in improving operations and creating positive effects of operations, increase of company value by creating competitive advantage, as well as the survival of the companies in the increasingly open global market in terms of the current global economic crisis. (Denic et al., 2014).

Table 2 Reasons for implementing SAP ERP solutions to enterprises in Serbia

Company name	Reasons for implementing SAP ERP solutions to enterprises
Srpska fabrika stakla A.D.	Improving the business, increasing the company's value.
Swisslion Takovo	Greater efficiency and productivity of operations.
Holcim Srbija	Within its own corporate SAP ERP.
JP PTT Srbija	The current system has unorganized data system. SAP ERP offers the lowest business risk.
Dijamant Zrenjenin	Effective business management and replacement of existing information systems.

Source: Research conducted in enterprises in Serbia, 2014.

In the analyzed companies it is predicted that they shall, together and individually, determine the respective roles and responsibilities in the project implementation of ERP solutions. The appropriate personnel working on a project is of the utmost importance therefore, the personnel have to be carefully selected. The teams working on the project plan development and implementation of appropriate ERP solution are typically diverse teams made from staff belonging to the solution makers and solution purchasers. (Denic N., Zivic N.,

Siljkovic B., 2013). It is important that in the team are, from both sides, adequate interlocutors, who recognize the problems which can occur.

During implementation, the staff was changing mostly in the team of solution makers. The project leader failed to suggest new staff members, and the people from other projects have been spontaneously hired, which had significant influence on the team motivation. In that respect, the project manager performed most of the work alone, and this fact suggested that the Purchaser had no professional leadership. From the Purchaser side, the team included two computer experts who were, more or less, coordinating the project in terms of connecting applications to support production of a new ERP solution. The project included eleven people in total from which six were engaged directly from the purchasing company and five from solution makers company. Also, project manager was chosen from the purchasing company and the other five representatives were from various areas of ERP solution knowledge. The role of information transfer and the inclusion of end-users in a new information system were assigned to them.
Prerequisite for participation in the project was that they were well introduced to the procedures for operating in the old information system. The solution makers offered one person to be appointed as the leader of the project, while the other four had the advisory role, each in specifically defined area. That is how they performed necessary programming work, because they had the role of the creator, more or less. They were even more motivated to work on the project, since it was shown that successful project is in the interest of all participants in the project, although there was very little time to perform. In that respect, the overtime was not an obstacle. From our point of view, regarding the success of the above projects, the prevailing opinion is that some companies can be observed as unsuccessful in ERP solution implementation, and that some companies, from the project management point, can be presented as an example of a successful project implementation and reconstruction of the existing information system. Due to the short period of implementation, the success of such project is more the exception than the rule.
Key users were additionally motivated to work on the project. Top level management, project team leaders and department leaders, had working meetings at which they discussed the progress of the project, as well as the problems and solutions. Despite the very short time for the project realization (three months) and the complexity of the project, it was realized in due time. At the end, the users accepted the implemented ERP solution.

The following Table 3 shows the metrics of responsibility on the project implementation of ERP solutions for companies.

Table 3: Metrics responsibilities on the project

	PM	PMC	PS	FSP
Definition of the target	P		C	
The requirements of a new information system	CO	PA	C	CO
Preparation of the draft document	P	P	C	C
Establishing the project organization	PA	P	C	
Determination of resources, team leader, motivation of participants in the project	PA	P	CO	
Management and supervision costs	CO		C	CO
Taking measures in case of deviation	PA	P	C	CO
Time monitoring of the project	CO	P	C	
Supervision of quality	CO	P		
Communication	PA	P		
Report on the progress of the project	P	P		
The conclusion of the project - report	P		C	C

Source: Denic N., Dasic B., Maslovara J. 2013.). Profitability of the investment project of introducing modern business information systems, Technics Technologies Education Management, Vol. 8, No. 1, 367–372.

Legend:
PM - project manager,
PMC - project manager of contractor,
PS - project supervisor,
FSP- financial supervisor of the project,
P-performing,
C-confirmation,
CO-cooperate,
PA- provides the answers

The management that manages changes in a company shall consist of well educated and high quality individuals, who have authority in the company, and enjoy the respect of subordinate staff, who must be able to understand the technical support of people in the company, which are implementing the ERP system and to have the trust at all levels of the business of the company,(Denic N., Zivic N., Siljkovic B., 2013). In this way, the company spreads good atmosphere and mood and desire for change, which is one of the most powerful advocates of change in a viewpoint. Most project managers are preparing very detailed reports on the cost parameters and they spent time in the implementation of ERP systems, and often, at the same time, they inform about the benefits and savings of ERP systems implementation. It is necessary to obtain data regarding the time which IT staff, in the company, is spending each month in order to prepare different orders or in fixing the errors associated with the Management orders and also, how much time is consumed in planning and control of the business system. However, this can be easily overcome with different tools, which allows the management to solely, and very simple, create their own orders. The ERP solution works more efficient if employees and IT staff work as a homogenous group.

Previous evaluations showed the importance of the project manager during implementation of ERP solutions in the company. Detailed presentation on the review of relevant scientific literature is presented in the table 4 while Figure 2 shows the percentage of companies with established ERP solutions across sectors and size, for year 2007.

Table 4 Some champion definitions found in the literature

Authors	Definition
Beath (1991, p. 355)	"Information technology champions are managers who actively and vigorously promote their personal vision for using information technology, pushing the project over or around approval and implementation hurdles."
Chakrabarti and Hauschildt (1989, p. 166)	"The Champion (process promoter) acts as a linkage. He has the knowledge of the organization and knows who should be concerned with the innovation, thus connecting the sponsor with the expert. His strength is the ability to translate the technical language of the innovation into one which is commonly used in the organization. By becoming a salesman of the new idea, the champion is able to develop a plan of action. His diplomatic talents provide access to different people within the organization".
Day (1994, p.149)	"The agent who helps the venture navigates the socio-political environment inside the corporation".
Ettlie et al. (1984, p.687)	"A person advocating" for the project.
Fischer et al. (1986, p. 13)	"The key characteristic of the product champion is the tension between the individual and what the organization wants".
Howell and Higgins (1990, p. 40)	Champions "make a decisive contribution to the innovation process by actively and enthusiastically promoting the innovation, building support, overcoming resistance and ensuring that the innovation is implemented".
Rothwell et al. (1974, p. 291)	"Any individual who made a decisive contribution to the innovation by actively and enthusiastically promoting its progress through critical stages".
Maidique (1980, p. 64)	"A member of an organization who creates, defines or adopts an idea for a new technological innovation and who is willing to risk his or her position and prestige to make possible the innovation's successful implementation".
Markham et al. (1991, p. 219)	"A role where individuals are strong advocates for a project and generate positive behavioral support for an innovation during its development or work on behalf of the project in the face of organizational neutrality or opposition".
Smith et al. (1984, p. 25)	"Sells idea to obtain resources. The major salesman to management for accelerating progress toward commercialization".
Shane (1994, p. 29)	"An advocate whose goal is to promote the innovation".
Roberts and Fusfeld (1981, p. 186)	"Recognizing, proposing, pushing and demonstrating a new (his or her own or someone else's) technical idea, approach or procedure for formal management approval".
Schon (1963, p. 84)	"Essentially the champion must be a man willing to put himself on the line for an idea of doubtful success. He is willing to fail. But he is capable of using any and every means of informal sales and pressure in order to succeed".

Source: Roure L. (1999). "Cultural Differences in Product Champions Characteristics: A comparison of France and Germany". Centre de Recherche DMSP, cahier nº. 268.

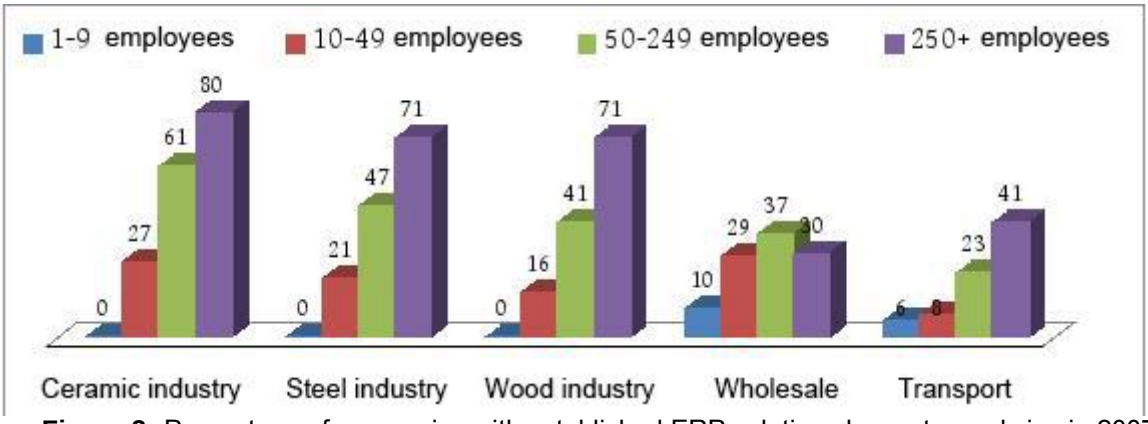

Figure 2: Percentage of companies with established ERP solutions by sector and size in 2007

Source: E-business W@tch. (2006). The Europeane-Business Report 2005 edition-A portrait of e-business i 10 sectors of the EU economy, 4th Synthesis Report of the e-Business W@tch. Luxembourg: Office for Official Publications of the European Communities. Accessed 12 April 2014 on the website http://www.ebusiness-watch.org.

Legend: The core of these industries is (100%) represented by the companies from seven EU Member States (Germany, France, Italy, Spain, Poland, Sweden, United Kingdom) and 811 companies from the chemical industry, 349 companies from the steel industry, 661 companies from the furniture industry, 1026 companies in the retail and transport activities 997 companies have been included.

3 REVIEW AFTER IMPLEMENTATION

Table 5: Comparison of IS before and after ERP solutions

	Before using ERP solutions	**With the help of ERP solutions**
Information Systems	Unconnected systems.	Integration system.
Coordination	Lack of coordination between business functions (e.g. production and sales)	Supports coordination between business functions.
Databases	Unconnected data. The data have different meanings. Inconsistent data definitions.	Linking data. The data has the same meaning in all business functions
Maintenance	Maintenance of individual IS. Inconsistent results. Expensive to maintain separate IS.	Uniform maintenance. Changes affecting several systems.
Interfaces	Impossible exchange interfaces between systems.	Unified interface between systems.
Information	Repetition, inconsistency.	Information is available in real time (e.g. customers, suppliers)
Architecture system	Is not uniform.	Based on a client / server.
Processes	Incompatible processes.	The integrated business processes based on business models
Applications	Various applications (e.g. several different systems for acquisition).	Uniform application - modules (e.g. common data acquisition)

Source: Sumner M. (2004). Enterprise resource planning. New Yersey: Pearson, Prentice Hall.

As shown in the above Table 5 Sumner, M. (2004) amongst other, claims that the greatest success of the ERP solutions is to ensure the availability, visibility and consistency of data across the enterprise.The respondents' opinion, after the implementation of the new SAP ERP solution, in comparison to the old software solutions, was positive, and 80% were satisfied with the new solution and new user interface.

Figure 3 shows a comparative overview of the new and old software solutions.

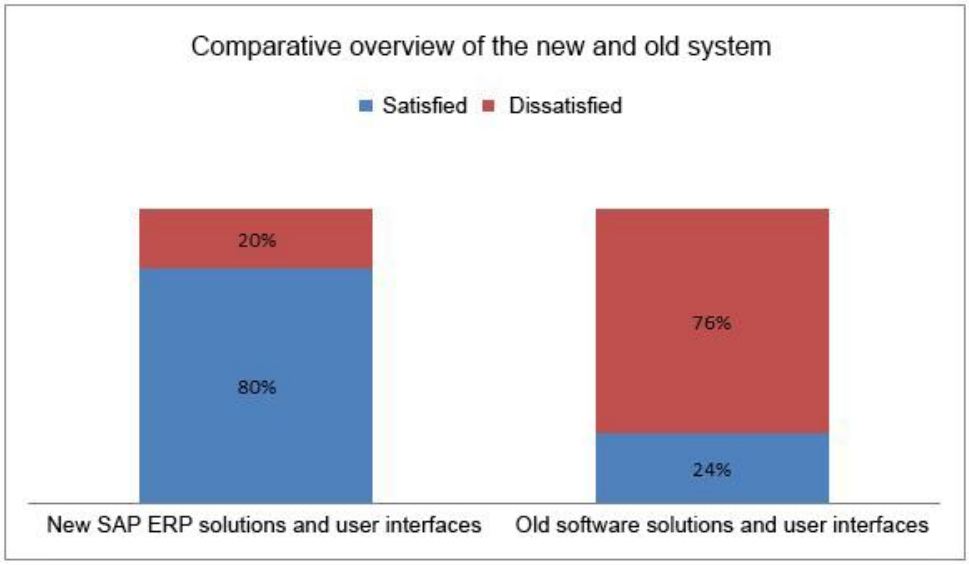

Figure 3 Comparative overview of the new and old system in chosen companies in Serbia
Source: Research conducted in enterprises in Serbia, 2014.

Table 6 presents an outline of the implemented modules in these companies.

Table 6 Display module implemented in companies

Company name	Implemented modules in chosen companies
Srpska fabrika stakla A.D.	FI, CO, MM, SD, PP
Swisslion Takovo	FI, CO, MM, SD, PP, BC
Holcim Srbija	FI, CO, MM, SD, PP, PM
JP PTT Srbija	FI, FI-AA, CO, MM, IM, HR, BC
Dijamant Zrenjenin	FI, CO, MM, SD, HR, PS, BC

Source: Research conducted in enterprises in Serbia, 2014.

Figure 4 shows the percentage of the implementation impact of SAP ERP solutions in Serbia. Implementation of SAP ERP solutions resulted in lower operating costs (80%) and it facilitated the management of the company with the maximum percentage. From a sample of implemented SAP ERP solution, implementation is completed in 60% of the sample, according to the planned time, while 40% is completed within the planned budget. The participant`s expectations from SAP ERP solution implementation were 60% while the quality of knowledge, adopted by the participants, is increased to the maximum.

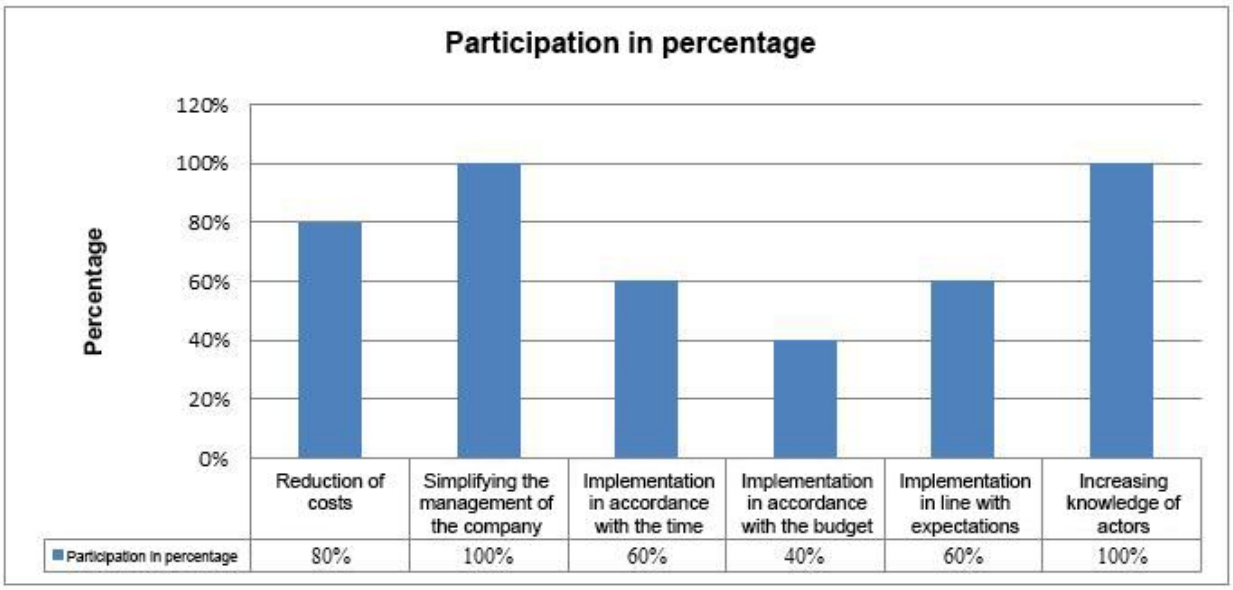

Figure 4 The percentage impact of implementing SAP ERP solutions in Serbia
Source: Research conducted in enterprises in Serbia, 2014.

A very important category in the process of introducing and implementing ERP solutions are costs. Most of the cost can be measured, i.e. they can be easily identified and evaluated in terms of the amount, while the advantages (benefits) of ERP solution implementation are difficult to estimate in that manner. They can be divided into two categories: (Cotterell M. & Hughes B. (1995).

- Direct benefits of ERP solutions are those that can be evaluated in terms of the amount, such as (Bodde et al., 2008) direct cost savings (reduction in costs due to automation of processes, such as reducing paper invoices), quality improvement (e.g. reduction of errors), avoiding the increase of costs (e.g. lower maintenance costs due to less damage), increased revenue (e.g. sales increase through new services), the survival of the business (e.g. if an organization wants to stay in business, it must provide certain services).
- Intangible benefits are usually long-term benefits of the project and they are immeasurable in terms of the amount, and very difficult to estimate. Olson (2004) states that they include the expected increase in the market share, improve customer`s service and image of the company. In addition, these benefits include satisfaction (dissatisfaction) of employees, supply chain integration and the ability to support e-commerce. Intangible benefits often lead to real competitive advantage, although the economic impact is often difficult or impossible to be accurately estimated.

Table 7: Total Cost of Ownership of ERP as a percentage

Costs	Disposable	Recurring
Direct costs:		
Hardware	5 -1 0%	
Software	2 5-30%	
Maintaining ERP Provider		2 0-30%
Programming	5%	
Training	1 0%	
Consulting	1 5-20%	
Indirect costs:		
Employees	10%	5%

Source: Harwood S. (2004). ERP: the implementation cycle. Oxford [etc.]: Butter worth Heinemann.

In the previous table 7 the total cost of ownership of ERP is presented, as a percentage, while in the following figure 5 the percentage of the cost of SAP ERP implementations in companies in Serbia is presented. The largest percentage of costs requires the involvement of consultants. The procurement and purchase of new equipment represents 13% of the total project cost.

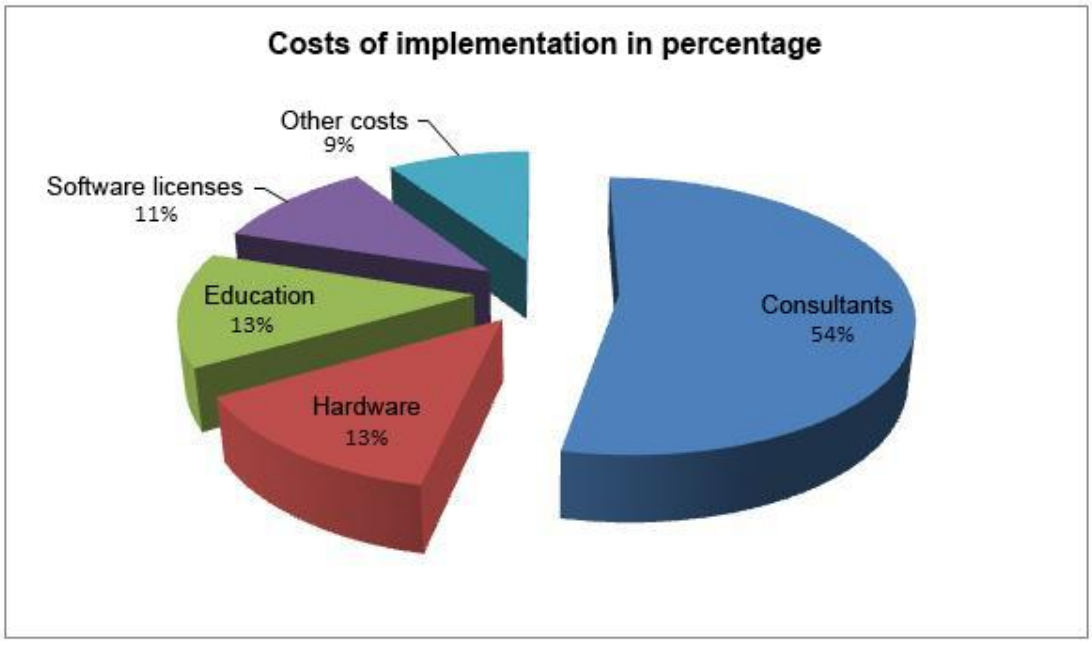

Figure 5 The percentage of the cost of the sample surveyed companies in Serbia
Source: Research conducted in enterprises in Serbia, 2014.

Given that ERP is a new information technology, and as such is constant, it is shown that the structure and goals of employees in the organization are changing, organizational structure, working values, information and knowledge are also changing, company goals are causing the change and that naturally create resistance,(Denic N.,2010). Usually, there are three types of planned changes in the organization of the company due to the implementation of ERP systems: structural changes, technological changes and changes focused on people (employees). Success is multidimensional and it refers to time and goals. Today`s success, does not have to be considered as such in two years (or 6 months). EPR systems which today provide a competitive advantage will provide such advantage if (or when) the competition reaches that competitive advantage (the advantage can become only a business expense). Success is sometimes evaluated depending on the company's unique goals in connection with the system.

The advantages of the implementation are:(Denic N., Zivic N., Dasic B., 2013)

- Real time Information across all functional areas,
- Standardization and accuracy of data, integrated information,
- Inclusion of "best practice" in the application,
- Standardization and acceleration of the business processes.

4 CONCLUSION

Given that ERP systems are new theme on this market and that relevant literature regarding the implementation of the ERP system exists only in developed countries, and that countries in the developing and third-world countries do not have the necessary knowledge and experience in the field of ERP systems implementation, this research paper provides a modest contribution to an improvement of research of above mentioned issues. Enterprise Resource Planning (ERP) systems are currently highly demanded in companies in Serbia and the region, especially for companies in the manufacturing and services based on industrial production, because they provide an effective management system that leads to significant improvement of productivity. What is presented in this paper is a comprehensive study to identify critical success factors and key benefits of ERP systems implementation using the responses from the concrete, chosen companies. The importance of these factors is examined in Serbian companies through the poll questionnaire. The results of the study provided practical guidance for business owners, management and ERP consultants in order to be more effective in managing the implementation of ERP solutions with its increasingly limited resources. In this paper, we were engaged in the research framework of the adoption and use of ERP systems, and we payed attention to the following questions: What are the factors and how much they influence on the adoption and use of ERP solutions by the company users. All previous studies have emphasized a small number of factors, so that none of them gives clear answers to the questions asked. In the introduction, the ERP system was presented, actually in order to be more precise, we have presented various definitions of ERP solutions and implemented an overview of the development of ERP solutions. In addition, we explained the advantages and limitations of ERP solutions, as well as trends in ERP solutions. Afterwards, the life cycle of ERP solutions is presented, and it was divided into four phases: identification of needs, selection of suppliers, the introduction and use,(Anderegg T.2000). If all of these phases are not being implemented during the life cycle of implementation, then their impact is significant in respect to the next phase of the life cycle and, directly or indirectly, to the adoption of ERP solutions by the users. The main contribution of this meticulously research is a comprehensive review of ERP solutions and its lifecycle.

Results of systematic research of the relevant literature and research conducted in different companies by type of activity and ownership structure clearly showed the following problems in project management of ERP solutions implementation in Serbian companies:

- Vague scope of the project,
- Under-definition of requirements,
- Bad assessment of deadlines
- There's no application of project management methods
- Frequent changes in management or project team members,
- Inadequate or insufficient training of end-users,
- Project does not provide solutions to interact with other systems.
- Lack of documentation of the system and the project as a whole.

Research has shown and confirmed that the benefits for the company which implemented the ERP system can be seen in perspective. It is also shown that, the most companies, do not assess the benefits and

impacts of the implemented ERP system to the organization and its operations. It is also indicative that the largest number of companies would not accept the research which will be conducted outside the company in respect to the effectiveness of the implemented ERP systems and their impact on the company.

As further directions of development and trends in ERP system implementation, the appropriate analytical methodology Hierarchy Process (AHP) can be used, and it can be used to determine the weight of the key success factors of ERP system implementation instead of, as up to now, the citations number of the key success factors, which were being used by some authors. Hestermann with co-authors (2009), in their research points, also emphasizes that in recent years the following trends were affecting ERP systems (especially for medium-sized enterprises):

- Verticalization system
- Modernization through the use of service-oriented architecture (SOA),
- Globalization, which is not only a characteristic of large companies,
- Consolidation of the market with a large number of mergers and acquisitions of ERP manufacturers.

REFERENCES

Anderegg T., CFPIM, CIRM&CIERP. (2000). ERP: A-Z implementer's guide for success. Eau Claire (WI): Resource publishing.

Boddy D., Boonstra A. & Kennedy G. (2008). Managing information systems– strategy and organization. England etc.: Prentice Hall.

Cotterell M. & Hughes B. (1995). Software project management. London etc.: International Thomas Computer Press.

Denic N. (2010) Menadzment informacioni sistemi, VTSSS Urosevac,.

Denic N., Dasic B., Maslovara J. (2013). Profitability of the investment project of introducing modern business information systems, TTEM - Technics Technologies Education Management, Vol. 8, No. 1, 367–372.

Denic N., Moracanin V., Milic M., Nešić Z.(2014). Risks the project management of information systems, Tehnički vjesnik, br. 6,.

Denic N., Zivic N, Siljkovic B.(2013). Management of the information systems implementation project, Annals of the Oradea University, Fascicle of Management and Technological Engineering, Vol. XXII (XII), Issue #2, September 32–35.

Denic N., Zivic N.. Dasic B.(2013). Analysis of factors of implementing ERP solutions in the enterprise, Annals of the Oradea University, Fascicle of Management and Technological Engineering, Vol. XXII (XII), Issue #2, September 27–31.

E-business W@tch. (2006). The Europeane-Business Report 2005 edition-A portrait of e-business i 10 sectors of the EU economy, 4th Synthesis Report of the e-Business W@tch. Luxembourg: Office for Official Publications of the European Communities. Accessed 12 April 2014 on the website http://www.ebusiness-watch.org.

Hamilton S. (2002). Maximizing your ERP system – apractial guide for managers. New York [etc.]: McGraw - Hill.

Harwood S. (2004). ERP: the implementation cycle. Oxford [etc.]: Butter worth Heinemann.

Hestermann C., Anderson R.P. & Pang C.(2009). Magic Quadrant for Midmarket and Tier2 - Oriented ERP for Product-Centric Companies. Gartner. Accessed 12 April 2014 on the website http://www.gartner.com/.

Monk E.F. & Wagner B.J. (2006). Concepts and enterprise resource planning– second edition. Australia etc.: Thomson Course Tehnology.

Olson D.L. (2004). Managerial issue of enterprise resource planning systems. Bostonetd: McGraw - Hill Irwin.

Roure L. (1999). “Cultural Differences in Product Champions Characteristics: A comparison of France and Germany”. Centre de Recherche DMSP, cahier nº. 268.

Sumner M. (2004). Enterprise resource planning. New Yersey: Pearson, Prentice Hall.

Research conducted in enterprises in Serbia, (2014).

MANAGING THE RISKS IN INFORMATION TECHNOLOGY (IT) AND ROLE OF INTERNAL AUDITING

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Abstract: *Information technologies provide new business opportunities and increase the economic effectiveness of the organization. With the increased application of information technology there occur new potential risks that must be identified and controlled. The paper emphasizes the importance of internal audit in risk management of information technology. Audit of Information Technology is considered an activity of crucial importance in achieving the expected efficiency of information technology. This paper describes the methods of risk assessment, control activities, objectives and contribution of internal auditing in the process of risk management of information technologies.*

Keywords: *organization, information technologies, management, risk management, control and internal auditing.*

1. INTRODUCTION

Rapid technological progress affects all areas of human activity, including the objectives, strategies, methodologies, techniques, practices and criteria for evaluating the efficiency of control functioning in the risk management process. Innovations and changes in information technologies are relatively frequent, providing new opportunities, but they also carry numerous risks to be managed, which is a new challenge for the management. New computerized systems that are being introduced to meet the goals must be under control, and any events that may prevent the fulfillment of the objectives must be identified and risks assessed. Information technologies (IT) are of capital i.e. of strategic importance to business, and therefore, require a proper organization, management and control. Information is controlled by the information system, which in that way, become the basis of modern business. The success of the entire business depends largely on the operation of its information system, for which reason it is necessary to pay due attention to issues relating to the introduction of effective control of information technology. Otherwise, the survival of the entire organization business can be questionable.

Organization management has the task to establish a convenient system for risk management in information technology, primarily to assess the fulfillment of the planned development objectives, identifying, eliminating or reducing the risk to a minimum. It is therefore necessary that the process of risk management implements the internal auditing, as a professional, independent and advisory function, which is a new challenge for the internal auditing. When defining the risk management strategy in IT, the function of internal audit is also included. It justifies a range of control activities in order to identify and assess the risks, it is focused on the areas of higher risk and on the probability that the risky situation will occur, as well as on the potential negative effects on the business, which that risky situation might cause.

2. INTERNAL AUDIT AS A COMPONENT OF RISK MANAGEMENT PROCESS in IT

The audit of information systems (information systems auditing) is most frequently referred to as auditing of information technology, Weber (1999) pointing out that the auditing the information technologies “is the process of gathering and assessing evidence based on which it can be determined whether the information system operates in the function of property preservation and integrity of data, whether it allows the efficient realization of business objectives, and whether the business resources are used in an efficient manner."
Internal audit provides independent and objective test functions, objectives and activities of an information system as to gather evidence that can be independently analyzed or be a good basis for the revision of other business areas of the organization. Internal audit collects sufficient and competent evidence on:

- the efficiency, effectiveness and cost-effectiveness of the information system (the three "E"),
- the preservation of the integrity of information systems and data, and
- whether the information system meets the requirements of legislation, policies and rules on generally accepted business practices of the organization.

Information technology innovations are always important. They provide new business opportunities and increase economic efficiency In addition, by its operation, the internal audit helps in establishing the control

environment, that must be established by an organization, as a part of the policy of compliance with certain standards. Activities of auditing system in information technology must be focused towards the creation of an effective control environment that ensures the identification, evaluation and prevention of risks and provides transparency of the internal control processes, (Sobel, 2007). Therefore, the internal audit function within the organization plays an important role in the risk management of information technology.

3. RISK ASSESSMENT AND OBJECTIVES OF GENERAL CONTROL ACTIVITIES IN AUDIT OF IT

It is almost impossible to imagine the flow of business processes of the organization and provision of timely and reliable information needed to make different business decisions without the use of information technology. Therefore, it is not necessary to emphasize the impact of information technology on the overall business process of the organization. Reliable information system allows a prompt transmission of accurate information to management and employees, coming from internal and external sources, which are of importance to them to carry out tasks under their responsibility. The erroneous risk assessments in information systems are not rare done by the management, which business organizations can present as huge losses. According to McNamee (2008) the most common examples of such estimates include:

1) The minimum investments in IT because there are leaders who believe that IT investments will not yield the expected results, as being unprofitable and
2) Lack of or inadequate supervision upon the information system.

Internal auditing carries out the evaluating procedures of the selected internal controls of information system to determine its compliance with the objectives of the organization or with the appropriate adopted internal control procedures. According to James (1999) the task of internal audit is that continuously checks how the system of internal control of electronic data processing. These methods usually comprise individual programs and procedures, as well as the environment in which processing of such data takes place.

3.1. THE PROCEDURE OF RISK ASSESSMENT IN IT

The success of risk management is to assess when and how to minimize risk, eliminate or accept a certain extent. The basic assumption of the risk assessment is preliminary familiarization with the organization's goals and risk exposure to achieve the set goals. Risk assessment is an important activity of internal audit in risk management of information technology. It involves performing procedures to identify and analyze risks.
Identification and analysis of risk instruments of modern risk management IT. Risk assessment up includes the identification and ranking of all relevant internal and external factors that could prevent the realization of the goals of the organization. At the stage of IT risk assessment, the internal audit function assesses the adequacy of internal control system. To achieve implement the following activities:

1) Determine the scope of the business processes of the organization that are subject to risks and the most important elements of organizational and business processes and the system of internal controls;
2) Assess the control framework and established controls in relation to the objectives, risks, and past experience;
3) Checks whether the system of internal control is of the appropriate nature and whether it operates successfully, primarily for protection against risks.

After learning about the organizational structure, business organization and system of internal controls, the internal audit determines the methods and techniques for risk identification, and then for its analysis and assessment. The risk assessment includes identification of the dangers followed by the gaps of information systems. According to Sawyer (2005), IT risk can be classified into two groups: (1) random and (2) intentional. One of the biggest dangers of random data processing is the threat of equipment destruction, the destruction of a folder, deleting data, assigning the wrong commands, force major (fire, floods and earthquakes), explosions , or acts of terrorism, loss of management personnel, improper installation of equipment etc. Intentional dangers (threats) are generally pre-designed frauds, such as data stealing, the use of prohibited programs, the abuse of certain data, hackers, various acts of sabotage, viruses etc.

When internal audit identifies potential risks, the next step to take is to identify the property that is most exposed to hazards listed, and then follows the risk assessment process. It often deals with forecasts of potential losses. It is therefore a very important task of auditing to, after the completion of the task, deliver the report to the management which will present and document any deficiencies in the control system, if noticed. The report will present their opinion on the possible consequences of deficiencies in control procedures, as well as suggestions for taking the possible preventive and corrective actions and measures to improve such controls, and implement process control of corrective actions and measures. Thus, the internal audit established in the risk management process is organized as a permanent activity.

3.2. CRITICAL AREAS AND OBJECTIVES OF GENERAL CONTROL ACTIVITIES IN IT

Control audit activities related to risk management of information technology, nowadays, are almost unavoidable. Internal Audit of Information technologies has a supervisory role and is the holder of various control activities, in cases where it is estimated that the main risks are those associated with information technology. Management is responsible for: (1) the establishment of an adequate system of internal controls and information technology to ensure that all critical areas and key business processes are covered by the control; (2) to design appropriate procedures to inform the employees of the policies and procedures of the organization, as well as of all changes. Employees are required to apply establish the control policies and procedures. According to Sawyer (2005), the general control of the internal audit is a set of policies and procedures that are meaningful in the risk management process, in order to achieve the following objectives:

1) *Provision of information*. Internal audit helps the management to provide accurate, timely and complete information, including accounting information for planning and monitoring the performance and reports on business operations;
2) *Ensuring the compliances*. Internal audit helps to ensure compliance policies and procedures of the organization with the legal requirements applicable to the business of the organization;
3) *To promote efficiency and efficiency of business operations*. Internal audit provides an environment in which the managers and employees can increase their efficiency and effectiveness;
4) *Realization of planned goals*. Internal auditing provides a mechanism for monitoring the achievement of pre-set objectives and tasks of the organization.

According to Moeller (2007), internal audit can adequately protect the information system, only if it is informed of all the threats that can attack and endanger it. This includes identifying of areas where the threat is greatest-the threat of the existence of errors or loss. To be effective, internal audit pays the greatest attention to potentially risky areas. Audit of Information Technology is considered an activity of crucial importance in achieving the expected efficiency of information technology, for several reasons, according to Weber (1999) the most common are:

1) To preserve the integrity of data
2) Preservation of tangible and intangible assets and
3) Protection of privacy.

Preserving the integrity of data. Data are a sensitive resource of organization, as they enable the analysis of business in the past, current and future periods. Data integrity implies to completeness, clarity and truthfulness. Data are complete when all business events are covered. Clarity means that the data can be interpreted in only one way and the user of the data must be in a dilemma regarding its meaning. Data are true when they faithfully reflect the events to which they refer. In view of the above facts, data integrity is a very important activity of the audit. It aims to verify whether the internal controls of information system are established, and if so, whether they work adequately.

By the proper processing the data are converted into information that is the basis of so-called information economy. Bringing the quality decisions, long and short term ones, mainly depends on the quality of data or information on which decisions are made. If an image is created of an organization on the basis of exact information data, the organization will have greater opportunities to adapt its operations to constant changes. But if the image is created on the basis of incorrect information, the organization will inevitably suffer significant losses, which are difficult to be compensated. This may be due to the lack of appropriate IT controls carried out by the internal audit.

Preservation of the assets of the information system of an organization. It is undisputed that data are very important resource of an organization, but it is equally true for other IT assets (hardware, software, staff). As a consequence of the influence of supply and demand, the prices of IT equipment are decreased, the total value of the equipment with software grows, and increasing is the price of labor experts in the field of IT. There are few experts in the field of computer science as compared to the needs of the organization, especially when it comes to e-business mode, which, from the global point of view, plays a dominant role. Even the most developed countries in the world have problems to adjust the rate of technological progress to the number of necessary experts. They resolve this issue by hiring experts who come from less developed countries, like our country, and these, on the other hand, have a problem because of the emigration of such experts. Any loss of IT resource, either data or property being in question, results in large financial problems in the organization. If, for example, there comes to a loss of a program (software), the confidential information could come into the hands of competitors, leading to large losses.

Activities carried out by internal audits for the purpose of protecting these assets are difficult because of the nature of property, and therefore, they are to be carried out with special due diligence of auditors. The

reasons why the traditional methods of managing IT assets must be replaced with new modern methods are: (1) a large value of intangible IT assets (2) big volume of this the assets (a large number of software codes), (3) infrastructure network of information system is located in different geographical areas, and (4) Internet work, presented at present, means the work in cyberspace. Possibility of any loss of these assets should be prevented by appropriate actions and measures, the significant role of which is the internal audit.

Protection of privacy In the information system, among other things, the data of the staff are collected and preserved, which can even be of personal nature. These are, for example, the data on the health status of employees, their culture, economic status, qualifications, family situation, education, political and religious orientation, etc. If the data of the privacy of the staff are not protected adequately, it may happen that they come into the hands of malicious persons. As privacy is one of the basic human rights, the organization needs to work on passing legislation and measures to protect and preserve the privacy of persons employed (business software solutions in Serbia, Belgrade (2011). Each organization, with its internal acts determines it's the issues of individual privacy and the necessary measures of protection, thus building up its information system. By control and auditing of information system will be established whether these rules are respected and conducted in the organization, to what extent and what results are achieved.

4. CONCLUSION

Information system is the basic infrastructure of business in an economy and the holder of the information resources of business, so any improvement of their efficiency, effectiveness, and cost-efficiency, as well as improving the preservation of assets and the integrity of data, will greatly affect the business strategy and business results of the organization. Any technology, including information technology itself, is neutral and can be of use to individuals or organizations and to the human community in general, but it can also be misused. The problem lies in its implementation. Appropriate risk management system in IT means the establishment of a number of procedures and criteria for the identification of rapid technological change, in order to fulfill the tasks and set the criteria for risk tolerance for the purpose of taking the necessary actions and measures for proper management of IT risks. Key events of rapid technological changes shall be subject to the identification and assessment of risks throughout the entire business process at all levels of management.

The main objective of the organization in managing the risks in information technology is to determine the procedures and scope of practice of the top-level management and executive management bodies, when making strategic decisions about the cost-effectiveness of IT investments, as well as when bringing the decisions, by which the business risks of extensive use of information system are managed.

Integrated internal audit in risk management system of information technology helps the organization establish an adequate system of internal control of IT, leading to the achievement of defined strategic objectives of the organization. It contributes to assuring quality, relevant and reliable information base for decision-making and management, which gives a positive reflection of the organization and increases its value, which is the basic concept of successful management.

5. REFERENCES

James, H.A. (1999). *Accounting Information System*. West Publishing Chompany.

McNamee, D. (2008). *Risk management & risk assessment*. USA: Pleier corporation.

Moeller, R.R. (2007). *COSO Enterprise Risk Management: Understanding the New Integrated ERM Framework*. Chicago: John Wiley & Sons, Inc.

Sobel, P.J. (2007). *Auditor's Risk Management Guide: Integrating Auditing and ERM*. Illinois, United States: CCH, a Wolters Kluwer business.

Sawyer, L. B. (2005). *Internal Auditing: The Practice of Modern Internal Auditing (5nd ed.)*. Altamonte Springs, Florida: Institute of Internal Auditors.

Poslovna softverska rešenja u Srbiji, (2011). Belgrade, Serbia.

Weber, R. (1999). *Information Sustems Control And Audit*. New Jersey, United States: Prentice-Hall.

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THE INTRODUCTION OF THE EFFECTIVE METHOD OF GIS TECHNOLOGY IN WATER SUPPLY SYSTEMS

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Abstract: *This document presents the created effective method of introducing Geographic Information System into Water Supply Systems. The main aim of this paper is to analyse the project on the introduction of GIS Technology in Water Supply Systems in Serbia. The result of the thorough analysis and research is the introduction of the effective method of GIS Technology. This method is developed and successfully implemented in Water Utility Service 'Vodovod Valjevo'. The main purpose of this method is the effective introduction of Geographic Information System with the maximization of the major effects. The created method can be used for the educational purposes but also as a starting point for the implementation of the project on the introduction of GIS Technology in other organizations which deal with water supply systems, only with the written consent of Water Utility Service 'Vodovod Valjevo'. The method consists of thirteen introductory phases. Five of these phases are the basic structural phases whereas eight other phases represent the phases of assessment, measurements and control. When the decision about introducing GIS Technology has been made, the main motivating factor for the introduction and implementation of the project is the enhancement of the whole organization's efficiency. The major expected effects of the implementation and introduction of GIS Technology in Water Supply Systems are: the increase in the economy, the development of the information system, the enhancement of employees' professional competences, and much better organization of the water supply system as well as the introduction of the strategy for ecologically sustainable development. This paper also presents the basic GIS software packages which are used in Water Supply Systems in Serbia and their functional analysis.*

Keywords: *geographic information system, efficiency, method, organization, water supply system*

1. INTRODUCTION

Following the development of information and communication technology management of PUC "Water Valjevo" in association withthe service of development is defined as a priority increasing of organizational effectiveness by information systems development.

„An information system can be defined as a set of interrelated components that collect, manipulate, store and disseminate data and information and provide a feedback mechanism to meet an objective" (Vavpotič., 2012). The introducing of geographic information system and its full integration with business information systems imposed as a priority in modern organizations including the PUC "Water Valjevo. Developed geographic information system will be used as a basis for reducing losses in water supply network,increasing efficiency, reducing negative impacts on the environment, the development of information system, increasing professional competence of employees and raising the level of organization.

2. COMPOSITION

Observing the effectiveness of water supply systems in Serbia can be easy to spot weaknesses in terms of ratio of the quantity of produced water for drinking and the amount of water which is invoiced to the direct customers. For the calculation of organizational effectiveness, we used the formula E(X), which place in relation precisely this type of loss and the goal of research is to reduce this kind of loss and increasing organizational effectiveness in this way.

$$E(X) = \frac{X}{Y^{!}} * 100\ \%$$

E(X) – coefficient of organizational effectiveness of water supply system
X- the quantity of water billed to the direct customers
$Y^{!-}$ the quantity of water produced

To make GIS system to be effective it is necessary to introduce GIS by the created model and to observe the phases of introduction. In this way, the GIS will achieve maximum results. Text that follows shows the phases of GIS technology introduction, created by effective method.

The introduction of GIS technology by an effective method consists of the following phases:

- The decision on implementation of GIS technology;
- Measuring justifiability of decisions;
- Forming the team;
- Review of the decision of all team positions;
- Hardware-technical structure;
- Review of the hardware-technical structure justification;
- Software solution;
- Rating of software solutions;
- Organizational procedures;
- Rating of defined organizational procedures;
- Evaluation of the first phase of the introduction of GIS technology;
- Rating the second phase of the introduction of GIS technology;
- Quarterly evaluation and control (include a review and re-consideration of the first 10 points.

The decision on implementation of GIS technology

The decision on the implementation of GIS technology represents the initial stage in the process of raising organizational effectiveness of water supply systems. This decision has to be made by top management that has a clear vision of the main objective of implementing GIS technology, the effects of the introduction of GIS, the cost of the project and the time schedule of the implementation.

The decision must be presented in clear, concise, formal, written document which must be verified by all relevant institutions in the organization. In case of PUC "Water Valjevo" it is supervisory board, the general manager, director of production and technical department and director of economic, legal and general affairs. Such written decision shall be submitted, in addition to the signatories themselves, and all managers of work units, department managers, heads of services, to all employees information system tasks that are expected full involvement in the implementation of future projects.

Measuring justifiability of decisions

As all other decisions, if we want to be relevant, timely, effective and supported by as many employees it is necessary to be periodically reviewed and examine justification. In the PUC "Vodovod Valjevo" justifiability of decisions is measured in such a way that to each of employee sent a questionnaire with the question "Do you think that is in the PUC" Water Valjevo "required the introduction of GIS technology?" If the answer is affirmative to all employee shall be given the opportunity to present on the same form their opinions, proposals, suggestions regarding the implementation of the project. Thus the completed questionnaire each employee sign and submitted to a central database.

Forming the team

Since the decision has been made by the top management in the next phase should form a team. Engineer of organizational sciences defines organizational roles, tasks and responsibilities of team members. The company's management elected among the staff members of the project team and the immediate supervisor of the team. As with any team, goal is full implementation of project by defined term plans and budgets. Members of the GIS team must achieve a synergistic effect. In addition, to staff from the organization team, can join and external consultants with relevant competent knowledge in this field.

Review of the decision of all team positions

For the successful execution of all activities of the project each team member must possess adequate knowledge or ability to learn and acquire new knowledge. Phase of the review is carried out on the way that team members in a closed questionnaire listed the name of a member who they feel most competent as a team leader. Thus obtained results is compared with already done choices and manager should make the decision reviewed. Also, team manager once again considers all positions in team and makes a proposal to the director of production and technical department makes the final decision on the selection of team members.

Hardware infrastructure

The basic elements of hardware infrastructure are: server, personal computers, tablet computers, portable computers, computer networks, storage devices, plotters, printers, GPS devices, total station, permanent

stations, orthophoto base, cadastral maps, transportation equipment, and in some cases, unmanned aircraft for orthophoto record.

Review of the hardware infrastructure justification
Selection of the basic elements of hardware infrastructure is choice of the management of each organization and the final decision is made by the manager of the project team within the available budget.

Software solution
To software selection must be given maximum attention because the market faced a number of software solutions that are more or less compatible with the needs of the organization. The most important software that GIS team should have can be classified into two major groups. The first group consists of software to run on the field and they are: software for independent GPS devices, software for GPS receivers, software for portable field computers and software for total station. The second group consists of software to work in an office and are software that are used to transfer and convert the data from the GPS device to the database server, the basic GIS software for data entry and processing on desktop computers, designed primarily for use in the office, reporting software and the database itself. For decision making of the choice of software may be used different.
"The decision-making model developed and implemented by Utility Service Department Vodovod in Valjevo consists of three phases. In the first stage, the employee, who is responsible for the Information System, decided upon the alternatives which will be the case of the furher analysis and decision-making process based on the Additional questionnaire" (Stajčić., 2012).

The main requirements that GIS software in water supply systems must meet are:

- The possibility that the same descriptive class feature keeps the lines, points and polygons;
- The ability to display the results of input on an unlimited number workstations without additional licensing and with its own software solution;
- The possibility that the visual appearance of each element on the layer folder changes independent of the pre-defined layout for the same;
- Integrated module for calibration, refinement and georeferencing of scanned maps;
- Support for raster files size up to A0;
- Nativna / Built-in support for connection without any additional application layer / attachment to all common RDBMS systems that can run on Linux and Microsoft operating systems;
- Built-in "CAD like" drawingoptions with the GUI and the principles of work similar to AutoCAD;
- During digitization, software must be able that element that is digitalised use already delineated geometry and takes her vertex coordinates;
- Defining a virtual column over the attribute tables that are dependent on the attributes that exist in the attribute table;
- Conversion in the multilayer PDF document with coordinates;
- Built-in support for Bing Maps without additional licensing;
- Built-in functionality to connect to the Google Earth service;
- Built-in ability to export data for Google Earth model;
- The possibility of developing additional modules and applications using its own development environment with its own editor, programming languages and compilers optimized for desktop GIS platform;
- Minimum of five developed own tools used in water supply systems;
- The supplier shall present a document certifying that he is authorized by the manufacturer, to sell the software in the Republic of Serbia.

All software for data entry and data processing can be divided into two major group. The first group consists of commercial solutions, and other non-commercial open source solutions:

1. Commercial solutions:
   - *ESRI ArcGis;*
   - *AutoCAD® Raster Design, AutoCAD Map 3D;*
   - *MapInfo;*
   - *MapSoft.*

   - "The software solution of ESRI company, ArcGIS is a synonym for reliable software for data entry and processing." (Esri., 2014). ESRI solutions are reliable and suitable for large water supply systems as a comprehensive solution. It includes 3D terrain modeling, ArcGIS Server, ArcGIS Web. All these modules are required water supply systems in later stages of the GIS. ArcGIS price, if supplied with all functionalities, is beyond the capabilities of small water supply systems the size of

the PUC "Vodovod Valjevo" so that the solution to price criterion is not acceptable. Large water systems, such as the water system Novi Sad, successfully implement this software solution. Analysis of software solutions for the model PUC "Water Valjevo" - Symorg 2012, this software solution is denoted as unacceptable because of the high cost of implementation and after the first round vote.

- AutoCAD ® Raster Design, AutoCAD Map 3D, are solutions that the PUC "Vodovod Valjevo" successfully implement and use since 2014. This solution comes in a package AutoDesk Suite. This solution comes in a package with other CAD functionalities but does not include all the basic requirements placed in GIS software. Since the PUC "Vodovod Valjevo" already owns the GIS solution and in view that does not meet all the software requirements, this solution is not considered as a solution that will be used as the basic GIS tools. The main representative of this software for our market is Autodesk.
- MapInfo is a basic GIS software solution of U.S. company Pitney Bowes Software, which has all the basic requirements of the GIS solution should have. "Its have the possibility of further development using its own compiler and programming language" (Lama., 2014). Modules such as WebGIS, 3D modeling are modules that this software includes with additional licensing. These functionalities are not required in the initial phase of the introduction of GIS technology, so this solution is acceptable because the cost is totally suited for smaller water supply systems. Water supply system of Uzice and Nis use this software solution. The main representative of this software for our market is firm Lama.
- MapSoft solution of Chinese company is the main GIS solution that recently appeared on the our market. This solution has not yet been implemented in any water supply system in Serbia. Therefore, this software solution is not acceptable for the water supply systems which as a condition placed delivery of the reference list. "This software solution has the possibility of additional software development" (Docus., 2014). Additional tools for water supply systems are still in the development stage, therefore, does not yet have the opportunity to present all the functionalities of the developed modules, thus the reliability of the further development of this tool is hard to measure. The main representative of this software for our market is firm Docus Cacak.

2. Non-commercial open source solutions are:
    - *Grass*
    - *Chameleon*
    - *Geonetwork opensource*
    - *Geotools*
    - *Gvsig*
    - *Ilwis*
    - *Jump gis*
    - *Openlayers*
    - *Postgis*
    - *Quantum gis*
    - *Terraview.*

These software solutions are suitable for minimum water supply systems and water supply systems which are not able to devote the funds and want to start with the implementation of GIS. In larger water supply systems, these software tools can be used as an additional solution. According to their functional characteristics these solutions do not meet all the basic requirements. The PUC "Vodovod Valjevo" successfully used Quantum GIS. This software is used to upload georeferenced cadastral plans and orthophoto basis. Given that the GIS department needed sophisticated software tools, this non-commercial solutions are seen as complementary and can be used in work places where entry is required and reading spatial data and where it is not planned expenditure and financial investment.

Rating of software solutions

According to the turbulent and dynamic software development, organizations that want to effectively use new technologies must review the decision of a chosen software. Once selected software solution will not be a permanent solution, it is justified at one time and one time interval. This period can not be defined in advance, but must be continuously performed evaluation of available software to help organizations always have the kind of software which is most appropriate at a given moment. Check and reviews of software in water supply systems should be carried out once half-yearly.

Organizational procedures

Organizational proceduras are a necessary prerequisite for effective GIS. Applying and defining redesigned and brand new procedures enable achieving a higher level of management. Organizational procedures must cover all aspects of the GIS team work, and the work of all departments which own data entries in a single

database. In PUC "Vodovod Valjevo" case were redesigned management procedures for defining the consumer, measuring points and measuring devices. Completely new organizational procedures created for entry of digitized projects, with all the objects and associated attributes, they are set as a prerequisite in creating.

Rating of defined organizational procedures
It is necessary to observe organizational procedures and re-review them, also and pre-defined stages. This procedure is necessary to carry out semi-annually. If determine the need for change then should redesign organizational procedures and defines an entirely new organizational procedures.

Evaluation of the first phase of the introduction of GIS technology
Represents a phase of measurement and control of the results achieved in increasing organizational effectiveness . GIS technology as a basis for raising organizational effectiveness has a purpose only if the coefficient of efficiency of the water supply system is stagnant or has grow. In the event of an unexpected fall of the coefficient, estimate of the first phase of introducing GIS is not positive, and expected results are not satisfactory. If this ratio declined it is necessary to determine the cause and to define strategies for proactive action. In the PUC "Vodovod Valjevo" the expected increase of this ratio for the first phase is only 1-2%. The low level of increase of organizational effectiveness is due to the fact that this is the introduction of new technologies whose implementation takes time to train all staff and work on the application of the use of GIS database can not go completely synchronized, but about using can speak only after 0,5-1% of the base is formed. Evaluation of the first phase should be carried out after the formation of 2,5% of the total base.

Rating the second phase of the introduction of GIS technology represents the second phase of the measurement and control of the results achieved in increasing organizational effectiveness. In the PUC "Vodovod Valjevo" the expected increase of this ratio for the second stage is only 2.5-5%. At this stage it is expected a significant increase of organizational effectiveness. It is assumed that the staff have sufficient training, the technology is fully integrated and therefore the coefficient can not be dramatically lower than expected. The second phase of the evaluation should be carried out after the forming up to 5% of the total base.

Quarterly evaluation and control (include a review and re-consideration of the first 10 points). Period of introducing GIS project in the water supply system should be divide into smaller cycles of time. These cycles should not be less than 4 months. After the end of each cycle should determine the coefficient of organizational effectiveness. This ratio can vary according to the number of available personnel involved in the operation, their training level, the type of used technology and method of application. This phase is presented by activity number 16 on the Gantt chart 1 (Figure 1).

	Task Name	Duration	Start	Finish
1	**PROJECT of GIS introduction**	**130 days**	**Fri 1.11.13**	**Thu 1.5.14**
2	The decision on implementation of GIS technology	5 days	Fri 1.11.13	Thu 7.11.13
3	Measuring justifiability of decisions	2 days	Fri 8.11.13	Mon 11.11.13
4	Forming the team	11 days	Tue 12.11.13	Tue 26.11.13
5	Review of the decision of all team positions	3 days	Wed 27.11.13	Fri 29.11.13
6	Hardware-technical structure	12 days	Mon 2.12.13	Tue 17.12.13
7	Review of the hardware-technical structure justification	3 days	Wed 18.12.13	Fri 20.12.13
8	Software solution	11 days	Mon 23.12.13	Mon 6.1.14
9	Rating of software solutions	3 days	Tue 7.1.14	Thu 9.1.14
10	Organizational procedures	15 days	Fri 10.1.14	Thu 30.1.14
11	Rating of defined organizational procedures	2 days	Fri 31.1.14	Mon 3.2.14
12	Evaluation of the first phase of the introduction of GIS	4 days	Tue 4.2.14	Fri 7.2.14
13	Data collection	22 days	Mon 10.2.14	Tue 11.3.14
14	Evaluation of the second phase of the introduction of GIS	4 days	Wed 12.3.14	Mon 17.3.14
15	Data collection 2	23 days	Tue 18.3.14	Thu 17.4.14
16	Quarterly evaluation and control (include a review and re-consideration of the first 10 points.	10 days	Fri 18.4.14	Thu 1.5.14

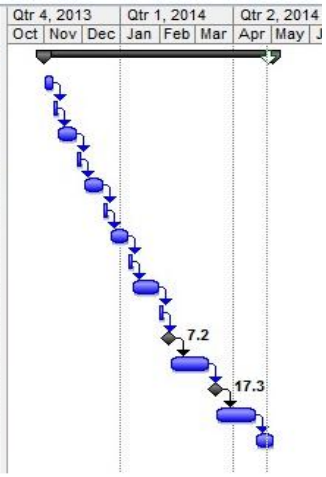

Figure 1: Gantt chart activities of GIS technology introduction

3. THE MAIN EFFECT OF INTRODUCING GIS TECHNOLOGY AT AFOREMENTIONED METHOD

The most significant direct effects of implementation are:

- the impact on the effectiveness;
- ecologically sustainable development;
- impact on the development of information systems;
- raising the professional competence of employees and

- a higher level of organization.

The impact on economy increasing
Large losses in water supply systems is the losses of water that is not invoiced to final consumers, but it is distributed in the system. The loss of water that is not billed to the final consumers, measured by the percentage is moving at about 50%. In water systems that are more economical, this percentage is much lower leads to a level below 10%. The aim of the PUC "Vodovod Valjevo" is phase shift implementation of GIS as a basis for measuring losses in the network. In this way in phases will be revealed and losses in the network. By detecting network losses and their elimination we will increase economy of the water supply system. In case of PUC "Vodovod Valjevo" long term goal is phased shift reduction of losses and bringing to the desired level of about 10%. The expected level of economy increasing is about 5% by looking at each phase of the implementation of GIS respectively.

The introduction of GIS technology in water supply systems form the basis of respecting principles of environmental management and the basic application of ecological strategies in their business. In fact, since water supply systems encompass a large amount of water they greatly affect the environment. Along with the increased environmental awareness and the need to introduce sustainable development there is and the growing need to introduce all forms of technology that will contribute to environmental protection. GIS technology has been used in water supply systems as a basis for the analysis of water losses in the network is a necessary condition for the respect of the principles of environmental management. The basic principle of environmental management that will be accepted is the principle of change in consumption patterns. The water in the system will be distributed with respect to this principle as the water system to be operated in this manner classified as environmentally responsible system.

The impact on the development of information systems,
Geographic information system viewed as part of the information system of organization aims to increase the effectiveness of water suplly systems. In fact, in a common base of information system enter data collected by GIS technology. These data is available to all users of the information system. In this way, the impact of GIS on the overall information system is very large. The most significant benefit of this way of linking is the availability of spatial data. PUC "Vodovod Valjevo" is in the process of integration of geographic information system.

A higher level of organization.
Geographic information system is not goal in itself, but should be seen as a means to achieve the strategy of raising the effectiveness of the organization. In water supply systems, GIS should be implemented in a way to raise the level of organization of the system. Introducing of GIS must follow, redesigning the organizational structure, defining organizational roles and tasks. The introduction of GIS has to follow the definition of completely new procedures that have not existed. In this way, occurs complexity of the organizational structure but only In this way GIS contribute to the development of the entire organizational structure and then we can talk about a higher level of organization. Procedures must cover all aspects of work with GIS in order to avoid situations that GIS remains an isolated part of the system.

Raising the professional competence of employees
All employees can be divided into two groups. The first group consists of persons who will use the information from the database, these employees expand their knowledge in the use of spatial data. The number of this employees will be equal to the number of personal computer users within the information system, which means that practically all users of the information system have access to information collected by GIS technology.The second group of employees are members of the GIS team. These members will be able to use themselves all the software and all the GIS hardware. Also, they will expand knowledge and gain new experience in organization, environmental management and information system. Their knowledge and experience will expand by the seminars, forums and direct benchmarking with organizations that have adopted GIS.

4. CONCLUSION

Geographic information systems in water supply systems is the basis for increasing organizational effectiveness . Geographic information system should be considered as part of the overall information system within the organization and as such it needs to be fully integrated with business information system. Only in this way, from information system can be expected maximization of results . All water supply systems are required to define as one of the goals of their business implementation of geographic information system. This objective is necessary to set, but and begin its implementation . The realization of this project does not always and in every case must be limited in terms of the water supply system is not able

to allocate some funds. Water supply systems can start this business with minimal financial investment,by engaging human potential. Water supply systems that do not have these resources can hire external consultants.

With the introduction of geographical information systems in water supply systems will achieve the expected raise of organizational effectiveness. The introduction of GIS technology we expect realization of direct effects: increase of economy, environmentally sustainable development, impact on the development of an information system, raising the professional competence of employees and higher level of organization . All direct effects are already achieved in the PUC "Vodovod Valjevo ."

REFERENCES

Lama., (2014), Tehnička specifikacija, Pitney Bowes Software

Docus., (2014), Tehnička specifikacija, Map Soft

Stajčić Dejan, (2012), The selection of software for the information system in utility service department „Vodovod in Valjevo“, University of Belgrade Faculty of Organizational Science

Esri., (2014), retrieved from http://www.esri.com/

Vavpotič, D., Vasilecas, O., (2012), Computer Science and Information Systems, Selecting a Methodology for Business Information Systems Development: Decision Model and Tool Support, ComSIS Vol. 9, No. 1.

IMPROVING SERBIAN HEALTHCARE SYSTEM WITH "FIND A MEDICINE"

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Abstract: *The main objective of this paper is to present a software system developed to provide access to data of public interest related to Serbian healthcare system. The focus will be on pharmaceutical institutions and information regarding medicines and their availability in pharmacies. The software integrates and centralize all relevant information from all healthcare institutions in Serbia. As a result, the system provides benefits to all stakeholders: citizens, healthcare institutions and National Health Insurance Fund (NHIF). Citizens can find the nearest pharmacies that has medicines they need at the time. Healthcare institutions integrates data from all organization units - pharmacies, enabling efficient medicines stock management. For the first time NHIF have access to accurate stock level for all medicines in all pharmacies in Serbia. NHIF uses the system to analyze the data in order to make decisions concerning procurements, rationalization, control raising performances and cutting costs of healthcare system. Software system is consisted of four integrated modules. Medicines search is provided in the form of web application at NHIF official website, and on Healthcare institutions websites, and also in the form of Android application for smart phones. Besides the system contains data integration module and analysis and reporting module.*

Keywords*: data of public interest, Serbian National Health Insurance Fund, Find a medicine, Medicines stock level, Software*

1. INTRODUCTION

The economic situation in the Republic of Serbia and inefficient management of the healthcare system has led to major problems in the functioning of almost all of its parts. This situation affected the healthcare institutions at almost all levels of healthcare system. Frequent shortages of medicines and medical supplies, increasing waiting lists, insufficient capacity to provide healthcare services are just some of the key issues facing the healthcare system.

NHIF has recognized these problems and set up a high priority level to resolve them. NHIF has performed a detailed analysis of the state of the healthcare system in order to determine the precise steps that will help to solve each of these problems. During the analysis it was determined that many health care institutions, and consequently the NHIF does not have information that are the indicators of the success of performing their activities. On the other hand, there are institutions that have well-maintained information systems and the necessary information, but this information in different institutions vary in content and structure. This situation did not meet the requirements of the users of the healthcare system. They did not have access to the necessary information related to healthcare. Also, due to incomplete and different data structures any attempt to aggregate data analysis by NHIF at the republic level was very difficult. That is the reason why increasing access to data of public interest have been identified as one of the preconditions in solving pressing problems. Yasnoff et al (2000) point out that "development of effective public health information systems requires understanding public health informatics (PHI), the systematic application of information and computer science and technology to public health practice, research, and learning".

The focus of this paper will be on pharmaceutical institutions and information regarding medicines and their availability in pharmacies. Frequent shortages and unbalanced distribution of medicines in healthcare institutions resulted with serious threats to the health condition of the insured persons. Also, it happens that old people and people with serious medical conditions visit several pharmacies in order to find a required medicines. Many pharmacies did not implemented any kind of searching of medicines stock level, while searching the medicines stock level at the republic level was out of the question.

The subject of this paper is the importance of transparency and functional integration of pharmacies data of public interest on a daily basis in order to improve the functioning of the healthcare system as a whole. Leape et al. (2009) proposed to increase the level of transparency as one of the measures to increase the level of organization of the healthcare system. In this way it can be ensured:

- uploading the medicines stock level on a daily basis in order to perform procurement of necessary medicines,
- perform their uniform distribution by pharmacies as it would not happen that in the a city or part of the city there is no required medicine, and in other has more than necessary. This leads to accumulation of inventories and hence unnecessary costs,
- provide a stable supply of medicines which would prevent possible shortages and
- simplifies the way users of healthcare services find required medicines

2. DATA OF PUBLIC INTEREST

The most important step toward better healthcare system was to identify the data of public importance which health care institutions have to make accessible on a daily basis. Primarily, it was necessary to define the unique structure of the data in order to enable adequate integration and analysis.

NHIF management board made a decision on data which will be mandatory as a content of a website of every health care institution and forced them to operate in accordance to this act. This act was published in Official Gazette no. 52 and was applicable from 14th of June, 2013.

NHIF made detailed specification of the data which every type of health care institution have to make public. This specification divided data to set of categories for every type of health care institution. So we have:

- Primary health care level
- Secondary and tertiary health care level
- **Pharmaceutical institutions**
- **Pharmaceutical institutions founded by means of private property that have signed contract with NHIF**
- Rehabilitation facilities
- Department of Public Health and the Institute

This paper is focused to pharmacy institutions, and relevant information identified are:

- Medicines - part regarding data of medicines that are financed from obligatory health insurance. This provides insured persons, health care institutions, medicine manufacturers and public in general to have insight to the information of the medicine
- Medicines stock level - related to the stock level of medicines, implant materials and medicine devices based on information provided by health care institutions.

This way NHIF standardized and simplified gathering of information from all pharmaceutical institutions and enabled centralized data analysis, better stock optimization and easier medicine search. Leape et al (2009) argues that all this leads to cost reduction and increasing satisfaction and trust of insured persons in the health care system.

It is very important to point out that along with the public pharmaceutical institutions which consists NHIF pharmacy network, this system includes pharmaceutical institutions founded by means of private property that have signed contract with NHIF to issue the prescription medication. This doubled the number of pharmacies and made medicine search easier and much more useful. On the other hand pharmaceutical institutions founded by means of private property that have signed contract with NHIF have opportunity to promote themselves and increase the sale.

3. FIND A MEDICINE

The software system that is the result of this project provides accessibility of data regarding the level of stock of medicines and medical devices as the information of public interest for each pharmaceutical institution and all associated pharmacies, as well as the centralization of these data for the purpose of business analysis.

This project was implemented as a Content Management System (CMS) which, in addition to functionalities related to input and display of data enables the functionalities related to the processing and analyzing the collected data.

The project has been realized through the implementation of three web applications and one android application which together constitute content management system. One web application is designed for employees of health care facilities and provides data entry concerning stocks of medicines in a pharmaceutical institution. Data entry is enabled by using web forms that are an integral part of the Content Management System. Users can upload the XML file which reduces the work load of employees. Another web application is meant to employees in NHIF and enables data analysis in order to improve control and

business operations. The third web application and Android application allows all citizens to access information of public interest and enables them to search of medicines they need.

Figure 1 shows the designed software applications. All business logic is located on the application server at NHIF, and communicates with a database server. The following applications has been developed, targeted to different user categories:

- The citizens - have the opportunity to view and search information of healthcare institutions. The ability to search the data is provided in two different ways:
  - Using a web application, which requires a web browser. It is available at http://rfzo.rs/index.php/component/content/article/16-infolekovi/2012-10-29-12-35-11/501-pronadji-lek,
  - Using the mobile application, which requires Android mobile phone. Application is free and available for download at https://play.google.com/store/apps/details?id=rs.rfzo.apoteke&hl=en. Pan et al. (2007) point out that mobile devices are getting smaller, smarter, and more connected, any time and any access to any information while on the move. According to Noordam et al. (2011) mobile devices are widely used within the health system.
- The pharmaceutical institution - responsible for entering and updating the data. This information is available to citizens and the NHIF.
- The National Health Insurance Fund - have the possibility of analyzing the data and creating business reports

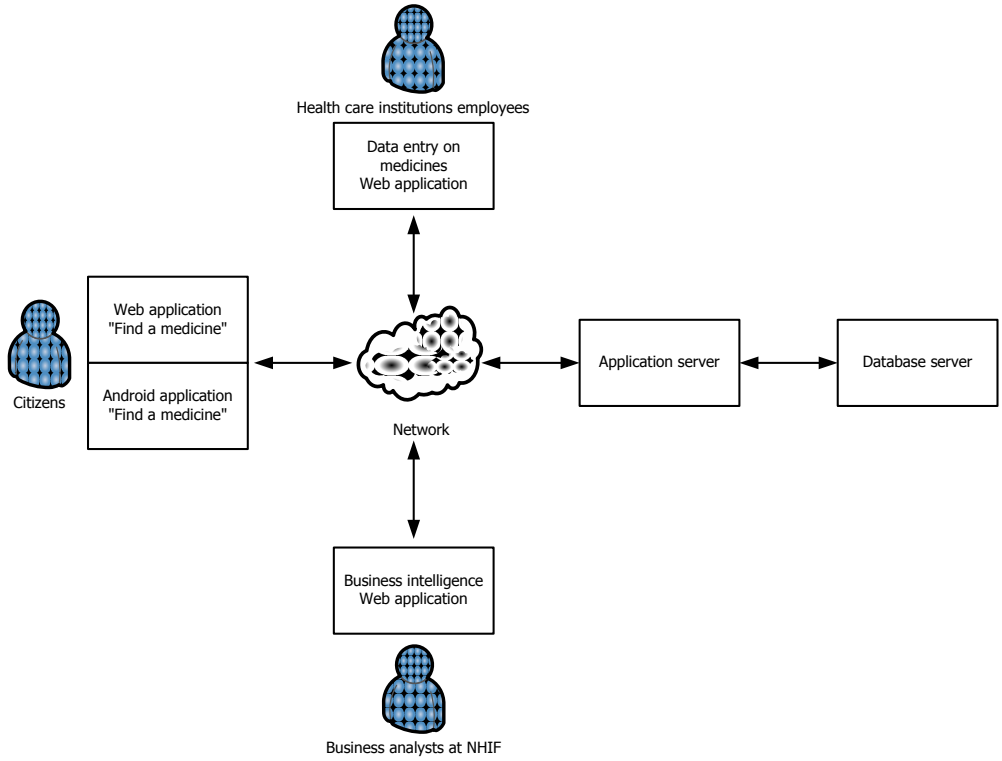

Figure 1: Designed software applications

The system enables all citizens to search the stock levels for all medicines and to find the pharmacy that is closest to the users location, and have the searched medicines on the stock at the moment of search. In addition, citizens are able to report all observed problems in system operation, especially in case the pharmacy refuses to issue a medicine while the stock level the pharmacy reported for requested medicine shows positive value. In this way, NHIF got another controlling mechanism and the ability to quickly react so to prevent these situations in future.

Table 1 represents the number of pharmacies in each branch office of NHIF. Numbers includes the public pharmacies and also the pharmacies founded by means of private property that have signed contract with NHIF.

Table 1: Number of pharmacies included in the system

Branch	Number of pharmacies
Belgrade branch	668
Bor branch	36
Valjevo branch	54
Vranje branch	50
Zaječar branch	21
Zrenjanin branch	64
Jagodina branch	59
Kikinda branch	63
Kragujevac branch	67
Kraljevo branch	44
Kruševac branch	23
Leskovac branch	73
Niš branch	127
Novi Pazar branch	24
Novi Sad branch	212
Pančevo branch	122
Pirot branch	29
Požarevac branch	49
Prokuplje branch	18
Smederevo branch	120
Sombor branch	65
Sremska Mitrovica branch	67
Subotica branch	87
Užice branch	39
Čačak branch	40
Šabac branch	107
TOTAL:	**2328**

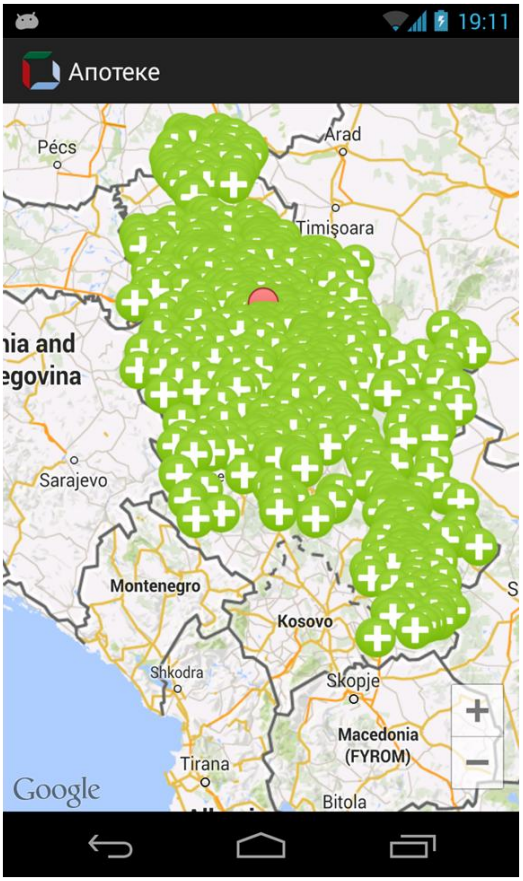

Figure 2: Each "+" sign represents a pharmacy that uploaded accurate medicines stock level

Information about the current medicines stock level at pharmaceutical institution can be submitted in the form of XML (Extendable Markup Language) document. It should be noted that the institution may submit an XML document that applies to all pharmacies in its network, but also any pharmacy can separately submit their medicines stock level. This way the flexibility is achieved because pharmaceutical institution at its sole discretion choose how to submit the data.

XML has become the standard for data exchange between systems. Based on the current medicines stock level in pharmaceutical institution the information system generates the XML document. The generated XML document must be well-formed and valid. For validation of XML documents it is necessary to use pre-defined XML schema. According to Varlamis & Vazirgiannis (2001), the schema can be used to validate the structure of the XML document automatically. An example of the generated XML document is shown in Figure 3.

```
<?xml version="1.0" encoding="UTF-8"?>
<PharmacyMedicineQunatitiyView>
      <PharmacyMedicineQunatity>
            <Pharmacy>32212133</Pharmacy>
            <OrganizationUnits>
                  <OrganizationUnit>1</OrganizationUnit>
                  <Dates>
                        <Date date="2013-06-18">
                              <JKL>0010200</JKL>
                              <Quantity>4.404</Quantity>
                              <JKL>0011551</JKL>
                              <Quantity>8.681</Quantity>
                              <JKL>0011553</JKL>
                              <Quantity>80.790</Quantity>
                              <JKL>0011841</JKL>
                              <Quantity>89.300</Quantity>
                              <JKL>0011856</JKL>
                              <Quantity>26.762</Quantity>
...
                        </Date>
                  </Dates>
            </OrganizationUnits>
      </PharmacyMedicineQunatity>
</PharmacyMedicineQunatitiyView>
```

Figure 3: "Medicines stock level" XML document

As presented, the "Medicines stock level" XML document contains following elements:

- **Pharmacy** - represents the identification number of pharmaceutical institution. The identification number must be in accordance with unified health institution registry at NHIF.
- **OrganizationUnits** - a complex element consisted of the list of all organizational units - pharmacies, and medicines stock level for a date for all organizational units.
- **OrganizationUnit** - represents the identification number of the concrete organizational unit - pharmacy. The identification number must be in accordance with unified health institution organizational units registry at NHIF.
- **Dates** - represents a complex element consisted of medicines stock levels for specified dates for a concrete organizational unit - pharmacy.
- **Date** - represents an element that contains attribute Date of medicines stock level.
- **JKL** - represents the identification code of medicine. This code must be in accordance with unified medicines registry at NHIF.
- **Quantity** - represents the available quantity of the concrete medicine at specified date at the specified organizational unit, at the specified pharmaceutical institution.
- In **Date** element, elements **JKL** and **Quantity** is repeated, and **Quantity** is given for each **JKL**.

The information system of pharmaceutical institution or pharmacy must provide the validation mechanism because only valid documents can be uploaded and integrated in the system. Figure 4 shows the algorithm for creation and uploading the Medicine stock level XML document at the system.

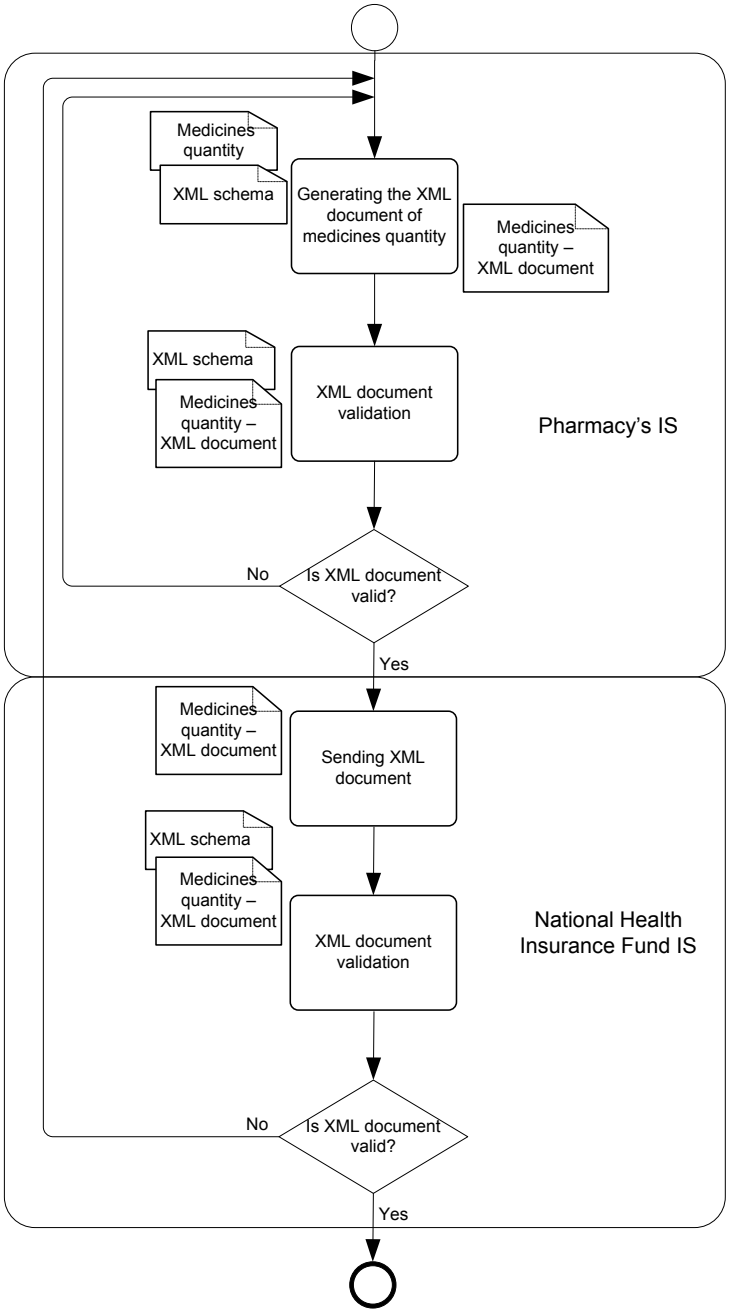

Figure 4: The algorithm for creation and uploading the Medicine stock level XML document

As a development platform of this system the JavaEE (Java Enterprise Edition) has been used:

- Java Server Faces - JSF as user interface of the web application. According to Mann (2005), JSF includes a set of web-based HTML controls and mechanisms for event processing. For each pharmacy is being displayed the position on a map, working hours, phone number and available quantities of required medicines in order to provide all necessary information so the user can get his medicine quickly. Web application user interface is shown in Figure 5.
- Enterprise Java Beans - EJB as business logic of the system, running on the GlassFish application server.
- Android SDK - used as the user interface of the application running on the Android operating system. Whipple et al (2009) point out that Android allows the development of innovative applications that can fully take advantage of the device's hardware (e.g. access to location services based on GPS system). Using location service applications become aware of the environment (position of user) of the execution. For each pharmacy is being displayed the position on a map, working hours, phone number and available quantities of required medicines. Android user interface is shown in Figure 6.
- Microsoft SQL Server 2012 database server as relational database. Madsen (2010) argues that relational data modelling presents power and most-popular database design method.

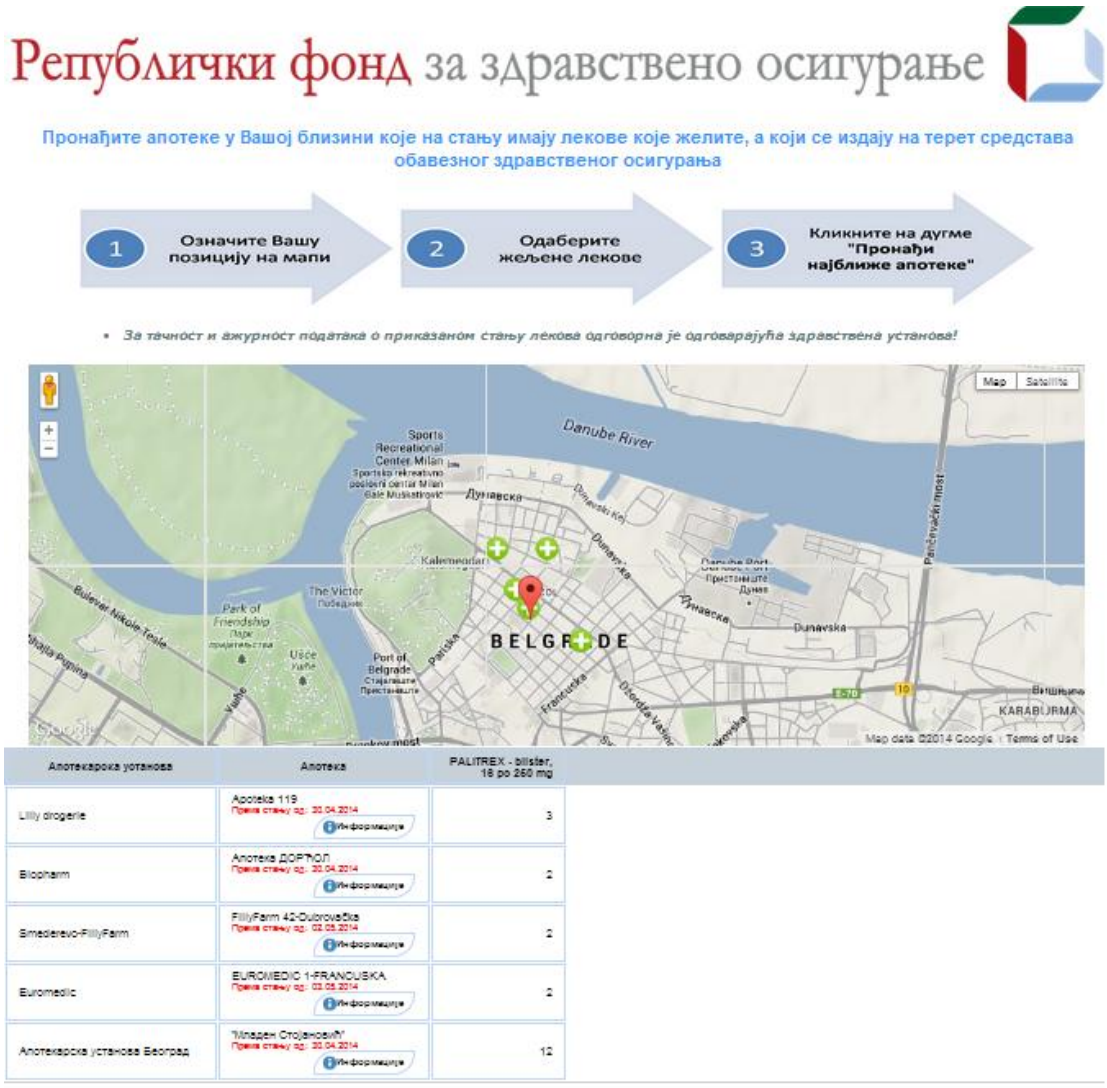

Figure 5: User interface of the "Find a medicine" web application

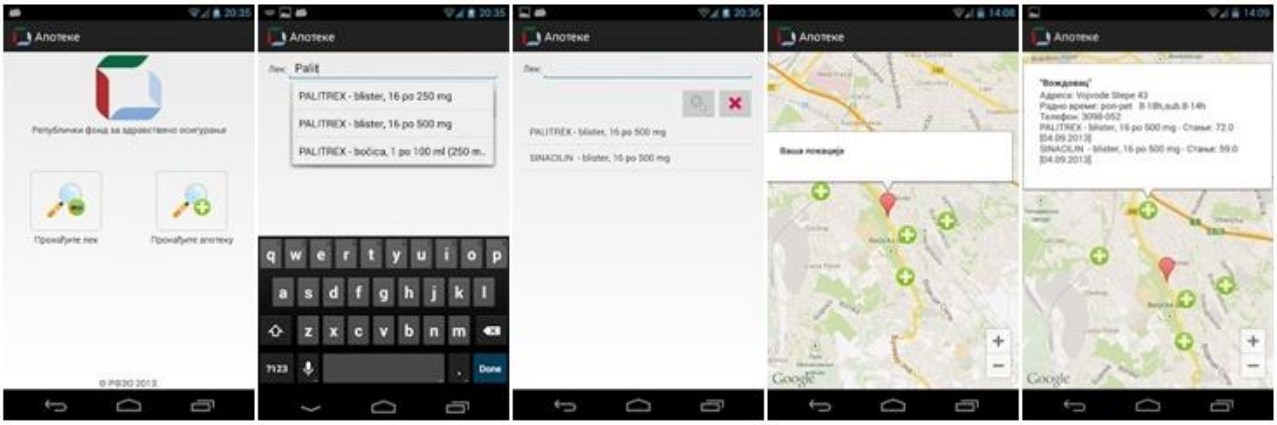

Figure 6: User interface of the "Find a medicine" Android application

These technologies are stable and supported by the largest software companies. In this way, applications which have been created are scalable and easy to maintain. These technologies are widely accepted and have strong support in the open-source community.

4. CONCLUSION

This paper presented software system which supports availability of pharmaceutical institution's public data, their integration and centralized collection. This data were identified as very important for both: users of health care insurance and NHIF.

One of the goals of this system was to provide centralized data analysis and better medicine stock control. In order to do that NHIF standardized the data of pharmaceutical institutions relevant for medicine stock management. Health care institutions have to send medicine stock level information in requested XML format on daily basis. This data are checked and saved in NHIF central data storage. As stated before, this enables centralized analysis, stock level optimization and provides possibility to find nearest pharmacies that have requested medicines. System also offers a possibility to make an irregularity report (inconsistency of medicine stock data provided on the website with real stock level in the pharmacy) which can be used as an additional measure of control.

As a result, the system provides benefits to all stakeholders: citizens, healthcare institutions and NHIF. Citizens can find the nearest pharmacies that has medicines they need at the time. Healthcare institutions integrates data from all organization units - pharmacies, enabling efficient medicines stock management. For the first time NHIF have access to accurate stock level for all medicines in all pharmacies in Serbia. NHIF uses the system to analyze the data in order to make decisions concerning procurements, rationalization, control raising performances and cutting costs of healthcare system.

REFERENCES

Leape, L., Berwick, D., Clancy, C., Conway, J., Gluck, P., Guest, J., Lawrence, D., Morath, J., O'Leary, D., O'Neill, P., Pinakiewicz, D. & Isaac, T. (2009). Transforming healthcare: a safety imperative, Qual Saf Health Care 2009;18:424-428

Madsen, M. (2010). Knowledge and information modelling. Health informatics (Vol. 151). IOS Press

Mann, K. D. (2005). Java Server Faces in Action. Dreamtech Press.

Noordam, A. C., Kuepper, B. M., Stekelenburg, J., & Milen, A. (2011). Improvement of maternal health services through the use of mobile phones. Tropical Medicine & International Health, 16(5), 622-626.

Pan, B., Crotts, J. C., & Muller, B. (2007). Developing Web-Based Tourist Information Tools Using Google Map. In ENTER (pp. 503-512).

Varlamis, I. & Vazirgiannis M. (2001). Bridging XML-schema and relational databases: a system for generating and manipulating relational databases using valid XML documents. DocEng '01 Proceedings of the 2001 ACM Symposium on Document engineering

Whipple, J., Arensman, W. & Boler, M.S. (2009). A public safety application of GPS-enabled smartphones and the android operating system. Systems, Man and Cybernetics, SMC 2009. IEEE International Conference on , vol., no., pp.2059,2061, 11-14 Oct. 2009

Yasnoff, W. A., O'Carroll, P. W., Koo, D., Linkins, R. W., & Kilbourne, E. M. (2000). Public health informatics: improving and transforming public health in the information age. Journal of Public Health Management and Practice, 6(6), 67-75.

AHP DECISION SUPPORT IN SLA NEGOTIATION[1]

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Abstract: *This paper analyses business-related Service Level Agreement (SLA) lifecycle phases. Focus is on SLA negotiation phase from user's perspective, where user may be end user or another service provider. Analytical Hierarchy Process (AHP) is chosen as a method for multi criteria decision making analysis. Goal is set to be SLA election among all offered SLA templates. Relevant criteria are defined by user's preference. Alternatives are SLA templates offered by service providers.*

Keywords*: service provider, user, SLA, lifecycle, negotiating, AHP*

1. INTRODUCTION

Service Level Agreement (SLA) is a contract between the service provider and the user which defines all technical, financial and legal aspects related to a particular service (Hasselmeyer, Merschr, Koller, Quyen, Schubert, Wieder, 2007). The term "user" can be regarded to an end-user, or another provider. The negotiation between service provider and user is based on a SLA template, which defines parameter ranges of service characteristics supported by the service provider. SLAs contain Quality of Service (QoS) properties that must be maintained by a provider during service provisioning. These properties, defined as a set of Service Level Objectives (SLOs), should be measured and monitored during the time period of provisioning the particular service that has been agreed in the SLA. The SLA must also contain a set of penalty clauses which could be applied in cases when service providers do not meet the agreed conditions of SLA. Specification, monitoring and identification of how SLOs may be impacted by the choice of specific penalty clauses are not straightforward. The participation of a trusted mediator may be necessary in order to solve conflicts between involved parties. Automating this conflict resolution process may provide substantial benefits. There are several possible outcomes. These include monetary penalties, impact on potential future agreements between the involved parties and the enforced rerunning of the agreed service. There are a number of concerns when issuing penalties for SLA noncompliance (determining whether the service provider is the only party that should be penalized, or determining the type of penalties that are applied to each party). Usage of monetary penalties requires certain payment system. Knowing the provider"s reputation, user can make decisions regarding the best service provider for a specific task. Reputation, based on the previous behaviour of the provider, can be represented as a numerical value quantifying compliance to one or more SLAs. This value can be used by other users to determine whether or not to negotiate with specific provider. In this paper, we focus on user perspective of SLA negotiation phase where user must evaluate all offered SLA templates and finally choose service provider to sign an agreement with.
The paper is organized as follows. After introductory remarks, second part of this paper analyses all stages of SLA lifecycle: planning and development, negotiation and sales, implementation, operation and maintenance, periodic assessment of the Quality of Service (QoS). Third part represents analysis of negotiation phase from user"s perspective. Several criteria and parameter ranges are defined according to user preferences. AHP is chosen as the most appropriate multi criteria decision making method. Concluding remarks are given at the end of the paper.

2. SLA LIFECYCLE

SLA lifecycle consists of at least five phases, as shown in Figure 1, (Stojanovic, Bostjancic-Rakas, 2009):

- Planning and development – considers a number of QoS and SLA aspects. It defines generic parameters and technology-specific parameters; design and development of SLA template that ensures that offered QoS guarantees are realistic;

[1]This work is partially supported by Ministry of Education, Science and Technological Development of the Republic of Serbia under No. 32025.

- Negotiation and sales – a service provider must negotiate and agree with the user about technical details of a service, where QoS parameters may be customized or the same as those offered in the standard template;
- Implementation – configuration and activation of the service, beginning of operation;
- Operation and maintenance –monitoring and operation, real-time QoS reporting and service quality validation and real-time SLA violation handling;
- Periodic assessment of the QoS and whether it meets the SLA –scheduled during a single user SLA agreement period where the assessment is related to the delivered QoS against the SLA parameter values and limits, and the levels of user satisfaction with the service product.
-

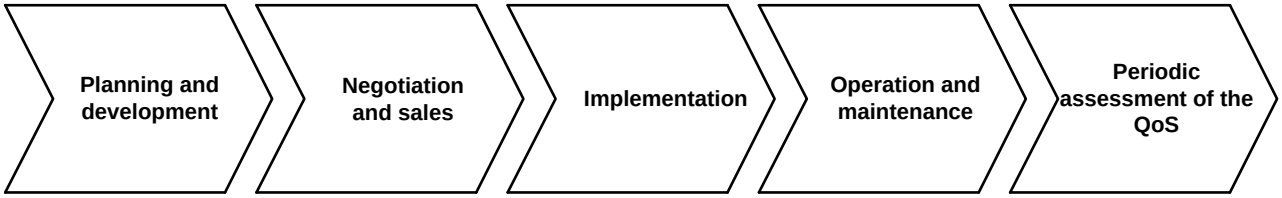

Figure 1. SLA lifecycle

SLA contains, among others, a service description and a list of guarantee terms that describe the duties of the involved parties, i.e. guarantees given by the provider and obligations to be observed by the user. The provider guarantees the fulfilment of specific service level objectives on well-defined metrics, and the payment of penalties - compensation in case of violating a service level objective (Schulz, 2011).The SLOs may include service availability, user response time, service response time, service outage resolution time etc.(Raju, Dhivya, Saranya, Abbinaya, 2013).
The negotiation between service provider and user is usually based on a SLA template. A template defines parameter ranges of certain service characteristics which are supported by the service provider. In the simplest case, there are no parameter options for the user. User can either accept the given offer or reject it. More complex negotiations are also possible (Andrieux, Czajkowski, Dan, Keahey, Ludwig, Nakata, Pruyne, Rofrano, Tuecke, Xu, 2006).

2.1 Template specification

Business practice in specification of SLA templates is not often economically efficient and present obstacle to successful business operation (Taylor & Tofts, 2006). A particular challenge for the specification of SLA templates is to obtain an understanding of the dependency between technical and business aspects. Definition of an evaluation function that maps each possible SLA template to a scalar scoring value that can be interpreted economically may address before mentioned challenges. The function is based on technical characteristics of the service provider, and gives a business-relevant evaluation of the SLA template. Thus, the evaluation function combines technical and business parameters from each SLA template into a single scoring value. Usually, many SLA templates result in the same score and a landscape of scoring values is formed. This landscape and its visualization provide a useful decision support for the selection of SLA templates that are actually offered to potential users. The final decision of the service provider is based on additional information like market situation and analysis of competitors (Schulz, 2011).
The approach for designing SLA templates by defining a scoring function on the space of all possible SLA templates is proposed in (Schulz, 2011). This methodology is depicted in Figure 2.

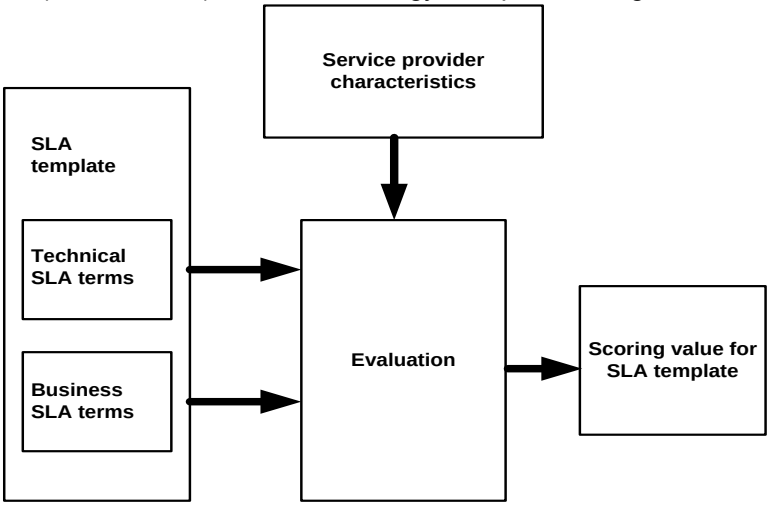

Figure 2. Designing SLA templates (Schulz, 2011)

The guarantee terms in a SLA specify allowed ranges for quality metrics and business value parameters like price and penalties. The technical terms express service level objectives by defining thresholds on the quality metrics. The fulfilment of objectives is evaluated over a defined time period. If the objectives are not met, an agreed penalty has to be paid by the provider. This can be a monetary payment or a period of free service usage, or some other form of compensation. The amount and calculation rule for the determination of penalty is defined in the business terms of the SLA.
Another input for the evaluation function is the service provider characteristic. This is a probability model for the quality metrics, based on empirical data of the service provider during past service operation (Dingle, Knottenbelt, Wang, L, 2008).
Metrics that can be observed are availability, response times, resource utilisations, throughputs and system productivity. Availability of the service is the ratio of time during which service is provided to users depending on the Mean – time – to Failure (MTTF) and Mean – time – to – Repair (MTTR). It can be represented as:

$$A = MMTF / (MTTF + MTTR) \quad (1)$$

Response time is the time from a user sending a request to receiving a response. SLAs are often concerned with means, variances, and percentiles of response times. Resource utilisation is the ratio of time for which a given resource is used by a given service. For example, it may be required that a service does not utilise more than 10% of available network bandwidth. Throughput is the average rate at which a given set of activities occurs. Productivity is a weighted sum of the throughput of a number of activities, where the weights are user specified rewards associated with completion of each activity. If the unit of the reward is financial, this measures a system"s profitability.
If the metrics depend on external parameters like varying user workload, the effect of external factors can be reduced by defining user obligations in the SLA and hence narrowing the range of external parameters. Combining the probability model for SLO metrics and the penalty model, an expected penalty can be derived. For each pair (target value, violation penalty) defined in the SLA template, the amount of expected penalty is calculated and represents the desired scoring value.

2.2 SLA negotiation

Many of the negotiation techniques can be applied for SLA such as game theory, time based decision making functions, machine learning, genetic algorithm, intelligent agents etc. Service negotiation is primarily based on decision making. In order to achieve rapid, effortless, and useful negotiation service, Analytic Hierarchy Process (AHP) might be used. AHP deals with many large, dynamic and complex problems. The advantages of AHP over other multi criteria methods are flexibility and ability to check the inconsistencies.

2.3 Monitoring

Monitoring of SLA begins once an SLA has been defined. A copy of the SLA must be maintained by all involved parties. It is necessary to distinguish between an „agreement date" (agreeing of an SLA) and an „effective date" (subsequently providing a service based on the SLOs that have been agreed) since a request to provide a service based on the SLOs may be undertaken at a time much later than when the SLOs were agreed. The monitoring infrastructure is used to identify the difference between the agreed upon SLO and the value that was actually delivered during service. It is necessary to define what constitutes a violation. Monitoring plays an important role in determining whether an SLA has been violated, and thereby determine which penalty clause should be applied as a consequence.
Providers" reputation and users" trust are largely based on the provided monitoring infrastructure. In the context of SLAs three monitoring modules can be distinguished: a trusted third party (TTP), a trusted module at the service provider, and a module on the user side. The trusted third party provides an independent module that can monitor all communication between users and service providers. After successfully completing the SLA all involved parties receive a signed ticket from the TTP that can be used for reputation building of the service provider. Trusted modules can also monitor communication between user and service provider and can similarly provide tickets after successful completion of an SLA. The main difference between TTP and trusted module is that the trusted module is integrated into the service provider. Thus, the internal state of the service provider can also be observed. However, their implementation is difficult. Usage of a module on the user side requires a user to determine if metrics diverge from the predicted behaviour of the service provider. In situations that require a high level of assurance, these monitoring modules can be combined. It is essential to monitor all relevant metrics and to provide all involved parties to retrieve such data in appropriate format.
Usually, a TTP module satisfies all required functionality for a monitoring service. Once a user and a service provider (SP) have created an SLA, the service provision is monitored by a TTP. This TTP can be a trusted module executing on the service provider"s system, or a server that is physically separated from the service provider. In all cases, the service provider must not have any access to the TTP, outside of the interactions that are properly defined. Built-in module and separate server are conceptually identical. However, the attacks on a built-in module can potentially be more difficult to detect. At the same time, user should have access to the TTP monitoring mediator for audit purposes, but without possibility to modify the data recorded

by the TTP. Messages are exchanged between the User (U), Service Provider (SP) and Trusted Third Party (TTP), as depicted on Figure 3. The TTP maintains a database of reputations (RDB), updating it whenever a provisioning takes place. The RDB is useful to import the reputation score at the beginning of a service provision and export it back at the end of the service provision so it can be used by other possible users. A user may also hold a local reputation value associated with a provider – based on monitoring the SLAs that it holds with a provider.

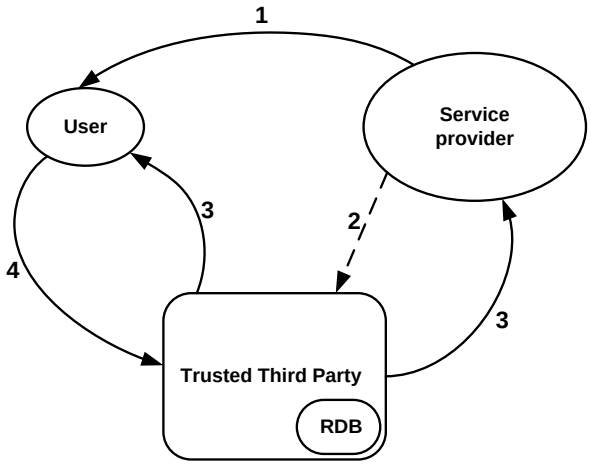

Figure 3. Messages exchange between the user, service provider and trusted third party

Whenever a service provider provides a service to a user (1), it is monitored by the TTP (2). This causes the TTP to update the reputation of the involved SP. The TTP sends a message to both the SP and the user notifying them about the update (3). User then sends a message containing its response (R) to the transaction. This response is used by the TTP to update the reputation of the service provider. Once the user sends its response, the TTP generates the new reputation of the service provider.

2.4 Types of violation

One of the main issues that the provider and the user have to agree during the SLA negotiation is the penalty scheme. Both the service provider and the user are free to decide what penalty to associate to the various types of SLA violations, in accordance with the weight of the parameter that was not fulfilled. Non-fulfilment comprises defective performance (parameter monitored at lower level), late performance (service provided at the appropriate level but with unjustified delays), and no performance (service not provided at all).

Based on these descriptions the following categories could be defined:

- All–or–nothing provisioning: provisioning of a service meets all the SLOs –i.e., all of the SLO constraints must be satisfied for a successful delivery of a service;
- Partial provisioning: provisioning of a service meets some of the SLOs – i.e., some of the SLO constraints must be satisfied for a successful delivery of a service;
- Weighted partial provisioning: provision of a service meets SLOs that have a weighting greater than a threshold.

Monitoring can be used for detection whether an SLA has been violated. Typically such violations result in a complete failure – making SLA violations an all-or-nothing provisioning process. In that situation a completely new SLA needs to be negotiated, possibly with another service provider, which requires additional effort on both the user and the service provider. Based on this all-or-nothing approach, it is preferable for the provider to satisfy all of the SLOs. An SLA typically contains several SLOs, where some SLOs may have higher priority than others. The importance of the different SLOs may be established during the SLA negotiation phase. Both user and service provider can then react differently according to the importance of the violated SLO. Weighted metrics can also be used to ensure a flexible and fair penalty mechanism in case an SLA violation occurs. Thus instead of terminating the SLA altogether it might be possible to renegotiate the violated part of the SLA. The more important the violated SLO is, the more difficult it will be to renegotiate the SLA.

2.5 Penalty clauses

Using penalty clauses in SLAs can lead to two questions that need to be answered: what types of penalty clauses can be used and how they can be included in SLAs. The focus is on penalty clauses for service providers. Behind the imposition of any contractual sanctions lies the idea that faulty behaviour of a provider should be deterred.

A penalty clause in an SLA may consist of the following:

- A decrease in the agreed payment for using the service – a direct financial sanction;
- A reduction in price along with additional compensation for subsequent interaction;
- A reduction in usage of service from the provider;
- A decrease of the reputation of the provider.

All parties involved in SLA negotiation can agree on a direct financial sanction for SLA violation. Usually, the amount to be paid depends on the value of the loss suffered by the user through the violation. Due to the difficulties in proving and recording the financial value of the loss, during the negotiation phase the parties may choose an agreed payment for non-performance that is a fixed monetary value that will have to be paid upon non-performance, regardless of the fact that no financial loss was suffered by the user. The service provider can deposit the negotiated penalty at a TTP that acts as a mediator, before the service provision commences. On successful completion of the service provision, based on the SLA, the TTP returns the deposit to the service provider; otherwise the user receives the deposit as compensation for the SLA violation. In this case, a trusted monitoring mediator is required since a user can never prove by itself that an SLA was violated. Another possibility is that a user reduces its usage of services from a provider that violated an SLA. A third kind of penalty clause can lead to a change in the reputation of a provider. In such a system the reputation of service providers that violate SLAs will decrease. Correct determination of the service provider"s reputation is necessary. In the SLA negotiation phase service provider and user can agree on which reputation mechanism to use.

2.6 Quantifying Reputation

Formally, an SLA consists of a collection of metrics $m=\{m_1, m_2, \ldots, m_n\}$ and time interval δt representing the period over which the SLA is valid. For each metric in an SLA its success or violation can be determined. Thus, success (m) takes value of 1 if metric m is fulfilled and value of 0 if metric m is failed.
The success rate φ of an SLA can be defined as the number of successful metrics relative to the total number of metrics n:

$$\varphi = \sum_{i=1}^{n} \frac{success(m_i)}{n} \tag{2}$$

Each metric can be weighted according to its relative importance for the user. Each weight, ω, can have a value between 0 and 1, where 1 means very important and 0 represents no importance to the user.
This gives the weighted success rate, τ:

$$\tau = \sum_{i=1}^{n} \frac{success(m_i)}{n} \times \omega_i \tag{3}$$

The weighted success rate, τ, of an SLA objectively quantifies how satisfied a user is with it. The weighted satisfaction rate, ψ, of a collection of SLAs can similarly be calculated:

$$\psi = \sum_{j=1}^{k} \frac{\tau_j}{k} \times \rho_j \tag{4}$$

where ρ represents a weighting factor that corresponds to the importance of each individual SLA, and k is a number of SLA contained in a given collection. Finally, the reputation, R, of a service provider can then be quantified by:

$$R = \sum_{l=1}^{p} \frac{\psi_l}{p} \tag{5}$$

where p represents number of all SLA collections. Initially, a service provider will obtain some default value for its reputation and as the number of agreements served increases its reputation will more accurately be reflected by R (Omer, Warnier, Quillinan, Brazier, Cojocarasu, 2008).

2.7 Termination

An SLA may be terminated in the following situations:

- when the service being defined in the SLA has completed;
- when the time period over which the SLA has been agreed upon has expired;
- when the provider is no-longer available after an SLA has been agreed (for instance, the provider is under liquidation).

In all three cases, it is necessary for the SLA to be removed from both the user and the provider. Where an SLA was used to provision a service, it is necessary to determine whether any violations had occurred during provisioning. As indicated above, penalty clauses are also part of the SLA, and need to be agreed between the user and the provider.

3. USER PERSPECTIVE OF SLA NEGOTIATION BASED ON ANALYTICAL HIERARCHY PROCESS

In this part of our paper, we analyse which SLA agreement user will choose among all possible SLA templates offered by the service providers. The decision is made using AHP. As mentioned above, AHP is very valuable decision making support. We suppose that user can either sign or reject offered SLA template, i.e. there are no parameter options for the user. Also, service provider offers one SLA template to one user. Various criteria along with alternatives for a particular problem can be implemented for SLA election. One example of possible criteria and alternatives are shown in Figure 4.

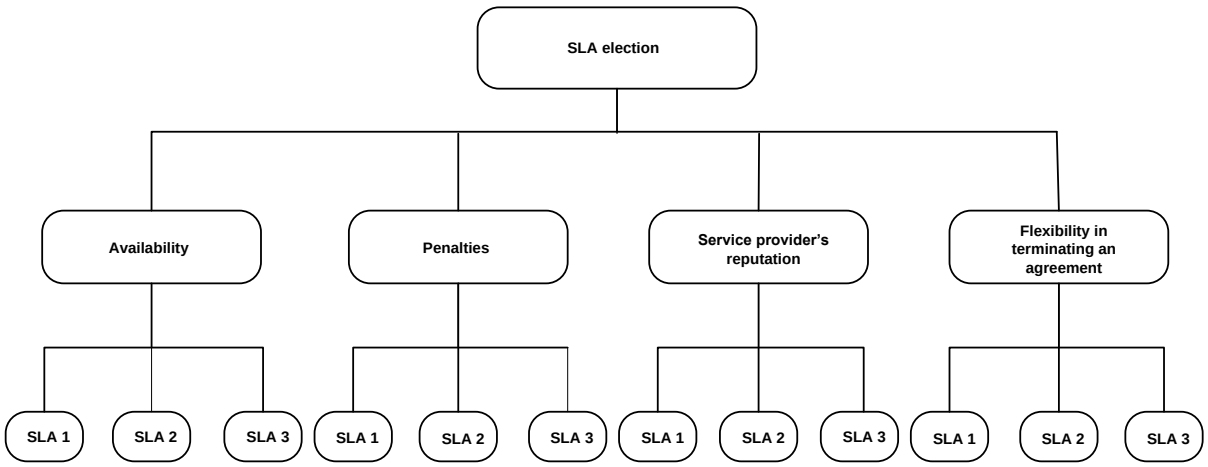

Figure 4. Structure of AHP decision making model

The user is choosing a service provider among three possible to sign an agreement with. Chosen criteria are availability, reputation of the service providers, penalty and flexibility in terminating an agreement. Availability is calculated using Eq. (1). We suppose that user prefers high availability, above 0.95. Reputation of service providers is monitored during previous service provisioning, and calculated using Eq. (5). We suppose that recorded data are available by TTP. Penalty clauses are defined in SLA negotiating phase. User has some flexibility in terminating an agreement on request under certain circumstances defined during negotiation. Relevant parameters in each SLA template are given in Table 1.

Table 1. Offered SLA templates

Relevant parameters	Service provider 1	Service provider 2	Service provider 3
Availability	0.967	0.941	0.982
Reputation	0.526	0.761	0.837
Penalty	20% price decrease	a month free of charge	30% price decrease
Flexibility in termination	compensation of all remaining financial obligations by user	compensation of 75% of all remaining financial obligations by user	compensation of all remaining financial obligations by user

We observe the two possible cases, regarding user preferences: (1) user is more sensitive in terms of availability and penalty clauses, and (2) user is more sensitive in terms of service provider"s reputation and penalty clauses. Obtained results are presented in Figure 5 and Figure 6, respectively.

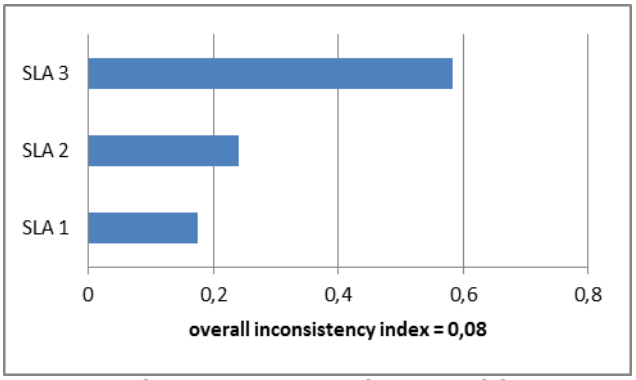

Figure 5. AHP results, case (1)

In the first case, both service provider 1 and service provider 3 offer high availability, above 0.95. Thus, an availability criterion is satisfied. From user"s perspective, penalties are also essential. Suppose that user prefers a certain time period of free service provisioning. Hence, service provider 2 is in advantage compared to service providers 1 and 3. Reputation of service providers is not essential in this case, but it is preferable to take higher values. Flexibility in terminating an agreement is also not essential, but user always prefers lower amount to be paid in the case of terminating an agreement before agreed SLA has expired. According to AHP, service provider 3 offers the best conditions and user will sign this agreement.

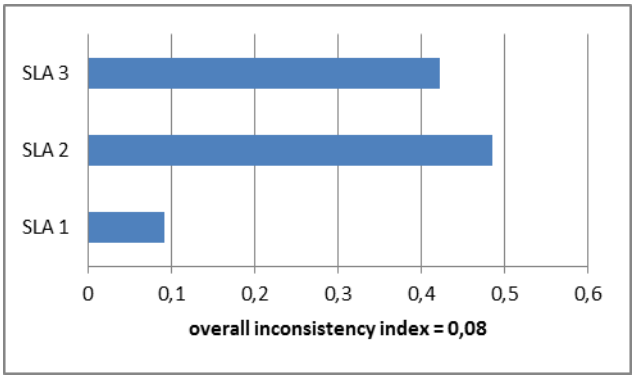

Figure 6.AHP results, case (2)

Case (2) presents the situation where user is more sensitive in terms of provider"s reputation based on previous service provisioning and penalty for SLA violation. As mentioned before, reputation is provided by TTP and it is preferable to be as high as possible. Penalties are also of great importance. Again, service provider 2 has advantage in comparison with other service providers, since user prefers a period of free service usage. Service availability and flexibility in terminating an agreement are not crucial. However, availability should be above 0.95 and it is preferable that user has possibility to terminate an SLA with the lowest financial compensation. Considering all criteria, service provider 2 best matches user"s requests. Thus, AHP suggests user to sign an SLA with service provider 2.

4. CONCLUSION

This paper presents business-related aspect of SLA through all lifecycle phases, from template design, through negotiation, implementation, operation, maintenance and monitoring to termination of an agreement. The focus is on SLA negotiation phase based on SLA templates. Essential challenge for the specification of SLA templates is to achieve understanding of the dependency between technical and business aspects. The proposed methodology for establishing a quantitative relationship between technical and economical parameters, which maps each SLA template to economical scoring value, is described. Monitored data in previous service provisioning are provided by mediator between service provider and user, Trusted Third Party. Service provider"s reputation is than calculated according to available recorded monitoring data. AHP is chosen as the most appropriate multi criteria method for decision support. Relevant criteria are set by user. Two cases are observed. The first one, when user is more sensitive in terms of availability and penalty clauses defined in SLA template, and the second one, when user is more sensitive in terms of service provider"s reputation and penalty clauses. In both cases, user obtains precise results with very low inconsistency index thus increasing a possibility of making satisfactory decision.

REFERENCES

Hasselmeyer, P., Merschr, H., Koller, B., Quyen, H.N., Schubert, L., Wieder, P. (2007, October). Implementing an SLA Negotiation Framework, Proceedings of the eChallenges e-2007 Conference.

Stojanovic, M., Bostjancic Rakas, S. (2009, December). Service Level Agreement in Next Generation Networks, XXVII Symposium on Novel Techlonogies in Postal and Telecommunication Traffic – PosTel 2009.

Schulz, F. (2011). Decision Support for Business-related Design of Service Level Agreements. 2nd IEEE International Conference on Software Engineering and Service Sciences.

Raju, R., Dhivya, D., Saranya, R., Abbinaya, S.I. (2013, February). SLA Negotiation for Web Service Consumption Based on Analytical Hierarchy Process. International Journal of Science and Modern Engineering, 1(3), 72-75.

Andrieux, A., Czajkowski, K., Dan, A., Keahey, K., Ludwig, H., Nakata, T., Pruyne, J., Rofrano, J., Tuecke, S., Xu, M. (2006, September). Web Services Agreement Specification (WSAgreement). GRAAP Working Group at the Open Grid Forum.

Taylor, R., Tofts, C. (2006, August). Death by a thousands SLAs: a short study of commercial suicide pacts.Technical Report HPL-200511.

Dingle, N.J., Knottenbelt, W.J., Wang, L. (2008). Service Level Agreement Specification, Compliance Prediction and Monitoring with Performance Trees. 22nd European Simulation and Modelling Conference.

Omer, R., Warnier, M., Quillinan, T.B., Brazier, F., Cojocarasu, D. (2008). Menaging Violations in Service Level Agreements.349-358. doi: 10.1007/978-0-387-78446-5_23

INNOVATIVE ORGANIZATION AND MANAGEMENT

MILITARY TRANSFORMATION PROCESS AND DISBANDING OF MILITARY UNITS

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Abstract: *Reductions in military personnel, material and financial resources are the most obvious effects in contemporary undertakens known as the military transformations. Reductions generates disbanding of military units, and that processes are not less complex than vice versa -forces generation. Disbanding process generate reverse logistics supply chains for huge amounts of military material. Parts of that material are weapons, vehicles, various equipment, ammunition, mines and other explosive items. Those are highly dangerous items which need special and specific care. Normally, logistics lines are not designed for altered flow direction of large amounts of war material. Large scale reverse logistics of explosive ordnance is unusual task and needs to be planed and realized on the project management basis. Another sensitive issue of disbanding process, is dealing with sufficient military personnel. For a number of reasons, solving the problem of military human resources surplus is expected also to be successful. All implications of disbanding of military units are complex and needs to be carefully planned and executed, which leave enough room for application of various methods of System Analysis, Project management, Operational Research and Management Science. Lessons Learned approach, that is, analyses of available experiences of former and current military transformation events, is precondition for success in the future.*

Keywords*: Military transformation, System analyses, Supply management, Human Resource Management*

1. INTRODUCTION

Military transformation is a complex process of changes of one military organization, undertaken to meet current and future challenges for national security. There are many subjects of change: size, organization, deployment, doctrine, training, equipment, organizational culture and values. There are many limitations and imperatives like: budget, time, law, visions of strategic decision maker, capacity for change, current obligations and engagements, etc.

At this moment, military transformation in case of many countries means next: downsizing of military personnel, units, garrisons and supplies; new organizational patterns of military units; technical modernization (new weapons and equipment); doctrinal changes (urban warfare, counter-insurgent operations, multinational engagement, peace missions); new profile of the military man, etc.

Collateral product of military transformation is disbanding of military units. Disbanding generate surplus of personnel, equipment, weapons and explosive ordnance. Those have to be processed somehow. Material flow direction has to be altered: dispose, collect and somehow terminate military material from end users (military units) to some point where it will be terminated in a safe and appropriate way.

Disbanding of military units means and comprises next activities:

- Dismissing a military unit from its obligations, tasks, duties, zone of responsibility, and cetera.
- Discharging of military personnel from theirs positions, duties, responsibilities, etc.
- Dislocations of material items that belong to a military unit which is a subject of disbanding process: main items (vehicles, armaments, etc), unit's supplies (ammunition, fuel, spare parts, food, etc); and other equipment, from current physical location of the unit into logistical bases of higher command or other predefined places.
- Dispatching a documentation of military units towards the Military Archive.
- Deserting the military facilities and infrastructures (release real estate form the presence of military units).

2. DISBANDING OF MILITARY UNITS

Military transformation is a process that takes time, money and good realistic plan. Part of transformation is change of the structure: number and composition of military units. At this moment, the change means downsizing or in other words: disbanding of military units. That is complex task which should be perceived as

project management problem. A number of different but connected and interrelated problems should be resolved in parallel, inside a specified time period, and with a restricted budget.

One of a large scale military transformation process in a near past, started in a time around a dissolution of former state (Serbia and Montenegro in June 2006). Serbian General Staff started with huge transformation of subordinate commands and military units (without administration of Ministry of Defense and its subordinate organizations). According to a former Chief of General Staff, general Ponos, in a period of one year (from June 2006, to June 2007) a number of garrisons was reduced for 47%, a number of brigade-size units decreased for 55%, and separate battalions cut down for 70% approximately; personnel reduction was planned at the level of about 30% (Ponos, 2007).

Figure 1 presents entities that should be processed (terminated in a proper manner) in disbanding of military units. General disbanding process presented at Figure 1, offers a lot of opportunities for creative application of the System Analysis, Project Management and methods of Operational Research and Management Science. The most challenging entities at Figure 1 are explosive ordnance reverse logistics and resolving a problem of personnel coming from disbanding military units.

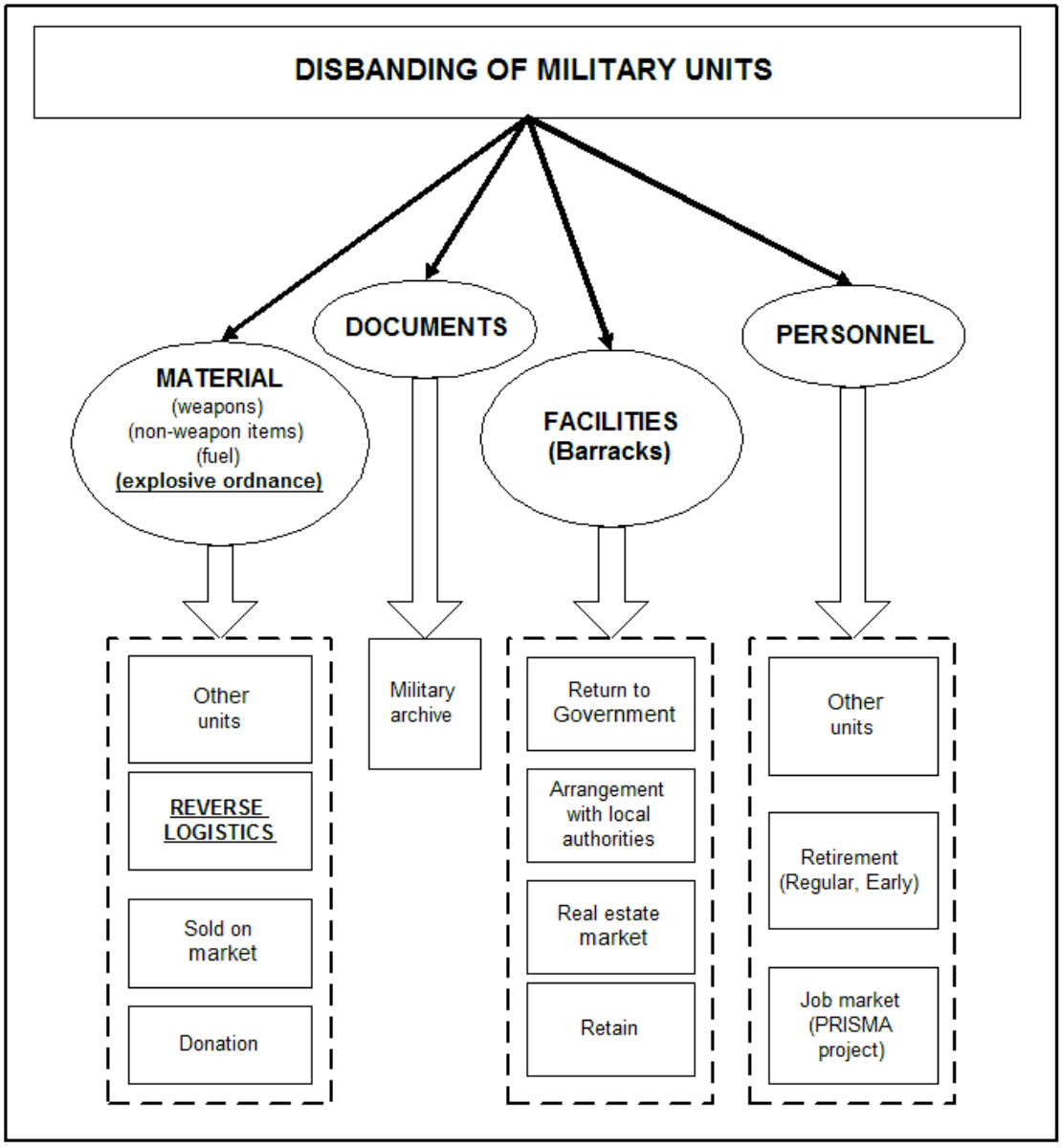

Figure 1. Disbanding of military units

3. DISCHARGING MILITARY PERSONNEL

Dealing with military personnel of disbanded military units is highly sensitive issue in many aspects and due to a specific character of military profession. Also, it is an organizational challenge for a human resources management.

There are different solutions for this challenge. Some of military professionals will be retired (regular or early retirement), some of them will be additionally trained and directed to civilian labor market. The rest will be distributed in other military units. In any case, many professional will make a career transitions inside or outside military organization.

Mechanisms for a Selective Early Retirement (SER) of military personnel exist in many countries, but in different forms that do not change the main two-fold idea. First, SER obtains care of military personnel after respective time period of military service (usually at least 20 years of service for full pension). And second, SER allows effective tool for military organization to transform itself (in this context to reduce its size) in a predefined time.

Ministry of Defence, jointly with some international organizations dedicated to the problem of security and demilitarization, developed the Program for Resettlement of military personnel (known as program PRISMA), in order to find one of possible solutions to the problem (Pietz, 2005). PRISMA was established and run in cooperation with some civilian faculties (Faculty of Organizational Sciences in Belgrade, in example), and with strong financial support from some partner states (Denmark, Norway, Sweden and Finland). Project PRISMA has lasted about six years, on more locations (regional centers) in Serbia, and costs near 10 millions of euros, encompassing around 7500 potential users.

On the other side, one vital organization should try to keep in active service better personnel. To make decision “who is better military professional” some criteria and some methodology are needed. Decision making theory and Multiple-criteria analysis could help here. Nikolic (2009), presented some problems and possible approach towards solution for better criteria for ranking of military officers. In fact, problem of ranking military officers (and other categories of personnel) belongs to wider area of the Human Resources Management (HRM). Various problems appears in the HRM due to the organizational dynamic, changes at the strategic level of organizational management, altering stakeholders preferences, changes in the wider organizational environment, an so on. In various periods, different problems can arise as dominant and place more care on human resources recruiting and development, or retaining or discharging. However, high quality and reliable system of ranking criteria, is always welcomed.

4. DESERTING MILITARY FACILITIES/INSTALATIONS

Problems with military facilities and installations (real estate), which remains empty in a disbanding process of military units, is logically simple but cumbersome for practical realization due to complicated laws, many stakeholders with different interests, etc.

In case of Serbia, Ministry of Defence, made a document known as “Master plan for military real estate”. The main idea behind that plan was expectation that many of buildings in former military bases will be sold on the real estate market. Huge amount of money was expected from that undertaken, and planned to be reinvested in some other urgent needs (like technical modernization).

However, that was too optimistic and many of those building are still in status quo. Some of main reasons for this were very complicated procedures, real estate’s documentation, valid and clear property proofs, differences in approaches to starting price level determination (market prices were very high, but potential buyers expected different treatment), problematic situation at real estate market, and of course negative influence of world economic crises in period after 2008.

5. DISPATCHING MILITARY UNIT’S DOCUMENTATION

Documents of military units usually go to the Military Archive and there is no special problem with this, except of heavy workload for the Military Archive services. This process assumes not only a physical relocation from military units to the Military Archive, but also accomplishment of some administrative procedures for classification, collecting and packing of unit’s documents, which is time consuming effort.

Military Archive is an organization in Ministry of Defence, whose mission is to collects, process and keeps documents that have been created in an army from its early days until today. In case of Serbia, that is the Military Archive who takes care of military documentation, starting from 1847 until today (www.isi.mod.gov.rs/vojni_arhiv02 , retrieved on March 24, 2014.). At the moment, there are more than 36 million pages of various documents generated in armed forces during the wars and peace intervals from 1847 up to now.

Documentation allocated in the Military Archive is valuable source for domestic and international historians, academics, courts, lawyers, and similar subjects, but also for common people who wants to get information about their relatives who served in military units in the past. Military Archive works according clear procedures and respects Republic of Serbia's law related to the archival material and archival service.

6. DISLOCATION AND PROCESSING OF MILITARY UNIT'S MATERIELS

Part of the disbanding process is the reverse logistics of all material of a military unit. First method for dealing with material surplus, coming from disbanding military unit, is relocation of material and equipment to other military units that will survive transformation. Second approach assume recycling of weapons, and it is relatively simple and benignly process besides it could be expensive due to cutting of high quality steel and generating transportation cost. Other methods for releasing the units from military equipment is selling it, or even donating it to some other (friends, partners,…) countries. Sometimes, donating material to the third subject/country may create mutual benefits (economic or political). Fuel can be "processed" through normal use or easily sold on market, so there is no problem with it besides it is a kind of dangerous and explosive items.

However, the situation is completely different in a case of explosive ordnance. Explosive ordnance is common term for all kinds of ammunitions, mines, missiles, rockets, and other explosive devices. There are many kinds of explosive ordnanace. They are very sensitivity and dangerous. Conseuently, they need special care, safety and security measures. Explosive ordnance are enery of war and have to be available to the military units in right amounts, at right time, on right place, and in right conditions. Explosive ordnance are very speciffic products with speciffic market. Consumption is not predictable enough: there is almost zero consumption in peace time, but within war demands increase drastically. Usually, all armies have some level of explosive ordnance supplies, which are calculated on the base of many factors.

There are many factors which make that explosive ordnance supplies become obsolete or surplus: changes in the strategic environment (peace dividend, change of adversaries, new security challenges and international agreements); technical innovations (new weapons); change of military doctrines; and end of life cycle of explosive items.

Military logistics system worked under heavy conditions in order to met hard lines of military transformation process. However, material flow was altered from its original design: all material from many disbanding military units flowed to a few depots. Disbanding of military units and, consequently, reverse logistics chain of explosive ordnance (EO), could be seen as important projects in the wider framework of military transformation process, because (according to set of definition of "project", Nokes and Kelly, 2007):

- It is "a temporary endeavor undertaken to create a unique result" (PMI definition of the project). Disbanding of military units and reverse supply chain of EO are discrete, almost unique events in life cycle of a military organization.
- It is "a set of coordinated activities, with a specific start and finish, pursuing a specific goal with constraints on time, cost and resources" (ISO 8402). Disbanding of military units and reverse supply chain of EO are complex endeavor usually forced with hard time-limits placed by strategic decision makers and constrained with prescribed procedures, laws and resources.

Besides a security sector reform, military transformation and disbanding of military units as a consequence, there could be more other reasons for ammunition disposals:

- International treaty obligations (bans of\n some kinds of ammunition or mines; weapons controls; CSBM – confidence and security building measures).
- DREAM (Disarmament, Demobilization, Reintegration and Arms Management).
- Decommissioning (the removal of weapons from active service induce removal of ammunition for that weapons).
- Return of military units from missions or wars.

"Normal" military logistics supply chains are well studied due to its primary importance, including new research trends and innovative concepts (in example: Wang, 2000; Dumond and others, 2001; Robbins at all, 2004). Main problem with reverse logistics supply chain for explosive ordnance in the case of disbanding of military units is a quantity of material which has to be processed in a short time with limited resources. In simple words, it is not designed for such level of reverse material flow.

In terms of the queueing theory, we have overloading of service channels, or at least heavy traffic conditions. Under pressure to finish task in a limited time, elements of supply system (depots) which receive material from a number of disbanding units, have to accelerate servicing (receiving, sorting, packing, stocking, securing). However, that could leads to a harassment of appropriate procedures and prescribed standards for safe stockpile management. The result is higher safety risk. Additional danger comes in situation with declared "non-perspective" ammunition. It is in a human nature to pay lower attention on items which are declared for disposition and destruction ("non-perspective" items).

7. CONCLUSION

Military transformation is a complex process that could be initiated on the basses of different events: political decision, international obligations, security environment, economical issues, societal changes, technological advancement, and so on. Military transformation assumes the change in its essence. There are many subjects of change: size, organization, deployment, doctrine, training, equipment, organizational culture and values. There are many limitations and imperatives like: budget, time, law, visions of strategic decision maker, capacity for change, current obligations and engagements, etc.

Military transformation in case of many countries means next: downsizing of military personnel, units, garrisons and supplies; new organizational patterns of military units; technical modernization (new weapons and equipment); doctrinal changes (urban warfare, counter-insurgent operations, multinational engagement, peace missions); new profile of the military man, etc. In this paper we identify and elaborate few main flows in a disbanding process of military units, as its main implications, which are: discharging of military personnel; dislocations and processing of material items that belong to a military unit which is a subject of disbanding process; dispatching a documentation of military units towards documentation warehouse (the Military Archive); and deserting the military real estate.

REFERENCES

Dumond J., et al. (2001). Velocity management: the business paradigm that transformed U.S. Army logistics. Technical report MR-1108. RAND, Santa Monica CA, USA

Joint Publication 1-02. (2007). Dictionary of Military and Associated Terms. Department of Defense, USA

Military Archive. (2014). Ministry of Defence, Republic of Serbia. Retrieved from www.isi.mod.gov.rs/vojni_arhiv02

Nikolic N. (2009). Culture of Career Development and Ranking and Selection of Military Officers. Western Balkan Security Observer, 14, 120-141. Retrieved from http://www.isn.ethz.ch/Digital-Library/Publications/

Nokes S., Kelly S. (2007). The definitive guide to project management. FT Prentice Hall, 2nd edition

Pietz, T. (2005). Demobilizing and Retraining for the Future. Bonn International Center for Conversion. Retrieved from http/www.bicc.de.

Ponos Z. (2007). Transformation of the Army of Serbia – Challenges and Responses. Vojno Delo, (3), 9-30. (academic journal on Serbian, ISSN 0042-8426, UDK 355/359)

Robbins M., Boren P., Leuschner K. (2004). The Strategic Distribution System in Support of Operation Enduring Freedom. Technical report DB-428-USTC/DLA. RAND, Santa Monica CA, USA

Wang Y.D.M. (2000). Accelerated logistics: streamlining the Army supply chain. Technical report MR-1140. RAND, Santa Monica CA, USA

POSSIBILITY OF ORGANIZATIONAL CONSULTING AS A PROCESS IN IMPROVING THE PERFORMANCE OF ORGANIZATIONS AND INSTITUTIONS

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***Abstract**: The paper deals with a problem of changes in external environment which influence and require organizational changes in organizations and institutions, in public sector above all. The process of continual organizational changes and role of consulting in the process of changes and implementation of proposed changes are analyzed in the second part of the paper. Organizations today recognize changes within themselves, in society and in the environment in general. They monitor changes that occur in all three segments in order to develop mechanisms which would enable them to cope with the inherent risks mainly relating to lenience of organizational boundaries, disintegration of internal hierarchical structures and crisis of trust. Organizations in which people work and provide livelihood ceased to be perceived as a safe place, which also relates to public sector, health organizations, educational sector and others. Changes and transformations, as well as increased permeability of institutions bring some benefits, but also evident risks and damages that can be seen in hindering the fulfillment of the primary task. These changes can have particularly serious consequences certain sectors such as public health and education. There is a trend of increased monitoring of the performance of the public sectors, but it is accompanied with pronounced requirements to achieve results with limited economic resources, which leads to dissatisfaction among staff. A group of professionals from different sectors and different roles in organizations are interested in the process of further education in organizational consulting within the Section of psychodynamic and group analytic approach to understand the psychodynamics of institutions, organizations and society. They are studying the possibility of "curing" institutions. By studying psychodynamics of institutions in the sensitive time of transition and changes and by using different techniques and process organizational consulting, a positive contribution to the individual goals within the organization, as well as to group and overall goals of the organization may be provided. Psychodynamic approach is a significant step in improving the work and it contributes to the improvement of the matrix of the organization.*

***Key words**:*
Organizations and Institutions, Process of Transition, Organizational Consulting, Psychodynamics of Institutions, Matrix Organizations

1. CONTEXT

The paper deals with a problem of changes in external environment which influence and require organizational changes in organizations and institutions, in public sector above all. Organizations today recognize changes within themselves, in society and in the environment in general. Organizational boundaries are more lenient, more fluid, more flexible, but also unpredictable.

Network communication, influence and partnerships within and among organizations are more developed. Partnerships between organizations are developing rapidly, but this merging changed the conventional boundaries of the organization and the field. Outsourcing or obtaining services needed for its work from outside the organization, change the structure, procedures, methods of work, and also contribute to the openness of the system, transformations and changes.

Hierarchy in organizations today are not "straight" and clear, but complex, overlapping and fluid. Individual authorities of some roles in the organization are continuously the subject of negotiation in

relation to the short term task and goal, which is a risk for individual management roles, as well as danger for the whole organization. Permanent teams of rigid structure are changed by the teams formed by the project task, of long or short duration, but limited time frame.

It seems that where once a boundary (of the organization) used to be, there is a network now. The good side of this phenomenon is the diversification and expansion, and the accompanying, negative side is certainly the risk of dislocation, disintegration, degradation. It is therefore important that consultants knowledgeable in this area discuss the topics of great importance:

- sociological and psychological characteristics of a new organizational system,
- opportunities to work in new organizational circumstances,
- characteristics of the consultations of the new organizational groups and possible dilemmas,
- impact of gained experiences on the theory and practice here and now.

Public sector, as well as health sector and educational sector are important sectors in all countries (Crnjanski V 2012, NHIS 2014). They have many employees, represent a large system of special sensitivity to outcomes that are expected of it and these organizations are in line with the changes, less rigid than before, and the boundaries of organizations are more lenient. Professional and commercial networks of impact are more developed; availability and flow of information are more present, as well as partnership and cooperation, but also mechanisms of disintegration, which are more and more evident in the organizations.

Organizations monitor changes that occur in wide work environment and in the region in general. It is necessary, therefore, to develop an awareness of risk and knowledge of risk management of modern organizations, both with managers and workers, i.e. members of the organization, in order to overcome disintegration and crisis of trust to the best extent possible (Cooper and Darlington 2004).

The group matrix as a secure base was investigated by Liza Glenn and nature of matrix is most consistently described as a network and not easy to understand (Glenn L 1987). Galbraith Jay wrote in her book that organization structure does not fail, but management fails at implementing them correctly (Galbraith J 2014).

Considering the importance of the public sector, it is necessary in the analysis to take into account that this sector is inseparable from other sectors of society, and that our societies are becoming increasingly structured around bipolar opposition, between the net and the self (Castells 2000). State of instability is present in all organizations, and it is necessary to get used to this situation and to seek ways of functioning outside the state of stability. Society and its main organizational units and sectors are in the continuing process of transformation, and new states of stability, it is completely obvious, cannot be expected in the near future (Schon D 1973).

As large institutions and organizations are especially vulnerable and instability is more visible, it is obvious that the age of anxiety did not bypass the public, health and educational sector and did not remain within the limits of one country, political system or economic level of development. Lack of trust in managers and implementation of their solutions is deeply rooted in the health sector, and managerial roles can often be associated with the post of the scapegoat. Being powerful does not mean having a job well done, but it seems more often being good in a complex game of avoiding pitfalls, winners and losers (Cooper and Darlington 2004).

There is a trend of increased monitoring of the performance of the public sectors, especially those of health and education. The control system of performance is becoming more complex. The question is how to work in the new organizational environment in light of the many new negative occurrences and more pronounced requirements to achieve results with limited economic resources. The perspective that funding will be more and more complicated and difficult is clear and therefore there will be growing dissatisfaction of individuals in health sector organizations.

The question is how to work in the new organizational environment in light of the numerous adverse events, challenges of changes and demands for achieving better results, with limited economic resources. Resistance, uncertainty and control dominate the atmosphere in institutions and organizations. Trust and positive economic outcomes in the present circumstances, are difficult goals

to achieve, which often threatens the realization of the primary task, for example treatment of patients and improving the health of the population in health sector.

Public sector, health organizations and educational sector as well as individuals are exposed to all the influences of the present age. Consequently not only tradition and history but also an organization's vision and mission are exposed to the influence of various external factors. The relations within the health organizations are a consequence of both the external factors and the internal norms developed within the same organization. Human resources, equipment and facilities are basic elements of an organization. Further structuring depends upon the vision, mission aims, type, purpose, possibility, legal frame but there are some organizational segments that are not easy to formulate or analyze. This part of an institution's organizational capacity makes a matrix which does not follow any technical, legal or other strict procedural aspect of the organization. It significantly influences the feelings of an individual within the organization as well as the image that the organization sends to the outer world.

2. METHODS

Bearing in mind the overall general situation which monitors public sector and health organizations, the aim of this paper is, among other things, to show the possibility of using psychoanalytic and group analytic approach in work with organizations of the public sector and health organizations.

The attempt is made to improve the working results of the health system using the method of the psychoanalytical and group-analytical approach to understanding the psychodynamics within the work process of institutions, organizations and society.

For this purpose, a systematic approach to the education of experts interested in contribution in this area, who are basically of different educational backgrounds but share ambition of focusing their work in the future on the improvement of the work in organizations, has been designed.

The education is organized by the Section for psychoanalytic and group-analytic approach to understanding the psychodynamics of institutions, organizations and society, which is a part of the Group Analytic Society Belgrade (GASB), and in cooperation with the Society for consulting and education 'Consulting-Art' (Jevtic M et al 2013).

The entrance interview is obligatory and the education consists of: theory, supervision, experience in working in a small group-analytic semi-open group, social dreaming experience, experience in working in medium group-analytic group as a facultative activity, as well as a facultative participation in two international educative workshops in this field. Theory and supervision are organized in 14 modules (12 regular and 2 facultative modules). Reporting on an organizational situation from the point of view of a leader, manager or HR representative or any other view or reporting on some other social group situation in which a trainee has participated in is discussed and linked to the theory and practice of this field.

By acquiring theoretical knowledge, presenting and showing examples from the practice, by practicing through the role of the client, observer, supervisor, as well as a consultant, course attendant acquires the knowledge and ability to conduct process consulting in health and other organizations.

3. RESULTS

The complex relations within groups and organizations as well as the effects of external factors are especially important to all sectors and institutions. They are not only affecting the efficiency and quality of the provided services but also the mental health of both health professionals and clients and patients. The organization's matrix is of great importance for its efficiency, especially in the public sector and health system.

Over 30 experts from the health system are being additionally educated in the field of organizational consulting organized by the Section for psychoanalytic and group-analytic approach to understanding the psychodynamics of institutions, organizations and society. The significant capacity for "healing" of organizations and institutions is gained in such a way. For example, today the network of public health institutions in Serbia consists of over 150 primary health care institutions, over 40 hospitals, 30 specialized hospitals, 16 institutes and 4 clinical centers. Clinical centers as the most complex

organizations with several thousand employees are undergoing organizational transition, which economically represents a difficult situation, and have extremely complex system of relations among individuals and groups.

The result of the work is the realization of two levels of the Course of organizational consulting, with two generations of attendants and gradual establishment of a network of the people interested in working in the public sector, different institutions and health system, with the appropriate capacities and acquired skills and knowledge that can benefit the organization, whether that work is carried out in the form of external or internal process of consulting. The emphasis is on process, not the expert consulting, which is also important note, because it requires the development of partnership between the consultant and the client (clients).

4. DISCUSSION

All organizations are nowadays more networked than before, and hierarchies are not "straight" and clear, but complex, overlapping and fluid. Individual authorities of individual roles in the organization are continually subject to negotiation in relation to the current task. This leads to the inexorable uncertainty among managers, endangered status in relation to others and in relation to the own self.

Andrew Cooper and Tim Darlington (2004) primarily studied public sector organizations, in which the boundaries of autonomy and control are dissolved, and which are at the same time followed by instability and complexity, as accompanying features. They compared the contrast of a new organizational order and orthodox psychoanalytic theory of functionality and dysfunctionality, wondering to which extent fitting into the current reality of people's experiences in organizations goes. The prerequisite of human psychological and social health at work are processes of containment as a common practice of thinking and, in a way, a new kind of phenomenal form in the organization. Thinking leads to the discussion of the disappearing organization, i.e. organizational containment in a networked world.

Linda Hoyle points out that the change is an additional potential for creativity. Reactions to changes are, however, very different, and it is important to explore the psychoanalytic theories of unconscious resistance to a change (Hoyle L 2004). Elliot Jaques (1955) and Isabel Menzies (1989) who have also dealt with these works, point out that people use social systems (organizations) to ward off anxiety. Stress and anxiety in the system of hospital personnel cannot, for example, only be attributed to the task and to the fact that the social defense system is insufficient to reduce anxiety because it also produces it. Change in the organization conducted by the management faces different reactions from sycophant (absolute followership) to sabotage and reactions of positive support with constructive comments, or negative and contradicting, with the stated reasons for such an attitude can be found among them. On the basis of this study the possibility of using the model of process consulting, by helping people in the organization to move from the extreme roles of saboteurs or sycophants, to contemplating and constructive positions in which they would give a better contribution to the work of the organization, with the aim of contributing to the realization of the primary task in the public sector and health sector, has been open (Menzies I L 1989, Jaques E 1955).

It is also important to emphasize that the understanding of individual existential primary task, which is a source of resistance to a change, is using a process of bringing the existential task into conscious awareness with the aim of understanding one's own anxiety and the perception of resistance as a non-compliance with the organizational normative primary task.

The standpoint of Sarah Vaughan on the impact of organizational culture in dealing with conflicts in the workplace is interesting one. Conflict is natural and useful in solving problems in the organization, but it can also be devastating and lead to destructive and negative behaviors in the workplace, including physical and verbal aggression, intimidation and victimization, leading to the development of negative consequences, both for the employee and organization as a whole. Because of the severity and magnitude of the problem in health systems and their importance to society as a whole, the study of culture, ethics and the relationship between national culture and organizational culture in the function of the realization of the primary task in health care organizations is important (Vaughan 2011).

Due to the significance which all institutions and organizations represent to individuals, for its size, capacity and aim, it can be said that:

- It is necessary to constantly search for new approaches in order to find a new possibility to improve the organization
- Today, more than ever before, organizations represent a challenge when studying processes and dynamics within them is concerned
- Group analytic therapy can be further developed to research the psychodynamics of institutions, organizations and societies
- There is a significant interest among group analysts and other professionals as well for education in this segment in order to improve the relations in the organizations, different groups and society in general.

5. CONCLUSION

Interdependence in modern organizations and systems increases; this also applies to the public sector, health and educational organizations, which is important for intergroup relations.

In order to achieve the progress a step toward cultural fluidity and flexibility is needed, as well as the work of the containment, and in its absence the risk of instability, destruction, unpredictability is high and the chances for promotion of solidarity, creativity, and sense of security, are smaller.

Naturally, the question of psychoanalytical theory and practice persists, as well as this function, it can become real, applicable and with satisfactory results. Until we make effort, invest time, knowledge and creativity, it cannot be known. One thing is certain, that every kind of such and similar work in organizations, the use of the psychodynamic approach, brings small or large steps in advancing the work of the organization and contributes to the improvement of the matrix.

Groups within health organizations have different levels of cohesiveness which mainly depends on the common aim and a motive deriving from it. Therefore, the research of group and subgroup characteristics within organizations is an important topic whose aim is to improve the management of all institutions which nowadays can be candidates for the work improvement through the group-analytic organizational consulting.

6. REFERENCES

Castells Manuel. The information age: Economy, society and culture. Vol. I, The rise of the network society. Malden: Blackwell, 2000. 2nd Ed. 594 p. ISBN: 0-631- 22140-9.

Cooper A, Darlington T. (2004) The vanishing organization: organizational comitment ina a networked world. In Working Below The Surface, Karnac Books, London

Crnjanski V (2012) Human resources and social responsibility in health institutions in Serbia. Andrejevic Foundation, ISBN: 978-86-525-0088-8

Galbraith J. (2014) Designing matrix organizations that actually work. Galbraith Management Consultants, USA, Colorado

Glenn Liza (1987) Attachment theory and Group Analysis (SAGE, London, Newbury Park, Beverly Hills and New Delhi) Vol.20 109-26

Hoyle Linda. (2004) From Sycophant to sabouter responses to organisationa change. in Wolking Below the Surface" Huffington C, Armstrong D, Halton L, Pooley J. Karnac Books. London.

Jaques, E. (1955) Social systems as a defence against persecutory and depressive anxiety. In: M. Klein, P. Heimann and R. Money-Kyrle (eds), New Directions in Psychoanalysis, pp. 478–98. London: Tavistock.

Jevtic M, Mojovic M, Cemerlic Adjic N (2013) Possibilities for using group-analytic method and knowledge for the organizational consulting of health institutions. EHMA Annual Conference 2013, Abstract Book, Bocconi University, Milano, Italy 112-113

John Kotter (March-April 1995.) "Leading Change: Why Transformation Efforts Fail" Harvard Business Review

Menzies Isabel Lyth (1989). A psychoanaytic perspective on social institutions.The Dynamics of the Social, Selected Essys (pp.26-44), London, Free Association Books

National Health Insurance Found (2014) http://www.rfzo.rs/download/mrezazu.pdf (available 20.04.2014)

Schon D (1973) Beyond the Stable State. W. W. Norton

Vaughan Sarah. (2011) The influence of Organisational culture in dealing with workplace conflict: an ethical and cultural perspective In Organisational Culture. Saga. London.

MANAGEMENT OF INNOVATIVE ACTIVITIES OF COMPANIES IN THE FUNCTION OF ACQUIRING AND MAINTAINING A COMPETITIVE ADVANTAGE

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***Abstract**: The study shows how innovation activities combine the dimension of management and innovation activities, and whether the appropriate intensity of their use may affect the competitiveness of enterprises. The research had been conducted in order to explore an impact of management innovation activities on the competitiveness of small, medium and large enterprises in Bosnia and Herzegovina. Survey has been used as a methodology and sample has been made of respondents from companies. Based on the identified barriers in the management of innovative activities, the model of innovation activities that would escalate innovative activities on daily basis has been proposed. Within the model it has been proposed framework and criteria for investment flow and measure the results of innovative activities. The model is applicable to all companies, regardless of their size.*

Keywords: *management, innovative activities, competition, enterprise model.*

EXORDIUM:

Uncertainty business, innovation activities and competitiveness do not represent a new theme in the business environment, but its perseverance promote that the only certainty of surrounding is the fact that tomorrow will be the same as uncertain as today. It is precisely in the fact that the environment changes are constantly monitored and it that lies the greatest problem related to the management. And it is very clear that even today many trends change, creating the conditions under which it will be in due time to change the rules in the existing industries. The path of development is based on change and flexibility, due to the fact that positive changes in the long term will contribute to greater wealth, higher levels of employment and freedom of the individual (Jovicic, 2006). Nevertheless, talking about the constantly changing environment and a high degree of uncertainty, the basic principles of good management, if necessary, adapt and configure compared to the changed circumstances.

Good management is essentially what has always been a challenge to make the accumulation and use of all available resources, especially knowledge. The ability of management is a key moment in response to external changes and trends (*Preston, Kerr and Cawley 2009; Hotho and Champion, 2011; Cunningham, Cutler, Hearn, Ryan, and Keane, 2004*), and on the cooperation with educational institutions in designing relevant innovative plans and programs (*Bauer, Viola and Strauss, 2011; Haukka, 2011; Bridgstock 2011*). In practice, every manager has to deal with the problem of changes, challenges and new opportunities that must react to innovative activities (*Jaksic-Levi, 2001*). In today's turbulent environment, the question is pointed on survival, the survival of enterprises and even entire countries to the global market. It is necessary for management to adapt to changes in the environment, and to maintain the strength in the innovation activities of enterprises continuity to maintain in the business, and in order to survive. If you are not able to follow the changes, to initiate change, to be innovative, to change their own organization, products, methods, technology, etc., it is inevitably that it will befall crisis. The aim of the study is to review the existing practices of innovative activity management in companies in Bosnia and Herzegovina (B'n'H) and its effect on strengthening the competitiveness of enterprises caused by the same.

1. REVIEW OF THE LITERATURE

For the management of the last century it can be said that it is an activity of coordinate tasks that they perform more efficiently and effectively. Management evaluates started and expected changes in the environment that will inevitably impact on the overall strategic position of the company. These changes are often subtle, inaudible and should been seen, heard, identified and assessed much earlier than do competing companies (SehiC, 2002). This, above all, a skill that is focused on finding such measures and actions to improve the implementation of certain activities and enterprise, and the functioning of the economic and social system makes it more efficient, today it's called management, and it took its place among the modern scientific disciplines *(Jovanovic, 2009*). However, management theorists of twentieth

century have made the management of most companies to have a similar hierarchy pyramid structure, so it's hard to find the best practical examples of management who are really good enough. Even for those companies that are set to be an example, are not sufficiently flexible as they should be, and not innovative as they could be. It is clear that what limits the innovation company is not operational, but its business model management. Theorists innovative management, management of the XXI century, are trying to change the principles of management of the last century (*Hatunić, Kuc, Hatunić, Mesic, Kuc, 2011*).

Previous studies, some more than 80 years in the field of innovation management have pointed to two conclusions. Innovation is primarily a process, not just a single event, and in accordance with this innovation should be managed. The second conclusion relates to the fact that the result of the process of innovation can influence by influencing the process of innovation (*Tidd, Bessant and Pavitt, 2005*). The main challenge today is the fact that the level on which is placed the management of innovative activities is expanded significantly. Globalization moves the competition from the level of prices and technical innovation to the knowledge management and innovation management (*Djordjevic, Cockalo & Bogetić, 2010)*. Accordingly specified words, it comes to mass innovative phenomena in organizing and managing work in companies, and recent research has focused on the management associated with cognitive management doctrine (*Avolio, Walumbwa and Weber, 2009).* As a result, management takes an innovative-creative character, and companies that successfully implement innovative activities become more innovative companies. The introduction of innovation in the enterprise cannot be realized without good governance same. American professor of management Tide (Tide, 2009), suggests four stages in the process of innovative activities that would lead to their accelerating, namely:

1. Management scanning and searching internal and external environment;
2. Managing strategic selection of ideas;
3. Manage the allocation of resources for the development of knowledge and the use of selected and collected signal;
4. Management implementation innovation.

From ability of management depends on innovation enterprises, improving operations, risk management, working effectively with employees, improving employees' knowledge, adequate organizational culture and climate, etc., all of which leads to the effectiveness of investments. Efficient management is an important success factor (*Mumford, Scott, Gaddis, and Strange 2002*). Evidence suggests that management plays an important role in the production of creative thinking and innovation (*Rickards and Moger, 2006*). Bigliardi (*Bigliardi, 2013*) emphasizes the importance of managing the development of innovative activities to meet the needs of customers, and the end result would be the improvement of financial results and distancing himself from the competition. Empirical results (Ibid, 2013) confirms that by increasing the level of innovative activity has improved financial results of the company. Today, managers are viewed primarily as professionals who possess effective knowledge, skills and abilities, and who know that it successfully applied to other employees in order to strengthen the innovative activities, produce results and achieve corporate objectives. So young and avant-garde company usually seeks managers who are able to make quick, intuitive decisions, without hesitation of applying innovative approaches to problem solving (*Lalic, 2010*).

According Rejnert (*Rejnert, 2010*) from the profile manager largely depends in what extent the company will overcome the inherited problems and accept market rules because the challenges are much greater than they were before 20 years or more, and the reasons are that:

1. Modern enterprises focus on the provision of services;
2. Modern enterprises are enterprises in the sphere of knowledge economy;
3. Modified form of techno-economic causes major changes;
4. The amount of allowable defects is much smaller than in the past;
5. It is impossible to choose the winners;

With regard to management of enterprises of B'n'H, attention was not paid to management, probably because of leadership, which is the legacy of socialist planning, but also because of the fall of consciousness during and after the war. The strategic course of B'n'H is integration into the European Union and the placement of domestic enterprises and the economy into the European and world market, which can only be achieved by their competitiveness. In front of the management companies from Bosnia and Herzegovina lies a complex task that requires awareness of the importance of innovative activities of enterprises, competent management, good choice of strategy, business flexibility, elasticity organizational structure, etc. (*Hatunić et*

al, 2011). Therefore, the motive of the research was to investigate the influence of management companies in B'n'H on encouraging innovative activities in enterprises and the importance of same ones, to the competitiveness of enterprises.

2. RESEARCH METHOD

After briefly looking at the characteristics of management and innovative postulates, the focus of the next phase of the research was to identify the connection of innovative activities and the competitiveness of enterprises. Data collection for the study of relation of innovative activities and the competitiveness of enterprises in B'n'H was made by constructed questionnaire. The final sample size is 100 companies, of which 69 SMEs (small and medium enterprise)s, and 31 great companies from all parts of Bosnia and Herzegovina. Study was initiated on December 6, 2012., sending online questionnaires to address of the enterprise and it was completed on 7th April 2013th year, which analysis and synthesis of data were collected. Questionnaire was designed for the management of the companies.

The closest relationship with the aim of research, and the research hypothesis, which states: "*Raising the level of innovative activity in enterprises is the basic prerequisite for gaining and maintaining competitive advantage*".

3. RESULTS OF RESEARCH

The results of empirical research on the management of innovation activities in SMEs and large enterprises in B'n'H, for the most part, indicates the opinions and attitudes from the theoretical part of the study. In this regard specific obstacles were identified in the management of innovative activities which are reflected in the following:

- Outdated internal structure of knowledge, technology and other tangible and intangible assets (61% of respondents);
- Most managers of companies from BiH was not well versed in innovative activities in which areas to apply them (56% of respondents);
- Low-frequency in the development or innovative projects of enterprises (44% of respondents);
- Lack and limitation of financial resources (74% of respondents);
- Low-level monitoring innovation, managerial skills and writing projects (46% of respondents);
- Weak links of the economy, public sector and educational institutions (69% of respondents);
- Interaction between management and employees is at a low level (58%);
- Awareness of the importance of the development of innovative activities and changes in companies is low (66% of respondents);

For claims from another part of the questionnaire, which were available for therespondents ,there was offered a Likert scale. Engineered Likert scale, with 5 answers indicates the attitude of respondents from SMEs and large enterprises in B'n'H on innovative activities in enterprises, as well as their competitiveness. Within these statements, on which the respondents tried to identified themselves, offered answers were: (1) No (2) A very small part of the case, (3) Partially so, (4) For the most part it is true, (5) Yes, completely so. Replies of respondents were ranked the scores 1, 2, 3, 4 and 5 replies under 1 and 2 are the negative attitude of the respondents in relation to the fact assertion, grade 3 represents a neutral stance, while customer 4 and 5 imply a positive attitude of respondents from SMEs and large enterprises in Bosnia and Herzegovina.

Certainly that is one of the most interesting results obtained from the first statement of the questionnaire exactly the number of newspapers that the company has introduced in the last three years (Figure 1).

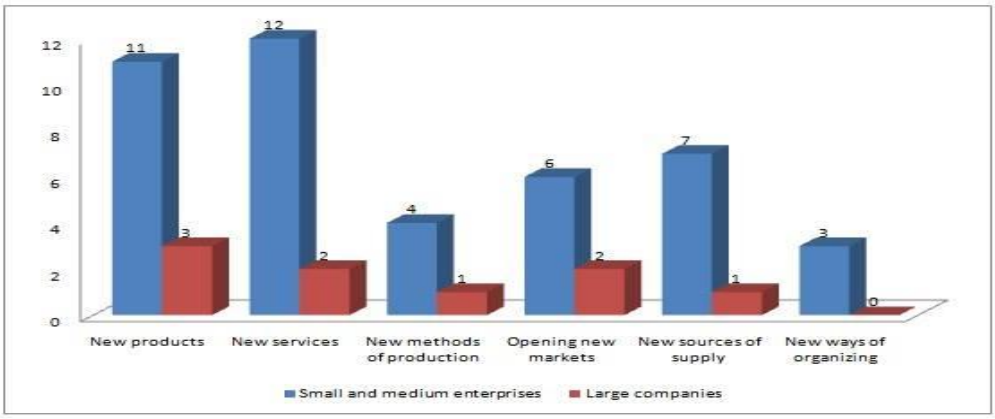

Figure 1. Innovation companies

As you see in the Figure 1, in the last three years, SMEs and large enterprises introduced a total of 52 **recent additions** that were completely new to the company. Of these 34 innovations that have already been used by other companies, and 18 recent additions are full innovations in the branch of the company. Also, it was found that some companies introduced more novelty, so that the number of companies that are actually have introduced some of the 41 innovations (34 *SMEs and large enterprises 7)*, while 59 companies did not have any innovations in the last three years. On the other hand, the European Union, according to official data of the European Commission (*European Commission: Enterprise and Industry, 2013)*, more than half of the companies have reported that they had to put up some of the innovations in the last two years, the undisputed leader of Germany whose even 79 % of companies had some of the innovative activity in the last two years. Therefore, it can be concluded that companies from B'n'H are largely behind, not only from the leader as Germany is, but also from the European average. Their views on the remaining five offered statements are presented in the Figure 2.

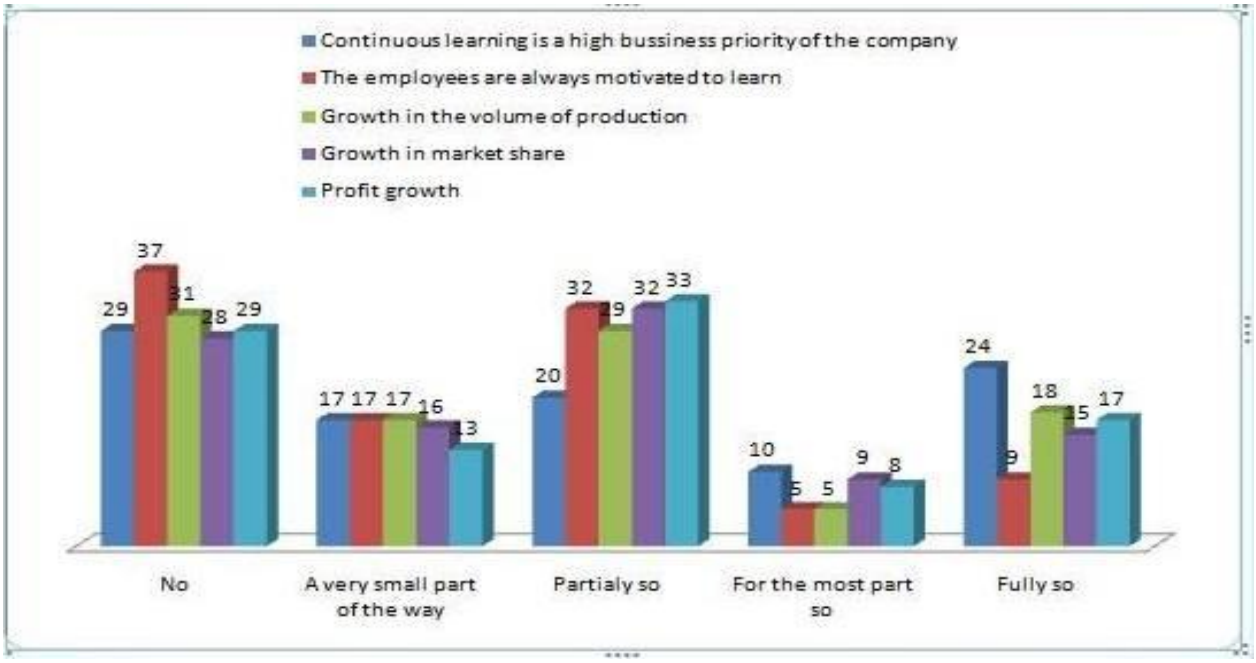

Figure 2. Answers given to the allegations set

Based on data collected from the questionnaire for respondents, it has been possible to test hypotheses through a program for statistical analysis of the data, "IBM SPSS 21." Approach was made by formation of two variables, and innovative activities and competitiveness, which contained claims which respondents could express their disagreement or agreement.

First step in data processing was the formation of scale on the basis of statements and analyzes internal homogeneity statements based on the value of Cronbach's alpha coefficient. Table B1 shows the value of Cronbach's alpha coefficient used measurement scale for variable innovation activities and competitiveness.

Table 1. The value of Cronbach's alpha coefficient (α) for the applied measurement scales

Scales	N	α	Total α
Innovation activities	100	0,826	0,899
Competitiveness of enterprises	100	0,791	

Based on the values of Cronbach's alpha coefficient it is possible to conclude that the applied measurement scales possess a satisfactory level of homogeneity (Table 1). In addition, values are displayed and Cronbach's alpha coefficient for each scale separately.

Table 2. Effect of claims on the Cronbach alpha coefficient (α) of the scale for innovative variable activities.

Claims	N	α	Total α
Innovations	100	0,728	0,826
Motivation	100	0,846	
Continuous learning	100	0,678	

Based on the values of Cronbach's alpha coefficient it is possible to make a conclusion that the applied measurement scale (innovations, motivation, continuous learning) have a satisfactory level of homogeneity of the variable innovation activities (Table 2).

Table 3. Effect of claims on the Cronbach alpha coefficient (α) of the scale for the variable competitiveness.

Claims	N	α	Total α
Volume of production	100	0,810	0,791
Market share	100	0,704	
Profit	100	0,618	

Based on the values of Cronbach's alpha coefficient it is possible to make a conclusion that the applied measurement scale (production volume, market share, profit) have a satisfactory level of homogeneity of competitiveness variable (Table 3). Therefore, it can be concluded that the odds of internal homogeneity for all of dimensions is satisfying, and based on these dimensions it can form two variables: innovation activities and competitiveness variable.

In order to understand the connection established variables the method of correlation analysis is used to determine the connection type of innovative activities and the competitiveness of enterprises. This method is a bivariate correlation analysis, and is thereby used Spearman 's correlation coefficient. With this method will identify functional connections established variables which will confirm or reject, respecting the existence between the established variables. The value of Spearman 's correlation coefficient ranges in the interval from -1.00 to +1.00. Direction of correlation, indicating that the (- / +) sign, will determine the direction between the variables that may indicate a negative or positive correlation. A values of 0 indicates that no relationship (correlation) does not exist (Pallant, 2010).

To accept the hypothesis of work requires to meet the following:

1. The correlation coefficient is statistically significant at $p < 0.05$;
2. Correlation coefficient is predicted direction.

The obtained Spearman correlation coefficient is 0.840 and indicates a high correlation between the variables, indicating that the strengthening of innovative activities and strengthen the competitiveness of enterprises. In addition, it is measured the correlation between the dimensions of innovative activities and competitiveness.

Table 4. The value of Spearman 's correlation coefficient

		Innovative Actions	Competitiveness
Innovative Actions	Spearman's Correlation Sig. (2-tailed)	1	,840**
Competitiveness	Spearman's Correlation Sig. (2-tailed)		1

**. p <0.05

The obtained Spearman correlation coefficient is 0.840 and indicates a high correlation between the variables, indicating that the strengthening of innovative activities and strengthen the competitiveness of enterprises. In addition, it is measured the correlation between the dimensions of innovative activities and competitiveness.

Table 5. Value Spearman 's correlation coefficient measuring innovative activity and competitiveness.

	Innovation	Continuous learning	Motivation	The volume of production	Market share	Profit
Innovation	1	.770**	.559**	.434**	.532**	.799**
Continuous learning		1	.597**	.487**	.651**	.847**
Motivation			1	.475**	.596**	.628**
Volume of production				1	.395**	.519**
Market share					1	.647**
Profit						1

**. p <0.05

Shaded fields are fields significant correlation values, while others are obtained values are also statistically significant, but fall into the category of medium and low correlations (Table 5).

4. PROPOSED MODEL FOR FACILITATION OF INNOVATIVE ACTIVITIES OF ENTERPRISES

The aim of the study was related to the perception of obstacles managing innovative activities in companies, and the impact of innovative activities on the competitiveness of enterprises. Research has shown that there is a difference in the management of the companies that are innovative-active, and those which are not, and that good governance must have innovative activities for strengthen of competitiveness enterprises. Based on the identified obstacles to managing innovation activities in enterprises, it is necessary to focus on management issues, such as:

How to create conditions for innovative activities which must be continuous process in the company and how it is supported by all employees?

How to develop a behavioral model that defines the behavior of the company in the management of innovative activities on everyday level?

In this regard, it has been proposed a modified model of management innovation activities (Skarzinski and Gibson, 2009) that would motivate employees and contributed the innovative activities on daily basis.

In order to build and maintain the ability for innovative activities, the company should be carefully managed in innovative activities. Under the proposed management model innovation activities it is necessary to strengthen the innovative offer in order to reach as many creative ideas by employees in order to strengthen the innovative offers.

Strengthen innovative demand in a way that older managers were interested to demand creation of employment, improving the innovative demand.

Establish a zone pressure in a way that managers do innovative activities as a priority in their business. As one of the solutions, there is some pressure on managers in terms of: the number of new ideas and the speed with which they come, the master income level of innovative activity, how much time the manager is paid to supporting innovative activities etc.

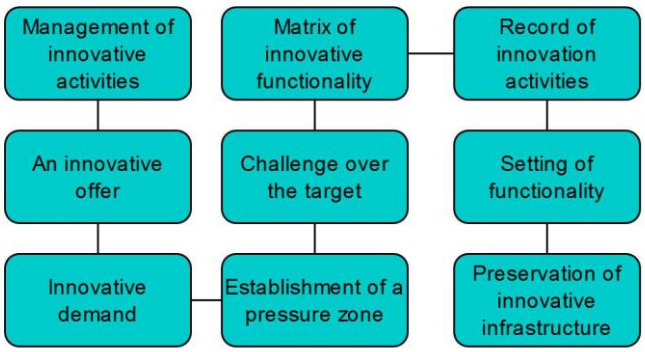

Figure 3. Model Management in innovative activities

To put a challenge above objectives in terms of focusing on unrealized need or solve a consumer of today's global problems, such as pollution or poverty, which can act very inspiring. When employees understand that they are part of the company that wants to create history, not just profits, it can create energy and enthusiasm on employees, and to voluntarily engage in innovative activities.

Establish matrix innovative functionality that is, an efficient system for the measurement of innovative activities and their effectiveness. In this connection it may be proposed modified framework benchmarks for investment flow and measure the results of innovative activities (Table 6) successful company "Whirlpool" (*Skarzinski and Gibson, 2009*).

Table 6. Criteria innovative activities

	Invested assets	Flow	Result
Process	The range of communication networks	The number of new ideas, and pace which progress	The number of innovations in phase experimentation
Management and employees	Percentage of time dedicated to innovative activities	Percentage of employees dedicated to innovative activities	Percentage of trained employees
Efficiency and financing	The percentage of the budget that is allocated for innovative activities	Assessing quality in against targets	Total income from innovative activities

For matrix to be completely functional, process, management and employees, efficiency and financing, must be measurable through invested and realized, that the end result would be to measure the number of innovations in the phase of experimentation, the percentage of skilled workers and the total revenue generated from innovative activities.

Creating record of innovative activities, or database. When company do better and faster to develop a database it makes it better to be able to monitor and evaluate their own innovative capability.

Adjust the functionality of innovative activity in the case: that the company has not sufficiently innovative ideas; to come to "jam" the idea in the midst of the company, or channels, etc. If the above comes to management may decide to:

1. Increasing the number of ideas that arrives through the channel;
2. Increasing the budget for innovative activities;
3. Mild lowering the criteria for passage of ideas, etc.

Preserving innovative infrastructure is priority management. To preserve its innovative enterprise infrastructure should not be compacted innovation in some corner of the company, but to incorporate innovation into every corner of the enterprise, and that innovation is equal to the operational efficiency (*Skarzinski and Gibson, 2009)* ..

Therefore, the present model would be applicable to all companies, regardless of their size. Presented model, which would be developed over time and through experience, it could be a good prerequisite for the successful management of innovative activities.

5. CONCLUSION:

Summarizing all the above it can be concluded that BiH is one of the few countries on whose territory, despite the significant changes that have occurred in the transition countries and global processes that affected the whole world, the management has not taken hold and is completely left out of practice. It is not significantly altered inefficient management system and has not obtained a new quality or new productive forces, similar to that of the management system in enterprises market economy countries. The management have been made only formal innovations, only new institutional control bodies such as the assembly of the shareholders and board of directors. Management companies in BiH is addicted to bureaucratic management employees and the existence of the bureaucratic enterprise. Generally speaking, the companies in B'n'H has not developed an awareness of the importance of the development of innovative activities, which points to the fact that the management company is not a strategic partner with the employees of the company, and does not affect the awareness of employees about the importance of innovative activities. Theoretical and empirical exploring it has been determined, and it is particularly devastating fact that in most enterprises in B'n'H is still present consciousness that creates a successful competitive position by introducing novelty. One way to gain and maintain a competitive advantage must be sought in an appropriate management model of innovative activities and the proposed model in this study may have been a one of the solutions. The model is applicable to all companies that strive to be innovative, regardless of their size. This model, whose development is taught through time and experience, he could be a good prerequisite for the successful management of innovative activities, especially in companies in transition countries such as Bosnia and Herzegovina.

6. LITERATURE;

Avolio, B.J., Walumbwa, F.O. and Weber, T.J. (2009). *Leadership: Current Theories, Research, and Future Di rections.* Annual Review of Psychology, 60, 21-49.

Bauer, C., Viola, K. and Strauss, C. (2011). *Management Skills for Artists: 'Learning by Doing'?* International Journal of Cultural Policy, 17, 26-44.

Bigliardi, B. (2013). *The effect of innovation on financial performance: A research study involving SMEs.* Inno vation: Management, Policy & Practice: Vol. 15, No. 2, pp. 245-256. doi: 10.5172/impp.2013.15.2.245

Bridgstock, R. (2011). *Skills for Creative Industries Graduate Success.* Education + Training, 53, 9–26.

Cunningham, S.D., Cutler, T., Hearn, G., Ryan, M. and Keane, M. (2004). *An Innovation Agenda for the Creat ive Industries:Where is the R&D?* Media International Australia incorporating Culture and Policy, 112, 74-85.

ĐorĈević, D., Ćoćkalo, D., Bogetić, S. (2010). *Analysis of the competitive ability of domestic enterprises in the light of new global flows.* JUSK ICQ 2010 *The third conference of development of business excellence and competitiveness*, 2010. JUSK Beograd. str. 332 - 335.

Europea Commission: Enterprise and Industry. (2013, Januar). U: *Innovation Union Scoreboard 2013.* Preuz eto 25. januara 2013, sahttp://ec.europa.eu/enterprise/archives/ius2013/IUS2013.html

Hatunić, E., Kuĉ, H., Hatunić, E., Mešić, M., Kuĉ, A. (2011).*The management of the future,* Tuzla: OFF-SET " d.o.o.

Hotho, S. and Champion, K. (2011). *Small Businesses in the New Creative Industries: Innovation as a Peopl e Management Challenge*. Management Decision, 49, 29–54.

Haukka, S. (2011). *Education-to-Work Transitions of Aspiring Creatives.* Cultural Trends, 20, 41–64.

Jakšić-Levi, M. (2001). Strategic management of innovation, Beograd: FON.

Jovičić, M. (2006). *Definition of model for measuring the performance of managers in countries in transition,* Banja Luka: Acta Economica 4/6, Ekonomski fakultet Banja Luka.

Lalić, N. (2010). *Managerial decision-making,* Bijeljina: Pedagoški fakultet Bijeljina.

Mumford, M.D., Scott, G.M., Gaddis, B. and Strange, J.M. (2002). *Leading Creative People: Orchestrating Ex pertise and Relationships.* The Leadership Quarterly, 13, 705-50.

Pallant, J. (2010). *SPSS: Manual for survival,* Beograd: Mikro knjiga.

Preston, P., Kerr, A. and Cawley, A. (2009). *Innovation and Knowledge in the Digital Media Sector - An Information Economy Approach*. Information, Communication & Society, 12, 994–1014.

Rejnert, E., (2010). *Spontani haos,* Beograd: Ĉigoja štampa.

Rickards, T. and Moger, S. (2006). *Creative Leaders: A Decade of Contributions from Creativity and Innovati on Management Journal*. Creativity and Innovation Management, 15, 4–18

Skarzinski, P. i Gibson, R. (2009). Inovacija pre svega, Beograd: Finesa.

Šehić, Dž. (2002). *Strateški menadžment,* Sarajevo: Ekonomski fakultet Univerziteta u Sarajevu.

Tidd, J., Bessant, J. Pavitt, K. (2005). *Managing Innovation: Integrating Technological, Market and Organizati onal Change,* John Wiley & Sons, Ltd. 3rd Edition

Tidd, J., Bessant, J. (2009). *Managing Innovation, Integrating Technological, Market and Organizational Cha nge*, John Wiley & Sons, 4th Edition.

INTERNATIONAL MANAGEMENT

THE IMPORTANCE OF ASIAN CONGLOMERATE BUSINESS MODELS IN INTERNATIONAL MANAGEMENT

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Abstract: *This paper analyzes the prominent Asian conglomerate business models in terms of contemporary international management. The paper examines their specific characteristics and contribution to increasing the competitiveness and export performance. It also reviews current and future importance of business networking in practice, with special reference to the conditions of discontinuity. The emphasis is on the significance of the implications of the Asian management in the development of conglomerates and independent business entities within them. It has been shown that important business models in the Asian market with its existence shape the conditions of profit making and the course of regional integrations. The paper displays the results of studies of Asian management and its importance for the improvement of the position of Asian conglomerates in the global market. The innovativeness of Asian management is also important as it contributes to companies' success in international business with its specific knowledge and methods. The focus is on the management of international activities and prospects of the global success of Asian business groups. Practical examples provide insight into the most important advantages that characterize the Asian conglomerate business models in the context of comparative management.*

Key words: *Asian conglomerate business models, International management, Business groups, Export, Competitiveness*.

1. INTRODUCTION

The complex business environment in Asia requires timely optimal business decision making in order to achieve planned economic results of operations. The current environment demands a flexible adaptation to new international markets, due to the existence of different quality and quantity of important resources, such as knowledge, capital and technology. Management of these resources is the key to the future and sustainable development of Asian companies. Bearing in mind that the given conditions are followed by increasing fluctuations within the aggregate supply and demand, and the different needs of consumers, Asian markets require a modified approach to the creation of the business model. Based on this, it can be concluded that the modelling of business ventures has to be founded primarilly on innovation. New business models in Asia can be viewed as parts of the business system, consisting of a series of interdependent links, thus creating an advantage and making competitive business viable (Mayo & Brown, 1999).

Models of modern business networking in Asia realistically reflect the growing economic prosperity of the Asian economies. The use of business opportunities to create value for consumers is visible in applying specific management skills in practice. There is a trend of business process improvement, with the aim of generating profits with the help of synergistic effects of knowledge, capital and information.

The analysis of specific characteristics of conglomerates and business groups in Asia requires exploration of the entire social and economic environment of enterprises, which is reflected in the decision making processes of managers. The impact of cultural heritage and its consequences for the management structure provide a broader picture of the reasons for the creation of innovative approaches to business. A distinctive holistic approach is featuring along with the connections with traditional values of society on the one hand and focus on future business success at the international level on the other. Multidisciplinary nature points to the continuous need of Asian management for improvement and enhancement of business processes, while achieving efficiency and developing knowledge management. The existence of business groups contributes to the success of regional integrations and acts as an important factor of achieved macroeconomic performance and enhanced competitiveness.

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2. CHARACTERISTICS OF ASIAN CONGLOMERATE BUSINESS MODELS

Business groups in Asia start from a competitive performance in the market, with the development of strong business relationships with multinational corporations abroad. Their essential characteristics are diversification of production and centralized control. In the modern international management, they are associated with the specifics of the Asian management and the centuries-old tradition of culture that ultimately resulted in the formation of hierarchical structures largely based on the age and experience of managers.

Some authors (Almeida & Wolfenzon, 2006) emphasize the family management of firms in business groups as a major difference compared to other conglomerate companies in the world. Business groups are characterized by the operation of separate business entities that are under the same ownership and work with the unique control. The high degree of independence and domestic market imperfections promote economies of scale and incremental growth of innovation, contributing to long-term success in international business.

The achieved results are largely attributed to specific managerial skills, unique, original business models and development of new methods of management. For our analysis, especially important business groups in terms of the specifics of doing business in the modern practice of international management are *chaebol* groups in the Republic of Korea, conglomerate companies *qiye jituan* in the People's Republic of China, the *business houses* in India and *keiretsu* in Japan.

The sales of *chaebol* business groups are equal to about 75% of Korea's GDP (gross domestic product) (Colpan, Hikino, & Lincoln, 2010). These groups are the main drivers of innovation in Korea, significant in terms of international competitiveness, as well as a great strength of the economic prosperity of the state. Their characteristics are management of companies in accordance with paternalism, and in some cases a lack of transparency of information. Development of *chaebol* groups has a crucial impact on total exports and future course of economic development of Korea. Continuous changes in the external business environment impose detailed analyses of the functioning of the *chaebol*, as a factor of shaping the social, economic, cultural, and technological components of the entire Korean society. The challenge of testing the responsibility delegation functions and the creation of new management processes in the business of *chaebol* consists of defining the modified business paradigm that will serve the next generation of managers as a basis for decision making.

By applying the reformed regulations and rules, transparent operations and increasing the number of specific skills, the management of *chaebol* calls for the harmonization of the existing system and the new model of international business. The mechanism of the high degree of state intervention, present since 1950s of the twentieth century, involves a hybrid form of close cooperation between the public and private sectors in the Republic of Korea. The impact of modern business models of companies in *chaebol* groups depends precisely on the market deregulation and mutual cooperation with major international corporations. The liberalization of markets, the increased level of competitiveness of enterprises and generating new business strategies affect the need for a smaller share of the instruments of state action, with an increasing emphasis on the sustainability of the business model of *chaebol*. Sustainable management integration has increased by 25% over the period of 2007-2012, as a result of a better distribution of responsibilities, increased investment in research & development and investments in sustainable business opportunities (Solability, 2013). Internal management strategy called New Venture Units (NVU) focuses on the replication ideas of start-ups business model in context of existing firms (Kim, Bae, & Bruton, 2012). The growing interest of *chaebol* managers for innovative solutions arising from the internal business environment makes NVU a new foothold of innovation development, as the main reason for the huge success of these business groups in international business.

According to the (International Chamber of Commerce, 2013**)**, based on the Open Markets Index, the Republic of Korea is ranked at the 45th place out of 75 countries, with a score of 3.6 (on a scale of 1 to 6). Notwithstanding its rank, according to the market openness, among the G20 countries, the intensity of local competition, according to which the Republic of Korea takes the eighth place out of 189 countries, indicates the negotiating power of the *chaebol* management and competitive strength they possess and in foreign markets (Schwab & World Economic Forum, 2013). Outsourcing in the stage of interorganizational actions of the company has an increased participation, where *chaebol* groups position their production processes in the countries of the region. Capital capabilities and effective human resources management provide an impressive level of absorptive capacity of the *chaebol* in the case of the global economic crisis. Continuous

improvement of cohesive business policy, which respects the principles of successful corporate governance, contributes to the preservation of the economic power of *chaebol* in global terms.

Paternalistic, authoritarian management style is associated with a high degree of nepotism in the *chaebol*, which proved to be economically efficient, given the presented work ethic, with respecting traditional and family values. The family is the initial reason for the existence of these groups, which is suggested by the term *chaebol*, which is a specific combination of two words "wealth (*chae*) and family (*bol*)." In the long run, vertical integration and operation within the internal market reduces transaction costs and promotes a more efficient allocation of resources between two associated enterprises (Murillo & Sung, 2013). The emphasis is on the synergy of specific knowledge, diversification of investment and attitude to business risk.

"Top 30" *chaebol* groups have an obvious role of a leading force in the economy of the Republic of Korea. (Moskalev & Park, 2010). Sustainability of business with own financial and technical resources contributes to *chaebol* groups competitiveness in international business. Solutions for global challenges faced by top management are found in the redistribution of equity, more efficient monitoring by the banks, a greater share of external markets in their business, with the aim of greater placement of the final products (Choe & Pattnaik, 2007). Equal distribution of wealth and the internationalization of business of small *chaebol* group members (*kyeyol* companies) are cited as key future strategic orientation, due to the increased geographic dispersion of distribution, growth of foreign competition and the importance of price competitiveness.

Internal monitoring and operation on the principle of holding companies is gradually adapting to the growing demands for a holistic, institutional management system in accordance with moral norms and beliefs of individuals. Reorientation of business towards technologically advanced products strengthens the interaction between managers and communication, given that the top management has the authority but not all of the relevant information, while the middle and lower management has the necessary information, but not the authority to implement them. The emphasis is on improving the management through changes of the existing business model in order to achieve the desired success and future economic prosperity of the Republic of Korea (Park, Shin, & Suh, 2008).

Building on the model of the future challenges of *chaebol* business groups, comparable to them are the basic principles of management of *qiye jituan* conglomerate companies in the People's Republic of China, that in the mid-1990s became an important form of doing business. *Jituan* business groups emerged from many state regulations and laws adapted to the creation of new conglomerates, which was expected to comprehensively incite the whole Chinese economy. Business ventures of Chinese *jituan* are mainly centralized, primarily stemming from the parent company to the subsidiary companies ("children" companies), in which the mother company owns a majority share in the property (Lu & Yao, 2006). With this multilayered management structure *jituan* is able to control a large number of partner companies, which is why diversification is a popular strategy aiming to achieve progressive development. Specific approach to managing complex *jituan* groups stems from deep-rooted Chinese cultural norms, based on which the business associations are achieved primarily through a personal relationship of managers (*guanxi management*). According to Chinese business customs, security of basic resources necessary for existence should be consolidated with a large network of *renqing* (exchange of private services among employees, manager empathy) and *mianzi* (face, reputation and honor of the individual) (Su, Mitchell, & Sirgy, 2007). The given principles are largely responsible for the extensive system of loans within the Chinese business groups, which continue to operate externally and shape other economic activities in the country. Quantitative analyses showed that the higher the interaction of managers within *guanxi*, the greater the rate of profitability and productivity of a company (Keister, 2000). On the downside, it is noted that the connections between *guanxi* managements hinders the implementation of acquisitions and spin-off of the business group members.

Intervention of the authorities and direct participation in decision-making arises, due to the implementation of the objectives of international management, the need for the division of Chinese business groups in terms of public and private property, in order to choose an adequate strategic approach to business. These two groups of companies primarily differ in the degree of diversification in the later stages of the life cycle of the company, where private Chinese business group are highly diversified, thus becoming a key factor in organizational mosaic of management in East Asia (Carney & Gedajlovic, 2003). The size of conglomerate Chinese companies gives them an advantage in the process of financing, and there are common examples of business groups establishing their own financial institutions, similar to those around which the processes are organized in the Japanese *keiretsu* groups (He, Mao, Rui, & Zha, 2013). National business groups in China are particularly effective in the sector of control of the group capital and distributing the final products. Increasingly present and incremental is the transformation into hybrid forms of business of conglomerates, connecting public and private sector and taking advantage of bilateral dependence in terms of economic

transition (Nee, 1992). Inefficiency can arise in case of frequent attempts of the state to use microinterventions to affect the decision-making of the management (Nee, 1992).

There is a tendency to reduce the influence of the state over *jituan* to a less extensive administration and partial control of the parent company of the conglomerate, which is considered to be a major step towards market economy and liberalization of trade in goods and services. According to (Keister, 2000), special attention should be directed towards analysis of the interdependence of government regulations and economic performance of conglomerate companies in China.

Dynamic collectivism, as a consequence of the philosophical values of Confucianism, contributes to the accumulation of firm specific knowledge within the Chinese business groups. Power of the Chinese management, resulting from the egalitarian collectivism and consensus-based decision-making, makes the model of business groups in China adequate for fast-changing markets in Eastern Asia. Vertical collectivism, as a still prevalent form of governance, shows a degree of inefficiency, which is indicated by the ranking of the People's Republic of China at the 60th position out of 189 countries included in the analysis, according to the willingness to delegate authority (Schwab & World Economic Forum, 2013). However, in the long run, both horizontal and vertical collectivism create a relationship of trust between companies and customers (Romar, 2004) and form the basis for moral reasoning of managers. Rule of law (*fa zhi*) serves as a framework for the design of structural change of groups and their strategic orientation of business relationships (Wang, Wang, Ruona, & Rojewski, 2005). Competitiveness of member companies of Chinese *jituan* pertains to the specific management initiatives, creativity and interpersonal cooperation of which improve the model of Chinese business groups. In the context of sustainable development in contemporary Chinese management, special attention is paid to corporate social responsibility (Milicevic, Lovric, & Markovic, 2012).

The emergence of complex business systems in India called *business houses*, as insufficiently tested models in the practice of international management, implies the importance of business networking in Asia. The diversity of the business portfolio and focus of financial resources to conglomerate core business support the expansion of the *business houses* in the restrictive business environment of India (Manikutty, 2000). Structure of business houses model, in a way similar to *chaebol* groups in the Republic of Korea, can set conceptual obstacles in improving management and timely implementation of business plans and make it difficult to allocate industry-specific resources, mainly inflexible and nonfungible (Colpan, Hikino, & Lincoln, 2010).

“Persons Acting in Concert” (PACs) represents individuals, companies or other legal entities through which the controlling shareholders may indirectly control affiliate companies (Colpan, Hikino, & Lincoln, 2010). The importance of the PACs for business is visible in the fact that the direct ownership of the family members of the owner of the *business houses* in India is very small, so in the company Reliance Industries it is only 0.75%, while in the Tata group it is not registered (Colpan, Hikino, & Lincoln, 2010).

Some authors (Khanna & Palepu, 2000) find that *business houses* in India by focusing on the strategy of unrelated diversification can fill institutional gaps and use their own capacity to play a key role in business ventures. However, while unrelated diversification would be an adequate response of optimal development in regulated market conditions, the Indian market deregulation allows groups to choose a route based on the use of the current opportunities, with the help of the core competences. When the capacities limit is reached, *business houses* expand their activities by signing license agreements with companies from industrial sectors that are not related to their primary group business (Nayyar, 2008). In the period after the implementation of the so-called "Second Wave" reforms, investments of Indian *business houses* largely turned to developed countries, promoting global competitiveness by geographical refocusing and changing the sector composition. Due to the saturation of demand and globalization of business trends, *business houses* are more concentrated on the production of technologically advanced products and marketing opportunities, with the possible neglect of generic resources within the group (Guillen, 2000). Effective management of international activities and turning towards capital-intensive industries make Indian business houses important global competitors. They also become a leader among developing countries in the number of mergers and acquisitions executed annually (Nayyar, 2008).

A comparative analysis conducted in 2006 shows that the company, members of business groups in India, were six times larger in terms of sales profits than stand-alone firms, and four times larger in terms of their overall assets (Colpan, Hikino, & Lincoln, 2010). Data analysis suggests taking advantage of economies of scale. Efficiency is reflected in the high turnover ratio of stocks, lower production costs and a higher rate of return, giving a strong negotiating power to management in India. Managers of business houses have a parental role, for which the Indian term is *mai- baap* (mother - father) business management (Goyal, 2012).

Thus, the top management also has a high reputation in international activities, where it implements important decisions based on competence and social equality of employees, which is particularly highlighted in the Indian conglomerate. A pragmatic approach to solving problems gives them the freedom resulting from the control of the business processes of the group, thus initiating the growth and indirectly influencing the improvement of the market mechanism.

Japanese *keiretsu* conglomerate groups consist of technologically superior companies in the Asian market. Business-oriented and financially concentrated around the major Japanese banks, *keiretsu* use the advantage of the positioning of its production facilities in the markets of neighboring countries, as indicated by the fact that they accounted for about 40% of all foreign direct investment of Japan in Asia (Peng, Lee, & Tan, 2001). *Keiretsu* systems are divided into horizontal and vertical, suggesting great heterogeneity of the organizational structure of Japanese conglomerates. Vertical *keiretsu* consists mainly of manufacturing companies and their subcontractors, where upstream suppliers and downstream distributors share the total costs of joint ventures (Lin, 2005). Common equity and close relationships among suppliers reduce transaction costs, promote better coordination and create long-term relationships of cooperation (Matsuura, Pollitt, Takada, & Tanaka, 2003). The combination of autocracy at the conglomerate level and a high degree of autonomy within the company strengthens the ability to create information and transition efficiency of the vertical *keiretsu* in the planning process and reciprocal monitoring of companies, during business internationalization process (Aoki, 1990). Intra-group information spillovers enhance innovation in member companies, and thereby enhance their business success (Lincoln, 2009).

Horizontal *keiretsu*, on the other hand, is based on a lesser degree of hierarchical structures, frequent informal bottom-up management interactions and the formation of the business core, generally of a bank or trading company, which provides financial support to conglomerate (Peng, Lee, & Tan, 2001). It is composed of companies from various industrial sectors, whose management makes independent decisions and shapes the policies *keiretsu* by equal rights (Lai, 1999).

The management of *keiretsu* conglomerates is characterized by the decision to establish long-term, flexible contracts with employees, frequent communication, reducing information asymmetry and specialized investments. The main source of competitiveness of *keiretsu* is its capability to generate extremely high profit margins through joint contributions of the member companies individually specialized for a particular business segment in the chain of production (McGuire & Dow, 2009). The power of *keiretsu* groups establishes the basis for secure business environment, promotes research and development and prevents destabilization of the economic development of the country, resulting in the generation of technological fusion in the Japanese market. Significant competitive advantage derives from the possession of rare, valuable and hard to imitate assets, which have the power to create great added value for the company during the initial stages of entering the foreign market (Peng, Lee, & Tan, 2001). The prominent internal control of *keiretsu* companies, one of the main features of their management, significantly increases productivity by using specific mechanisms and skills, which in practice proved to be very successful (Lai, 1999).

Total commitment to achieving the goal of reducing inventory costs and operating in accordance with the principle of zero inventory is what makes business management techniques of *keiretsu* one of the most efficient in the framework of international management. Special attention is devoted to teamwork, lateral communication and cyclic distribution of labor, according to which employees are trained to perform several different tasks (Wireman, 2004). *Anshin* management concept, which is literally translated as "peace of mind", is based on the establishment of trust between suppliers and manufacturers and a large investment of time and effort in establishing long-term business partnerships (Aoki & Lennerfors, 2013). Applying homogenization of management activities and promoting cooperation between companies, *keiretsu* groups skillfully combine traditional business values and the demanding requirements of the international aspects of business, thus positioning itself as a leader in cost- efficiency and productivity in the Asian market. Impact of the success of *keiretsu* companies in the Japanese economy is unambiguous. Thus, according to (International Chamber of Commerce, 2013), Japan is ranked as number 1 in the enhancement of production processes and the intensity of local competition, in the analysis that included 189 countries.

3. ASIAN CONGLOMERATES IN CONTEMPORARY INTERNATIONAL MANAGEMENT

Haier Group, a Chinese conglomerate group *jituan*, succeeded in a relatively short period of time since its establishment in 1984 to create a reputation of a highly efficient manufacturer of quality consumer electronics and home appliances. The strategy of internationalization of Haier Group is comprised primarily of the operation on the principle of Uppsala model, by successive greater physic distance and expansion of

products range in the early stage of export of products in developing countries, by forming a joint venture with local business partners. The goal of the management is to market the products whose brand is recognized worldwide, but with adaptation to the specific needs of consumers. In the markets of developed countries, business is started with low-end items by applying extender strategy of penetration pricing and then, by gradually building trust with users, the aim is to ensure competitiveness in the high-end consumer products sector (Duysters, Jacob, Lemmens, & Jintian, 2009). By emplying Dodger strategy of transfer of international competitive assets back to the domestic market, Haier Group avoids direct confrontation with immediate competitors and establishes technology alliances with the competition, as well as with global conglomerates in other industrial sectors. By "rural" and "green" strategies Haier Group has developed a large network of energy-efficient operations in rural areas of China, becoming a leader in this field since 2009 till today, which is a great foundation for testing different market segments (Chan, 2011).

Samsung Group, a globally renowned Korean conglomerate group, consists of more than 60 affiliate companies, the largest being Samsung Engineering, Samsung Heavy Industries, Samsung Medical Center and Samsung Electronics. Parental role of Samsung's headquarters is very present. An example of a particularly successful company within this conglomerate group is Samsung Electronics, which has made great progress in manufacturing technology components, which to them are cash-cow products (Rim, 2007). The strategy of expansion by extensions of partnerships and conquest of peripheral markets has allowed Samsung to become the leader in the memory chip industry, already after the first 10 years of operation (Mathews, 2006). Investment in research and development as a key to achieving sustainable competitiveness are substantial. The Samsung Advanced Institute of Technology as Samsung Group's R&D Hub has been established.

LG Group is characterized by an extremely complex network of business and dominance in emerging markets such as India, Indonesia and Brazil. Fields of activity of this conglomerate are primarily electronic industry (LG Electronics), chemical industry (LG Chem) and telecommunication industry (LG Uplus). Out of the total investment, significant funds are allocated to research & development, which is the main reason for its rising dominance in the sector of LED (Light- emiting diode) technology as a key innovation in the group. By increasing production capacity as a survival strategy, LG Group maximize economies of scale. Applying the tactic of aggressive internationalization through mergers and joint ventures, LG has become one of the world's most competitive business groups. By increasing the quality of the final product, LG becomes the best "value for money" competitor (Choe & Pattnaik, 2007). "Top - tier" strategy of sustainable competitive advantages enables LG Group to set the market standards in understanding what really needs to be done in order to create a balance between cost-efficiency and meeting the specific needs of the user (Choe & Pattnaik, 2007).

Reliance Industries Limited business house is the second company by income level in India. Business model of this business group gives a realistic picture of the advantages of the complex structure of a company and the benefits of intra - industry trade in goods, reducing transportation costs and inventory turnover ratio, as two important factors in the business sector of the petroleum industry. By backward vertical integrated management strategy of procurement of raw materials within the group, Reliance reduces costs for the amount of import duties and creates a sustainable business model, which is indicated by the fact that 2012 export of this business house had a share of even 14% of the overall exports of India (Reliance Industries Limited, 2013). The resiliance of the business model in the period of uncertainty and rapid changes results from the leadership in innovation and turning towards renewable energy sources, especially *jatropha curcas* biofuel production model, including sources of competitiveness, such as reducing greenhouse gas emissions and longer productive life of installed production plants (Pandey, Singh, Singh, Kumar, Singh, & Singh, 2012).

Tata Group has a long business tradition. Today, this renowned Indian business house is operating with more than 100 global affiliate companies in various sectors, including the sector of information and communication technologies, engineering, energy, automotive, chemical and other industries. Large companies that make up the Tata Group are: Tata Steel, Tata Motors, Tata Consultancy Services, Tata Power, Tata Chemicals, Tata Communications and Tata Beverages. The impetus of creative ideas and innovative solutions has resulted in the emergence of Business Excellence Model, where Tata Group views each subsidiary as a center of excellence, which decentralizes responsibility and accelerates the process of generating new business plans (Tata Group, 2013). Managerial competence within the group requires the formation of teams of experts, who continue to manage demanding operations abroad. Purchasing luxury brands such as Jaguar and Land Rover, Tata Group acquires significant market share in developed countries and know-how. A large part of its business activities is turned to the internationalization of business, with a strong focus on branding all product lines. Orientation towards business philanthropy is prominent.

An example of a successful horizontal *keiretsu* is a Mitsubishi Group, a part of which is also one of the six major banks of Japan, The Bank of Tokyo - Mitsubishi UFJ, Ltd., around which the operations of many other *keiretsu* groups are centred. Mitsubishi Group operates on the principle of management without a parental company, applying flexible strategy of high degree of unrelated diversification. Code of conduct and review of the development of individual management skills arising from collectivism puts the work ethic to the forefront of management. Respect for cultural heritage and a specific business model contributed to the international competitiveness of the Mitsubishi Group. The *"Shoki Hoko"* concept of corporate social responsibility, *"Shoji Komei"* concept of integrity and honesty, *"Ritsugyo Boeki"* the concept of expanding the business internationally represent the three basic principles of business philosophy that are the mainstay of integrated business chain of continuous customer satisfaction (Mitsubishi Corporation, 2012).

4. CONCLUSION

Analysis indicated the specificity of Asian conglomerate business models and confirmed the importance of effective management in terms of increasing competitiveness of the conglomerates in global business, the actions of which reflect the macroeconomic situation of individual countries. A prominent feature is the strategic orientation to stable operation and long-term development, with the implementation of sustainable growth components. Results and achievements on the level of business groups are reflected in the further development of the Asian economies. The conglomerates are expected to continue in the future to improve competitiveness at the global level through effective implementation of specific management models and techniques, as distinguishing features of Asian management.

Reform and harmonization of the decision making process with international trends represent a challenge and an opportunity for Asian conglomerates to expand their operations in highly developed countries, starting with the benefits of development of production processes in technologically advanced economies of Asia. The close connection between business, social and economic environment in Asia foregrounds the importance of strategic management decisions. The degree of government intervention, control and financial support must be seen from the aspect of increasing the business performance of networked companies.

Business trends in the global environment show that the business of conglomerates has a positive effect on the course of development of the Asian economies. In the international management particularly prominent are the achievements of the presented Asian companies in many sectors. Future role of Asian conglomerates is important from the perspective of sustainable competitiveness in a global context.

REFERENCES

Almeida, H. V., & Wolfenzon, D. (2006, December). A Theory of Piramidal Ownership. *The Journal of Finance*, 61 (6), 2637-2680.

Aoki, M. (1990, March). Toward an Economic Model of the Japanese Firm. *Journal of Economic Literature*, 28 (1), 1-27.

Aoki, K., & Lennerfors, T. T. (2013, September). The New, Improved Keirestu. *Harvard Business Review*, 109-113.

Carney, M., & Gedajlovic, E. (2003). Strategic Innovation and the Administrative Heritage of East Asian Family Business Groups. *Asia Pacific Journal of Management*, 20 (1), 5-26.

Chan, X. (2011). A SWOT Study of the Development Strategy of Haier Group as One of the Most Successful Chinese Enterprises. *International Journal of Business and Social Sciences*, 2 (11), 147-153.

Choe, S., & Pattnaik, C. (2007, May). The Transformation of Korean Business Groups after the Asian Crisis. *Journal of Contemporary Asia*, 37 (2), 232-255.

Colpan, A. M., Hikino T., & Lincoln J. R. (2010). The Oxford Handbook of Business Groups. London: Oxford University Press.

Duysters, G., Jacob, J., Lemmens, C., & Jintian, Y. (2009). Internationalization and technological catching up of emerging multinationals: A comparative case study of China's Haier group. *Industrial and Corporate Change*, 18 (2), 325-349.

Goyal, R. (2012). Management in India: Grow from an accidental to a successful manager in the IT & knowledge industry. Birmingham: Packt Publisher.

Guillen, M. F. (2000). Business Groups in Emerging Economies: A Resource-Based View. *Academy of Management Journal*, 43 (3), 362-380.

He, J., Mao, X., Rui, O. M., & Zha, X. (2013, September). Business Groups in China. *Journal of Corporate Finance*, 22, 166-192.

International Chamber of Commerce (2013). Open Markets Index 2013. Retrieved April 14, 2014, from http://www.iccwbo.org

Keister, L. A. (2000). Chinese Business Groups: The Structure and Impact of Interfirm Relations during Economic Development. New York: Oxford University Press.
Khanna, T., & Palepu, K. (2000, April). Is Group Affiliation Profitable in Emerging Markets? An Analysis of Diversified Indian Business Groups. *The Journal of Finance*, 55 (2), 867-891.
Kim, H., Bae, J., & Bruton, G. D. (2012). Business groups and institutional upheaval in emerging economies: Corporate Venturing in Korea. *Asia Pacific Journal of Management*, 29 (3), 729-752.
Lai, G. M. H. (1999). Knowing Who You Are Doing Business With in Japan: A Managerial View of Keiretsu And Keiretsu Business Groups. *Journal of World Business*, 34 (4), 423-448.
Lin, C. C. (2005). The transition of Japanese keiretsu in the changing economy. *Journal of the Japanese and International Economies*, 19 (1), 96-109.
Lincoln, J. R. (2009). Strategic Alliances in the Japanese Economy: Types, Critiques, Embeddedness, and Change. Institute for Research on Labor and Employment.
Lu, Y., & Yao, J. (2006, December). Impact of state ownership and control mechanisms on the performance of group affiliated companies in China. *Asia Pacific Journal of Management*, 23 (4), 485-503.
Manikutty, S. (2000). Family Business Groups in India: A Resource Based View of the Emerging Trends. *Family Business Review*, 13 (4), 279-292.
Mathews, J. A. (2006, March). Dragon multinationals: New players in 21st century globalization. *Asia Pacific Journal of Management*, 23 (1), 5-27.
Matsuura, K., Pollitt, M., Takada, R., & Tanaka, S. (2003, December). Institutional restructuring in the Japanese Economy since 1985. *Journal of Economic Issues*, 37 (4), 999-1022.
Mayo, M. C., & Brown G. S. (1999). Building a competitive business model. *Ivey Business Journal*, 63 (3), 18-23.
McGuire, J., & Dow, S. (2009). Japanese keiretsu: Past, present, future. *Asia Pacific Journal of Management*, 26 (2), 333-351.
Milićević, V., Lovrić, V., & Marković, A. (2012). Challenges of contemporary Chinese business and management. *Management*, 62, 5-11.
Mitsubishi Corporation (2012). Annual Report 2012 – Pursuing Sustainable Corporating Value. Retrieved April 2, 2014, from: http://www.mitsubishicorp.com/jp/en/ir/library/ar/pdf/archives/ar2012.pdf
Moskalev, S., & Park, S. C. (2010). South Korean Chaebols and Value-Based Management. *Journal of Business Ethics*, 92 (1), 49-62.
Murillo, D., & Sung, Y. (2013, September). Understanding Korean capitalism: Chaebols and their Corporate Governance. Retrieved April 4, 2014, from http://www.esadegeo.com/
Nayyar, D. (2008). The Internationalization of Firms from India: Investment, Mergers and Acquisitions. *Oxford Development Studies*, 36 (1).
Nee, V. (1992). Organizational Dynamics of Market Transition: Hybrid Forms, Property Rights, and Mixed Economy in China. *Administrative Science Quarterly*, 37, 1-27.
Pandey, V. C., Singh, K., Singh, J. S., Kumar, A., Singh, B., & Singh, R. P. (2012, June). *Jatropha Curcas*: A potential biofuel plant for sustainable environmental development. *Renewable and Sustainable Energy Reviews*, 16 (5), 2870-2883.
Park, H. Y., Shin, G. C., & Suh, S. H. (2008, January). Advantages And Shortcomings Of Korean Chaebols. *International Business & Economics Research Journal*, 7 (1), 57-66.
Peng, M. W., Lee, S. H., & Tan, J. J. (2001). The keiretsu in Asia: Implications for multilevel theories of competitive advantage. *Journal of International Management*, 7 (4), 253-276.
Reliance Industries Limited (2013). Reliance Industries Limited Annual Report 2012-13. Retrieved April 9, 2014, from: http://www.ril.com
Rim, K. (2007). Paradigm Shift and Challenges for Korean Industry: Case study of Samsung. Innovation and Technology in Korea – Challenges of a Newly Advanced Economy, Physica Verlag, 59-70.
Romar, E. J. (2004). Globalization, Ethics, and Opportunism: A Confucian View of Business Relationships. *Business Ethics Quarterly*, 14 (4), 663-678.
Schwab, K., & World Economic Forum (2013). The Global Competitiveness Report 2013-2014 - full data edition, Geneva. Retrieved April1, 2014, from: http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf
Solability (2013). Corporate Sustainability-Korea. 6th Annual ESG Review Strategic Sustainability Corporate Governance Energy. Retrieved April 1, 2014, from: http://www.solability.com/pdfs/ESG%20Korea_2013.pdf
Su, C., Mitchell, R. K., & Sirgy, M. J. (2007). Enabling Guanxi Management in China: A Hirerarchical Stakeholder Model of Effective Guanxi. *Journal of Business Ethics*, 71 (3), 301-319.
Tata Group (2013). Retrieved April 9, 2014, from: http://www.tata.com
Wang, J., Wang, G. G., Ruona, W. E. A., & Rojewski, J. W. (2005). Confucian Values and the Implications for International HRD. *Human Resource Development International, 8* (3), 311-326.
Wireman, T. (2004). Total productive Maintenance. New York: Industrial Press Inc.

FOREIGN DIRECT INVESTMENTS AND ECONOMIC GROWTH: THE CASE OF SERBIA

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Abstract: *In the global economy there are movements of capital from one to other countries. For the countries which carry out economic reforms, inflows of foreign direct investments (FDI) are important for achieving better economic performances. There are various research papers about the influence of FDI on the economic growth. The aim of this paper is to analyze the influence of FDI on gross domestic product (GDP), exports and unemployment in the Republic of Serbia from 2000 to 2012. The method used is linear regression applied on the World Bank data and the Statistical Office of the Republic of Serbia data. For the period of 2000-2012, the results show that there is no linear correlation between FDI and GDP per capita, exports and unemployment. The economic crisis has worsened the already poor economic situation in Serbia. For the period before the global economic crisis (2000-2007) the obtained results show that there is a strong positive correlation between FDI and GDP per capita, FDI and exports, FDI and unemployment.*

Keywords*: foreign direct investments, economic growth, gross domestic product, exports, unemployment, the Republic of Serbia*

1. INTRODUCTION

When trends of capital exports are analyzed, it is necessary to take into consideration the global economy, global markets and global competition. Exportation of capital from one to another country represents the investment of capital into the economic development of another country. The process of exportation of capital is carried out in order to realize higher profits from such investments than the profits gained from investing into domestic market. The capital moves to the regions where higher profits are expected. Investors invest in lucrative opportunities and possibilities for avoiding risks. Natural resources, large domestic markets and lower production costs are a few attractive factors for investment. The movements of capital from one country to another could be observed from various aspects. The main and the most important classification implies two forms of capital exports: investments and loans. When deciding on investment of capital according to the above given classification, the basic criteria is the difference in profits or dividends if the capital is used for investing, i.e. the amount of interest if the capital is used for giving loans.

Of all types of capital flows, foreign direct investment is generally considered to be the most desirable. Capital inflows such as bank loans and bond funds tend to crowd out domestic investment; however FDI tends to increase the national investment in the equal amount. In today's globally competitive environment, attracting foreign direct investments is one of the top issues for most countries, and especially for the countries which carry out economic reforms. FDI has the potential to generate employment, raise productivity, transfer technology, increase exports and contribute to the overall economic development. Due to that fact, all countries try to improve many factors and policies that have influence on attracting foreign investors. There are different studies that show FDI has a positive effect on the economy (Borensztein et al., 1998; Campos and Kinoshita, 2002; Makki and Somwaru, 2004; Alguacil et al., 2011; Giroud et al., 2012) while also there are researches whose standpoint is that FDI has a negative effect on the economic growth and other economic variables (Hermes and Lensink, 2003; Stanisic, 2008; Doytch and Uctum, 2011).

The aim of this paper is to analyze the impact of foreign direct investment on the economic growth of the Republic of Serbia. The research has been conducted as an analysis of the influence of FDI on GDP, exports and unemployment in Serbia from 2000 to 2012. The method which was used is linear correlation conducted on the World Bank data and the Statistical Office of the Republic of Serbia data.

The paper is structured in five chapters. After the introduction, the second chapter offers an overview of the Serbian economy. The third chapter delivers applied methodology which describes the influence of FDI on the economic growth in the Republic the Serbia from 2000 to 2012. The next chapter gives an overview of the research results, while the last chapter reserved for the conclusion.

2. OVERVIEW OF THE SERBIAN ECONOMY (2000-2012)

Year 2000 is determined as the real beginning of economic reforms in Serbia and at the very start economic growth was present. Production growth in Serbia has been explained by the following factors: a) before 2000 Serbia already had a market-based economy, b) there was macroeconomic stability present, which improved business environment and helped achieve economic growth, c) the country received foreign support and donations (at the end of October 2000), and d) the UN sanctions had been lifted (Begovic et al., 2005). The reforms were implemented quickly. The expansionary fiscal policy and tight monetary policy were the main tools for developing better economic environment. A large number of enterprise privatizations was performed. The banking system, as a sector with a large inflow of foreign capital, was reformed as well. In addition, Serbia received numerous foreign grants and aid. The lack of savings and domestic capital slowed down further reforms and the ability to finance consumption and investment. In that situation, the solution was the inflow of foreign capital, especially foreign direct investments. Foreign capital had a role in achieving Serbian economic growth. Since then, FDI is considered an essential factor in starting production and realizing economic growth.

According to the Development Report of Serbia 2010 (2011), the economic growth of Serbia is based on domestic demand, import and the need for foreign funds. In the period 2001-2008 the average rate of economic growth was 4.9%. The achieved economic growth was a consequence of the process of undergoing economic and social policy changes, institutional reforms and the favorable environment in the international capital market (Đorđević and Veselinović, 2010). However, Serbia established a new model of growth. The new growth model was changed to pro-investment strategy and export-oriented economic growth. The new growth is based on the reform of the public sector, restructuring and infrastructure development. The main objectives of this model are correlated with the EU's goals – decrease of unemployment, human capital improvement, investing in knowledge and technology, export-based growth, rational energy use and poverty reduction. Accomplishing such objectives depends on – fixed investment increase, reducing the share of public consumption in GDP, raising the share of exports in GDP and reducing the current account deficit (Jednak et al., 2013). Although Serbia implemented the new model of economic growth, the rise in production output was not achieved. The possible reasons could be the lack of domestic capital, less foreign investments in comparison with the 2000s due to the global economic crisis, previous unstable political and business environment, insufficiently developed institutions, small domestic market or the distance from investing countries (Erstin and Uvalic, 2013). Further on, the exports are not high enough because the most investments are made the service sector which does not have a large share in the Serbian exports. During the time period 2000 – 2012, the FDI in Serbia had a different volume and trend. The most inflows of FDI were through the privatization and acquisitions in the banking sector, while the greenfield investments were very low.

Merlevede and Schoors (2009) analyzed the FDI inflow in 10 transitional economies and found that the FDI inflow in those countries is primarily affected by the used models of enterprise privatization. The study demonstrated that the countries which mainly used models of internal privatization and free distribution of stock to their citizens, attracted significantly less investments than the countries whose privatization was largely based on the external model.

The highest inflows of FDI were at the beginning of the analyzed period and in 2006 (mostly due to FDI in the telecommunications sector), while the declines of FDI were in 2004, 2008 and 2009. Total net FDI during the entire period amounted to about €15.1 billion (2001-2011). Foreign investors invested in Serbia in the following sectors - services sector (trade, banking, telecommunications, distribution of petroleum products, tourism) and production sector (beer, beverage, tobacco, food and metal and non-metals industry). The highest inflows of FDI came from Austria, Norway, Germany, Luxemburg, Greece, the Netherlands, Italy, Russia, Slovenia and Hungary. The highest foreign investments in Serbia (2001-2011) are Telenor (€ 1602 EUR mil), Gazprom Neft – NIS (€ 947 mil), Fiat Serbia (€940 mil), Delhaize (€933 mil), Philip Morris DIN (€733 mil), Stada – Hemofarm (€650 mil), Mobilkom – VIP Mobile (€633 mil), Agrokor (€614 mil), Banca Intesa (€508 mil), Salford Investment Fund (€500 mil), Eurobank EFG (€500 mil), Raiffeisen bank (€500 mil), Mercator (€500 mil) and StarBev – Apatin Brewery (€487 mil) (Business info group, 2012). Even though the inflows of foreign capital have been present in Serbia, the country's economy has not always had good economic performance. FDI had a direct and an indirect impact on economic activities in Serbia. Moreover, various investments had a different time of realization and influence on the output increase. Due to this fact, there is some difference between FDI and GDP. Based on this overview, the correlations between FDI and GDP, exports and unemployment will be analyzed in the following sections of the paper.

3. METHODOLOGY AND DATA

This paper is based on applied methodology and research carried out in the previous period in the Republic of Serbia (Šabić et al., 2012; Jaćimović et al., 2013). A survey conducted in 2012 (Šabić et al., 2012) found a high correlation between FDI inflows and GDP and between GDP inflows and exports, while the linear correlation between FDI inflows and the unemployment rate was very low for the time period of 2000 to 2010.

Jaćimović et al. (2013) conducted a linear regression analysis of the dependence of imports and exports of goods and services and the growth of GDP per capita from FDI inflows. Time period taken into consideration by this research is from 1995 and ends with 2011. The inflow of FDI was the independent variable, while the dependent variables were the import and export of goods and services and GDP per capita. This study led to several conclusions: 1) There is a strong linear correlation between these variables; 2) Albania has the highest influence of FDI on the dependent variables; 3) Bosnia and Herzegovina has the lowest degree of correlation between variables; 4) The impact of FDI inflow on GDP per capita is the lowest in Macedonia. However, the shortcoming of the research lies in the low statistical reliability of the used method. This is due to the fact that the only reliable correlation between the variables is identified in the case of Albania, where we can see that €1 million of FDI inflow leads to an increase in exports of €3.56 million, the growth of imports of €5.73 million and the growth of GDP per capita by $4.3. In all other cases, R^2 is lower than 0.5 which makes it impossible to analyze the remaining SEE countries. The authors distance themselves from the results and suggest different effects of the global economic crisis on the analyzed countries as the reason for these results.

In this paper, the Inward FDI Performance Index was calculated for the period from 2000 to 2012. Subsequently, the linear correlation between FDI inflow and GDP per capita, FDI inflow and exports of goods and services and FDI inflow and the unemployment rate for the same time period were analyzed.

Inward FDI Performance Index ranks countries according to FDI inflows based on their economic strength (measured by GDP level). The index is calculated using Equation 1:

$$\frac{FDI_i / FDI_w}{GDP_i / GDP_w}$$

where FDI_i represents the FDI inflow for the observed country, FDI_w represents the total amount of FDI in the world, GDP_i represents the GDP of the country observed and GDP_w the total world GDP.

If the index value is greater than one, it indicates that the country attracted more FDI than it contributed to the total global production (measured by GDP) and vice versa in the case when the index is lower than one. The Inward FDI Performance Index measures the country's attractiveness for foreign direct investment according to its market size, while other factors are considered to be of equal importance. Other factors may be various: political and economic stability, the presence of natural resources, development of infrastructure, business environment, opportunities for participation within the privatization process and similar (Bandura, 2005).

Pearson's coefficient of simple linear correlation will be used for measuring the degree of concurrence between: (1) FDI (x) and GDP per capita (y); (2) FDI (x) and exports of goods and services (y), and (3) FDI (x) and the unemployment rate (y) in Serbia for the time period 2000-2012. The standard formula for calculating Pearson's coefficient is used:

$$\frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

To simplify the interpretation, the coefficient of determination R^2, which represents the squared value of Pearson's coefficient, will also be used. The determination coefficient measures the degree of the variance of the two variables which is common, in other words, we examine the common part of the FDI variance and a) GDP per capita, b) exports of goods and services, and c) the unemployment rate in Serbia for the observed period of 2000-2012.

Data on FDI and unemployment rates are downloaded from the database of the World Bank, while data on GDP, GDP per capita and exports of goods and services was obtained from the sources of the Statistical Office of the Republic of Serbia. The data was analyzed using statistical software package IBM SPSS

Statistics 22. It was used to calculate the previously explained Pearson's coefficient of linear dependence. The Inward FDI Performance Index for Serbia for the period 2000-2012 was calculated based on the data obtained from the World Bank.

4. RESULTS AND DISCUSSION

The Inward FDI Performance Index for the observed period demonstrates different values by years (Table 1), so it can't be claimed that a trend in FDI inflows exists. The index has the minimum value in the first (2000), as well as in the last analyzed year (2012). The index value is also lower than 1 in 2001. In all other observed years, the index exceeds the value 1, indicating that Serbia attracted more FDI in relation to its economic strength in global terms, measured by domestic GDP share in world GDP. The highest value of the index is realized in 2006 (5,00) and 2003 (4,78).

Table 1: Inward FDI Performance Index for the Republic of Serbia (2000-2012)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Inward FDI Performance Index	0.06	0.70	2.02	4.78	2.58	2.72	5.00	2.01	1.77	2.42	1.69	2.54	0.60

Based on the data, Pearson's correlation coefficient was calculated and the results are shown in Table 2.

Table 2: Correlations between FDI net inflow and exports of goods and services, GDP per capita, unemployment rate (2000-2012)

		FDI net inflow	Exports of goods and services	GDP per capita	Unemployment rate
FDI net inflow	Pearson Correlation	1	.446	.492	.488
	Sig. (2-tailed)		.127	.088	.091
	N	13	13	13	13

Based on the obtained results, it can be concluded that there is no statistically significant correlation between FDI and exports of goods and services (R^2=0,199); FDI and GDP per capita (R^2=0,242) and FDI and the unemployment rate (R^2=0,238). These results imply that there is no influence of FDI on the basic macroeconomic indicators and the economic growth in Serbia. The reasons for this can be found in the impact of the global economic crisis on the Serbian economy and the significant decline of all macroeconomic indicators.

To comprehend whether the global economic crisis had an impact on the relationship between FDI and economic growth in Serbia, the analyzed period of 2000-2012 was divided into two sub-periods: the period before the global economic crisis from 2000 to 2007 and the period after the global economic crisis from 2008 to 2012.

The obtained results for the first sub-period are shown in Table 3. The results are considerably different from the results for the whole given period.

Table 3: Correlations between FDI net inflow and exports of goods and services, GDP per capita and unemployment rate (2000-2007)

		FDI net inflow 2000-2007	Exports of goods and services 2000-	GDP per capita 2000-	Unemployment rate 2000-2007
FDI net inflow 2000-2007	Pearson Correlation	1	.870**	.743*	.792*
	Sig. (2-tailed)		.005	.035	.019
	N	8	8	8	8

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The correlation between FDI and exports of goods and services is statistically significant at $p<0.01$, while the linear correlation between FDI and GDP per capita and FDI and the unemployment rate is statistically significant at $p<0.05$. At the same time, FDI and exports of goods and services share 75,69% common variance (R^2=0,757); FDI and GDP per capita share 55,20% common variance (R^2=0,552) and FDI and the unemployment rate share 62,73 of explained common variance (R^2=0,627). It is evident that in the period of 2000 to 2007, the highest linear correlation is present between FDI and exports of goods and services, which may indicate that the FDI were mainly export-oriented.

However, there is a positive correlation between FDI and the unemployment rate, which confirms that the increase in FDI inflow raises the unemployment rate. This can be explained by the fact that FDI were mainly the result of the privatization process, which implied rationalization of business operations, which in this way found a new owner.

The obtained results for the sub-period of 2008 to 2012 are presented in Table 4.

Table 4: Correlations between FDI net inflow and exports of goods and services, GDP per capita and unemployment rate (2008-2012)

		FDI net inflow 2008-2012	Exports of goods and services 2008-2012	GDP per capita 2008-2012	Unemployment rate 2008-2012
FDI net inflow 2008-2012	Pearson Correlation	1	.090	.862	-.666
	Sig. (2-tailed)		.885	.060	.220
	N	5	5	5	5

It is visible that there is no linear correlation between FDI and exports of goods and services. Pearson's correlation coefficient for the relationship between FDI and GDP per capita is 0.862, while the coefficient of determination is 0.743, which indicates a strong connection between FDI and GDP per capita for the period of 2008-2012. However, due to the shortcoming of Pearson's coefficient and its sensitivity to the size of the sample, this relationship is not statistically significant, i.e. it can't be confirmed with how much trust the obtained results can be accepted. There is a moderate inverse linear correlation between FDI and the unemployment rate (Pearson's coefficient equals -0.666), while R^2 equals 0.444, which confirms that there isn't a statistically significant correlation between these variables. The inverse correlation between FDI and the unemployment rate can be explained by the creation of new jobs by the inflow of investments by slowing down the privatization process in the period of 2008 to 2012.

4. CONCLUSION

Based on the analysis of the economic state of the transition countries which carry out economic reforms, it can be concluded that the macroeconomic stability, economic growth and development, political climate, legal certainty, tax policy and other factors have the biggest influence on FDI inflows. The development of a market based economy, opening of the economies to the world, strengthening of the private sector, stability, and above all political stability, legal system reforms and its adaptation to the European legislation, as well as the consistent implementation of adopted laws and tax harmonization with the ones existing primarily in the European Union, are the internal factors which directly influence the decisions of foreign investors to put their money into the developing countries. Some of those factors have a negative impact on a potentially higher FDI in the SEE region. First of all, this refers to the slow implementation of legal system reforms, the slow economic restructuring, the problems in the privatization process, slow and weak growth of the private sector, as well as the unstable political situation in the recent years that had its culmination in war activities.

For the developing countries, the transition economies and the countries which carry out economic reforms, foreign direct investments are the key factor for achieving better economic performances. Those countries have a lack of domestic capital. Thus, their model of the economic growth is based on the foreign capital. However, some of the countries could not obtain output increase. Various research explore correlation between foreign direct investment and GDP. Some of the studies show a positive correlation between those two variables (Borensztein et al., 1998; Campos and Kinoshita, 2002; Makki and Somwaru, 2004; Alguacil et al., 2011; Giroud et al., 2012), while others show a negative correlation (Hermes and Lensink, 2003; Stanisic, 2008; Doytch and Uctum, 2011).

This paper analyzes the Serbian economy and the role and impact of FDI on the economic performances - GDP, exports and unemployment for the period of 2000-2012. The results show that in the analyzed period of 2000-2012, there was no statistically significant correlation between FDI and macroeconomic indicators (GDP per capita, exports of goods and services, and the unemployment rate). Surely that the global economic crisis affected the economy of Serbia and made the already bad economic situation even worse. In order to comprehend the effects of the economic crisis, the analysis was divided into two sub-periods: the period before the economic crisis, from 2000 to 2007 and the period after the financial crisis, from 2008 to 2012. In the first sub-period, the results showed that there is a strong linear connection between FDI inflows and macroeconomic indicators. The most important is the relationship between FDI inflows and the exports of goods and services. This may indicate that investments increase the export potential of Serbia, which is very important given the constant balance of trade deficit. There is also a high correlation between FDI and the unemployment rate, which is primarily the consequence of the fact that FDI was attracted through the privatization process, which included restructuring and downsizing in order to increase efficiency and a small number of greenfield investments. The period of 2008-2012 was characterized by a high correlation between FDI inflows and the exports of goods and services, while there is no significant linear correlation between FDI inflows and GDP per capita and FDI inflow and the unemployment rate. The results for the second sub-period can be explained by the effects of the global crisis on the Serbian economy and the deterioration of all macroeconomic indicators in the given period.

Based on the research on the impact of FDI in the process of transforming the economies of numerous world countries, and especially the former Eastern Bloc, into the modern market economies, attracting foreign capital has become the priority of the economic policy of the Republic of Serbia. Given the fact that Serbia is one of the last European countries to enter the transition process, it has the advantage of the experiences of other countries at its disposal in terms of FDI inflow.

REFERENCES

Alguacil, M., Cuadros, A., & Orts, V. (2011). Inward FDI and growth: The role of macroeconomic and institutional environment. *Journal of Policy Modeling*, *33*(3), 481-496.

Bandura, R. (2005). *Measuring country performance and state behavior: A survey of composite indices*. New York: Office of Development Studies, United Nations Development Programme (UNDP).

Begović, B., Bisić, M., Đilas, M., Ţivković, B., Matković, G. (2005). *Četiri godine tranzicije u Srbiji*, Centar za liberalno-demokratske studije.

Borensztein, E., De Gregorio, J., & Lee, J. W. (1998). How does foreign direct investment affect economic growth?. *Journal of international Economics*, 45(1), 115-135.

Business Info Group (2012). *Foreign Direct Investments in Serbia 2001-2011*. Available at http://www.big.co.rs/

Campos, N. F. and Kinoshita, Y., (2002*). Foreign Direct Investment as Technology Transferred: Some panel Evidence from the Transition Economies*, Centre for Economic Policy Research, Discussion paper no.3417.

Development Report of Serbia 2010, (2011). Ministry of Finance and Economy. Available at http://mfp.gov.rs/UserFiles/File/dokumenti/IZVESTAJ%20O%20RAZVOJU%20SRBIJE%202010.pdf

Doytch, N., & Uctum, M. (2011). Does the worldwide shift of FDI from manufacturing to services accelerate economic growth? A GMM estimation study. *Journal of International Money and Finance*, *30*(3), 410-427.

Đorđević, M., & Veselinović, P. (2010). Razvojne karakteristike srpske ekonomije u periodu tranzicije. *Škola biznisa* 21-30, Visa poslovna skola Novi Sad.

Elteto A., Sass M., (1998). *Motivations and Behaviour by Hungary's Foreign investors in relation to exports*. WP No. 88, Institute for World Economics of the Hungarian Academy of Sciences, Budapest.

Estrin, S. and Uvalic, M. (2013). Foreign direct investment into transition economies: Are the Balkans different? LSE Europe in Question Discussion Paper Series, LEQA Paper No. 64/2013

Giroud, A., Jindra, B., & Marek, P. (2012). Heterogeneous FDI in transition economies–A novel approach to assess the developmental impact of backward linkages. *World Development*, *40*(11), 2206-2220.

Hermes, N., & Lensink, R. (2003). Foreign direct investment, financial development and economic growth. *The Journal of Development Studies*, 40(1), 142-163.

Jaćimović, D., Bjelić, P., & Marković, I. (2013). Uticaj svetske ekonomske krize na međunarodne investicione i trgovinske tokove u regionu Zapadnog Balkana. *Economic Themes*, *51*(1).

Jednak S., Makajic Nikolic D., Kragulj D., Vujosevic M., (2012). Structure and Performances of the Sectors in Serbian Economic Development. BALCOR 2013, XI Balkan Conference on Operational Research, conference proceedings,12-21.

Makki, S. S., & Somwaru, A. (2004). Impact of foreign direct investment and trade on economic growth: evidence from developing countries. *American Journal of Agricultural Economics*, 86(3), 795-801.
Merlevede, B., & Schoors, K. (2009). Privatisation and foreign direct investment in 10 transition countries. *Post-Communist Economies*, 21(2), 143-156.
Šabić, D., Vujadinović, S., Milinčić, M., Golić, R., Stojković, S., Joksimović, M., Filipović, D., Šećerov, V., & Dimitrijević, D. (2012). The impact of FDI on the transitional economy in Serbia–changes and challenges. *Acta Polytechnica Hungarica*, *9*(3), 65-84.
Stanisic, N. (2008). Do foreign direct investments increase the economic growth of Southeastern European transition economies. MPRA Paper No. 8875, *South/Eastern Europe Journal of Economics* 1, 29-38.
Statistical Office of the Republic of Serbia (2014). Retrieved from http://webrzs.stat.gov.rs/
World Bank (2014). World Bank Indicators. Retrieved from http://data.worldbank.org/

INTERNATIONAL COMPETITIVENESS AS A RESULT OF ENTREPRENEURIAL INITIATIVES IN CONTEMPORARY BUSINESS

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Abstract: *Paper presents analysis of international competitiveness as a result of entrepreneurial initiatives. Business model is introduced as a tool suitable for such analysis and details of contemporary business model theory are presented in order to build a solid basis for analyzing competitiveness of companies. Another conceptual prerequisite for such analysis is considered in form of tools needed to grapple with competitiveness concept. Building on these an analysis is provided where the individual traits of the entrepreneur are pinpointed as an element of utmost importance for international competitiveness of entrepreneurial activities in contemporary business. The paper also presents the variety of entrepreneurial initiatives in the international environment.*

Keywords*: International Competitiveness, Business Model, Entrepreneurial Initiatives, International Business, Internet, Born Global Entrepreneurs.*

1. INTRODUCTION

The analysis of international competitiveness, so highly important for planning the new business venture or any other kind of international entrepreneurial business activity, is almost impossible without looking at the business model proposed for such an activity. Recent discussions and dilemmas regarding the business models related to some of the biggest entrepreneurial activities in ICT (Information and communication technologies) area such as IPOs (Initial Public Offering) of Twitter and Facebook companies and acquisition of WhatsApp firm illustrate this issue very clearly. To achieve international competitiveness is an ultimate business aim for any entrepreneur in a globalized and highly dynamic contemporary business environment. In order to achieve this clear cut business vision is needed along with the first class leadership skills. Although entrepreneurship by its definition involves risk taking and involving with activities regardless of resources on hand one must consider thorough planning when embarking on international business venture. Therefore the core importance of analyzing business plan related to it.

2. INTERNATIONAL PERSPECTIVES OF BUSINESS MODEL

There are many preconditions for the success of international entrepreneurial activity. Sometimes these fail in spite of the existence of resources and opportunities and many times the failure is due to inadequacy of the underlying business model. In order to avoid such failures, business model needs to be examined, looked at in detail and planned carefully in advance of an international entrepreneurial activity. Difficulty of this task is partly due to unexacting consensus on definition or the nature of business model concept among scholars and practitioners. Therefore we will have to look at different approaches in order to present more clearly this concept that bears such an importance for international entrepreneurial activities.

Dilemmas regarding the conceptualization of the business model are best illustrated by variety of synonyms used in place of the word model such as design, pattern, architecture or plan. Often we find in both practitioners notes and scientific papers instead of business model terms such as business concept, economic model or revenue model describing various aspects or the unity of the same phenomena. As business model describes very different aspects of an organization at different levels of comprehension of the inner workings of an organization such as economic, strategic and operational levels at which an organization functions. In order to bridge this gap an integrative definition of a business model has been proposed as: a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage (Morris,

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Schindehutte & Allen, 2005). Entrepreneurs need to consider six groups of factors related to their business activities in order to get a hold on overall picture of business perspective in a certain market that is best described and defined by the business model.

The first group of factors relate to the offering of the organization, its primary product or service, the way in which the product or service can be accessed by customers, the means of production or provision of services. Business model often fits into business deliberations of technology based spin-off companies and one such example is coming from Xerox company breeding grounds and the success they achieved based on the differences in their respective business models and pondering entrepreneurs did when envisioning the offerings of these spin-offs (Chesbrough & Rosenbaum, 2002).

The second group of factors defines market elements and the intended user groups defining those for whom the product or service has been planned for. Organization driving the entrepreneurial business may be B2B or B2C oriented and the intended market may be local or national or international. Also position of the customers in the value chain needs to be defined. The analysis and planning of the approach to user groups when defining the business model is of high importance, especially in the entrepreneurial activates related to ICT where the long tail principle drives most of the contemporary markets (Gordijn & Akkermans, 2001).

The third group of factors deals with internal capabilities of an organization and the factors driving it. These factors include all elements of the business from production and selling to R&D and supply chain management. According to (Viscio & Pasternack, 1996) the core competences of a company are of crucial importance for the business model and it is of utmost importance how this competence or competences if there are more then one in play fall in with other elements of the business model. If their importance is underplayed, then the organization most likely won't be able to exploit the full capacity it can derive from such a competence. On the other hand, if it is a sole object of the business model and if other elements are ignored and removed from the business planning process, then there is a danger of sudden and astonishing market or other occurrences disrupting entrepreneurial business activities.

The fourth group of factors important for a business model of entrepreneurial venture deals with competitive strategy issues such as innovation leadership, customer relationships, product quality and its features, overall operational excellence and dependability. It is often that a business model represents the design of content, structure, and governance and allow for creation of value through the exploitation of business opportunities (Amit & Zott, 2001). All the described elements playing into competitive strategy of an organization constitute important factors within the business model concept and that entrepreneur with intentions towards the international activities have to consider these important factors within the business model framework.

The fifth group of factors involves those relating to economic side of entrepreneurial activities such as pricing, revenue sources, and volume of production or service provision, revenues and profits. These factors although seemingly very well researched and known, still comprise many different aspects, such as influence of venture capital availability on entrepreneurial activity (Samila & Sorenson, 2011). If there is ample venture capital available, then it is more likely that an entrepreneurial activity will occur, obviously for reasons of financial resources at entrepreneurs' disposal, but also and perhaps equally important for reasons of increased overall entrepreneurial experience available related to the source of the venture capital and that inevitably follows this kind of capital.

The final group of factors that will be described and analyzed within the framework of a business model viable for international entrepreneurs comprise factors influencing the entrepreneur individually such as time available to him personally for entrepreneurial activities, scope and size of planned or intended entrepreneurial activities. These factors encompass many important considerations such as personal motivation and the aim one has when embarks upon any kind of entrepreneurial activity (Fairlie, 2013). This is especially true for international entrepreneur activities, since the stakes for the entrepreneur are usually much higher in such activities than in the one with predominant local features. Having in mind that the volume of activity, financial interest and time invested are much larger than in local or national business framework, all kind of different personal issues specific for international entrepreneurs, such as reputation in certain markets and in general, networking and experience, may arise.

By having a deliberate business model description involving so many factors is advantageous for analyzing entrepreneurial activities because of the complexities involved in conducting business in the international

environment that is nowadays characterized by globalization processes and cultural influences that demand innovative and creative business solutions. Business model is closely related to various concepts coming

from the field of strategic management that make analysis of international business ventures and other international entrepreneurial activities more accurate. One important concept is defined as strategy, which is the creation of a unique and valuable position, involving a different set of activities (Porter, 1996). Another one, similar, but very distinctive and different, is defined by the same author as operational effectiveness. This concept encompasses the notion of performing activities better, with fewer inputs and defects than competition (Porter, 1996). It is important to note that business model as defined previously contains elements of both strategy and operational effectiveness proving to be a powerful tool for analysis of international entrepreneurial activities.

Finally we will discuss the concept of entrepreneurial activities as an important addition to business model framework which we will use in next sections to analyze international competitiveness and entrepreneurial business initiatives. Business is conducted through implementation of various activities and thus inherently a business model builds framework that groups, describes and organizes the business activates and provide relationships among them in order to describe a meaningful overall picture or map of the business. Such grouping of activities provides good basis for describing elements of a business model and therefore an entrepreneurial business activity may be considered as a founding element for the business model describing overall entrepreneurial activity (Siggelkow, 2002).

Having this in mind we will examine once more the role of the business model and its usefulness for the entrepreneur as it is inextricably related to building successful international business venture and international competitiveness related to it. Advantages an entrepreneur can find in pondering over his business model are numerous, and four major incentives for this can be defined as: conceptualization of the business through set of strategic choices that are interrelated; seeking relationships that may be complementary, primarily these may be some of the elements that posses unique combinations; developing sets of activities around a framework that is logical in the given business environment; ensuring consistency of strategy, architecture, economics, growth, and exit intentions (Morris, Schindehutte & Allen, 2005). Interrelation between concepts of business model, strategy, operational effectiveness and business activities can provide an overall framework for efficient analysis of international competitiveness, so important for success of any entrepreneurial activity in contemporary business.

3. THE SIGNIFICANCE OF INTERNATIONAL COMPETITIVENESS FOR ENTREPRENEURS

When international competitiveness is mentioned the first thought that comes to one's mind is international competitiveness of countries. With readily available instruments that measure this phenomena on a yearly basis, such as The Global Competitiveness Report of World Economic Forum (Schwab & World Economic Forum, 2013) it is no wonder that such inspiration is probable. International competitiveness is of utmost importance for entrepreneurs and the prospect their enterprises have in an international market. There is of course relation between the two and some research provide data describing international competitiveness of countries supplemented by data describing dynamic trends of companies (Dosi, Grazzim & Moschella, 2013).

Country competitiveness is defined as the set of institutions, policies, and factors that determine the level of productivity of a country. Productivity determines rates of return and consequently investments in economy of a country, thus making a more productive economy, the one that grows faster over time (Schwab & World Economic Forum, 2013). According to same source twelve groups of factors are underlying for competitiveness.

Institutions' features make the first group of factors that determine competitiveness of an economy. By providing legal and administrative framework for entrepreneurs and their activities institutions largely define what is possible for organizations and in which timeframe.

Infrastructure available to the economy provides another important framework that determines what is possible and when for entrepreneurs. Transport infrastructure such as roads, ports and information infrastructure such as availability of the broad bend Internet defines the rate of flow of business and the rate of flow of information, which often is crucial for successful international entrepreneurial activity.

Macroeconomic environment and health and primary education make the third and the fourth group of factors that determine competitiveness of an economy by providing yet another layer of environment defining context for activities of entrepreneurs. Thus, macroeconomic environment provides possibilities for long term

planning if it is stable and predictable. Basic features of demographics that are important for many decisions in business are determined by health and primary education.

Higher education and training define fifth group of determinants explaining competitiveness of an economy. These determinants are very important in contemporary business that is mostly driven by innovation and managed by creative drive of the leaders. A knowledge economy and innovative, knowledge related business operation that are the goal of economies and of particular companies are standing on the shoulders of higher education and vocational training that mostly define the quality and the scope of skills that human resources may provide to businesses.

Efficiency of markets, the one of goods, the one of labor and the financial one are next three determining groups of factors for competitiveness of an economy. Efficient markets allow for flow of goods, experts and capital thus providing resources and inputs for entrepreneurial activities and means of distributing the outputs of these activities.

Ninth group of factors encompass technological readiness of companies to adopt and implement modern technologies with an emphasis on ICT that has become general purpose technology (GPT) of our times. Many times foreign direct investments determine the level of available technologies in an economy, thus the separation of this group of factors describing technology availability and the readiness to implement it from innovation.

Market size determines with great effect competitiveness of an economy in that the growth have been found to be related to trade openness i.e. market size. The inclusion of domestic and foreign market in overall market description and measurement provides for the unique measurement tool that can be applied for both developing and transitional economies and those more developed. It is also of utmost importance for international entrepreneurial activities to consider the size of the markets available worldwide.

Eleventh group of factors involve business sophistication that encompasses the quality of a country's overall business networks and the quality of individual firms' operations and strategies (Schwab & World Economic Forum, 2013). Both of these are especially important in very developed economies where more simple production improvements have been exhausted as a driver for productivity increase. Business network quality is also very important for an entrepreneur because of the cluster phenomena that is so influential in contemporary business.

The final, twelfth group of factors is related to innovation. It is very clear that this group of factors is the most important one since it alone can in a long run improve standards of living and productivity. It is especially true for developed economies that have existed means of improving productivity by application of existing technological solutions. As for the developing and transitional countries the globalization effects and dynamics of change in contemporary business environment make the innovation a must even for the companies in those economies that have ambitions to compete in world markets. The importance of innovation for international entrepreneurship activities is tremendous and usually such activities are depending heavily if not completely on an innovative service or a product.

In order to provide for better understanding of the described factors that determine the competitiveness of an economy, they have been grouped into three groups relating to the stage of economic development that each of these groups decisively influence. Thus, the first four groups determine predominantly the competitiveness and development of so called factor driven economies. These economies compete based on their factor endowments of which most important are unskilled labor and natural resources. Consequently the companies and entrepreneurs of these economies base their competitiveness on the price and are involved in activities such as sell of basic commodities and services. As an economy develops it becomes the efficiency – driven economy. The name comes from the fact that since the wages have risen in these economies they also have to maintain the increase in efficiency of production and quality of products and services in order to be able to increase their prices. In such economies factor groups five to ten are mostly responsible for determining competitiveness of an economy. Finally, when wages go even higher, the only way to sustain this is by having innovative and cutting edge products and services that are new and unique and are based on innovations. Such economies are labelled as innovation – driven economies and factor

groups eleven and twelve determine predominantly their competitiveness. As an illustration we will provide rankings of some economies according to (Schwab & World Economic Forum, 2013, 11, Table 2). Factor driven economies are mostly those of countries of Africa, South and Central Americas and Asia, such as Ethiopia, Nicaragua, India and Pakistan. Some of economies that are in transitional phase from factor driven towards efficiency driven are Azerbaijan, Iran, Saudi Arabia, and Venezuela. Efficiency driven economies encompass those of Bulgaria, China, Montenegro, Serbia and Romania. Transitioning towards innovation

driven stage are among others economies of Hungary, Brazil, Poland, Russian Federation and Turkey. And finally some of the innovation driven economies are Austria, Czech Republic, Germany, Israel, Italy, Slovenia, Taiwan, UK and USA. Having this in mind one can assess the important competitive factors for companies and entrepreneurs willing to compete and start entrepreneurial activities aiming at international markets coming from certain economies and thus focus the attention of both theoretical analysis and practical efforts at these factors.

International entrepreneurial activities are dependent on Internet in variety of ways, from information gathering to product delivery and customer relations building. If Internet related entrepreneurial activities are analysed their success is positively related with three characteristics: Internet or online reputation, technological competitiveness related to Internet technologies and finally existence of Internet communities related to entrepreneurial activity, entrepreneur or the brand. The life cycle of an organisation that relates its business activities to Internet is shorter in general. Only 37% organisations with less than 20 employees reach the fourth year of the existence and 9% endures more than ten years in business ventures. All of these aspects have to be grappled with and pondered over by entrepreneurs planning to start international business activities that are nowadays almost exclusively Internet related.

4. THE VARIATY OF ENTREPRENEURIAL BUSINESS INITIATIVES

The importance of entrepreneurship in economy was very well researched and defined (Drucker, 1985), (Schumpeter, 1934). Many different theories and a well sized body of research exist on different features of entrepreneurship in an effort to get a better understanding of this complex phenomenon and find ways to foster it, all in line with its enormous importance for contemporary societies and economies. The role of individual entrepreneur has been also looked into and it seems to be one of the crucial factors influencing competitiveness of an entrepreneurial activity, especially if it is aiming for more complex and knowledge intensive international markets. High importance of entrepreneurs has been often related to their ability to advance innovative business operations, thus innovativeness and entrepreneurship are related in many ways some being straight forward, and some being more complex. Although this fact may be almost self-evident it has been for years that researchers have treated these two fields as almost separate and data have been collected through unique research dealing with either of these two topics and seldom with both as noticed in (Sandberg, Hurmerinta & Zettinig, 2013). In this paper researchers define some individual traits of those prone to innovate and those prone to entrepreneurial activities and then look at what traits are common for these two groups. Innovators have these unique traits according to this research: willingness to change and curiosity and interest in problem solving. Entrepreneurs have the following unique traits: high need for achievement, internal locus of control. Both group share traits of: risk-taking propensity, high tolerance of ambiguity, persistence and self-efficacy. Having these traits in mind, it is important for fostering competitiveness in e.g. efficiency driven economies to focus efforts in higher education and vocational training to individuals with such traits since they are highly likely to be the ones to engage in entrepreneurial activities. In order to create competitiveness in international entrepreneurial ventures such individuals should be educated to a highest degree practicable having in mind their field of interest and character traits that have been described, in order to maximize the competitiveness of the companies they might be establishing and running in the future. A fine example of importance of education for entrepreneurial individuals is depicted in biography of Steve Jobs, founder and CEO of Apple Inc, nowadays a very successful company started exclusively by entrepreneurial activities of Jobs. He has always underlined how crucial for his individual development has been the educational experience from elementary school where a teacher who made a difference made an enormous impact on him, to the college that he never graduated from, but where he learned many useful thing, not obviously related to ICT, such as calligraphy, that made a lasting impact not only on ICT industry, but on the whole Western civilization and its culture (Isaacson, 2011).

The personal story of Steve Jobs is indicative for another phenomena regarding entrepreneurship. It is a relationship between start-up entrepreneurship and the one that is exercised in later phases of a company life-cycle. This phenomenon called strategic entrepreneurship plays a key role for entrepreneurs that are

searching, combining and trying out new resource combinations in the pursuit of profits under uncertainty (Bjornskov & Foss, 2013). The idea of combining research of early phase of activities of an entrepreneur when his company is called a start-up and later phases in which he is wheeling an established company, but still is driven by same entrepreneurial drivers and same individual traits, taking risks, trying out new ideas, etc. brings to life a holistic approach to role of entrepreneurship in defining the comprehensive output of an economy and competitiveness of both economy and individual companies. Therefore this approach must be considered when discussing international entrepreneurship and its competitiveness especially in the future,

since rise in body of research and knowledge in this area is expected along with its importance as an even greater number of economies will move towards innovation driven economic model.

Having discussed different personal traits of entrepreneurs and their importance for establishing international competitiveness of companies and economies, primarily their personal traits and their performance throughout the whole lifecycle of companies they are leading, it is not hard to come to understanding of the concept of the born global entrepreneurs. Those are the ones who start their entrepreneurial activities right in the middle of an international competition game, aiming for the global market right from the start-up phase of their companies. There are four propositions important for the born global entrepreneurs (Persinger, Civi & Vostina, 2007). The first deals with fact that the entrepreneurs with high need for achievement in the global arena will start globally oriented companies. If he is thinking in terms of international competition and thus international competitiveness, then it is likely that a company started will plan and execute its business operations in these relations. Next the entrepreneurs who decided to run as start-up that is aiming for the global or international market will not perceive their own behaviour as bearing special or higher risks. Again one is to consider the mind frame of the global born entrepreneur who thinks, informs himself, plans the business activities in global and not in local or national terms and therefore when it comes to acting on those thoughts information and plans it is not perceived as something very unusual or that bears a special risk. The third proposition deals with proactive attitude of an entrepreneur and such entrepreneurs will be more persistent in overcoming challenges in international markets (Persinger, Civi & Vostina, 2007). This is related to the final proposition of the authors, the one that makes relationship between strong global orientation of an entrepreneur and the high chance he will start a born global company. Again we see how important is the mind set of an entrepreneur in both overcoming challenges in new markets and for embarking on international or global entrepreneurial venture.

Having all this in mind, it seems like a good idea to provide a fuzzy comprehensive evaluation method for evaluating international competitiveness of entrepreneurial activities which is exactly what (Yanrong, Yu & Kang, 2011) propose in area of high-tech entrepreneurial enterprises. Their competitiveness evaluation index system comprise six indexes that deal with R&D ability, entrepreneurial ability, financing ability, marketing ability, profitability ability and growth ability. We have discussed in some length entrepreneurial ability driving mostly from personality of the entrepreneur and have concluded that it is a complex area influenced by many factors, an area that is very good suited for fuzzy logic solution. Therefore, further research building on proposed method is needed that will encompass additional elements and factors that influence entrepreneurs individual traits that are so important for competitiveness of international entrepreneurial ventures.

Finally, we will look into some of the activities of Internet entrepreneurship in Serbia that are international in their scope of activities as analysed in (Sofronijevic, Milicevic & Ilic, 2012). The good example for this is company Nordeus. It embarked on international business venture by launching Top Eleven software game through Facebook and Internet app stores for Android and iOS devices. By reaching global markets Nordeus established an international brand that brought it one of the prestigious The Europas awards for the best start-up in computer games in Europe 2011 (www.nordeus.com).

5. CONCLUSION

When contemplating business model as a basis for the analysis of international competitiveness of entrepreneurial activities in contemporary business, one have to bear in mind the broadness and complexity of business model concept. There are several emerging areas of interest related to business model concept such as business model being a new unit of analysis, its holistic approach to describing of how companies do business, relationship between business activities of the company and the underlying business model and explanation of how value has been created departing from the idea of explaining just how value is captured in a certain business model (Zott, Amit & Massa, 2011). Ideas as such present great expansion and

broadening of conceptual base of business model concept that allow for broader and more complex and all encompassing analysis of the entrepreneurial business. On the other hand, one always have to include the institutional context in the analysis of entrepreneurial activities, for especially in contemporary business there is no such a thing as a intervention free market or total freedom of capital, labor or product flow. A good example of such tendencies is presented by analysis of 2.854 life histories of entrepreneurs from twenty Chinese cities in order to conclude that the institutional background plays a very important role in defining entrepreneurial activities in China (Lu & Tao, 2010). The level of institutional influence is not the same all over the world, one may say that in China it plays a more important role than in some other markets and economies, but when one is envisioning an international entrepreneurial activity and analyze related

competitiveness of the company involved, one has to factor in the important role of institutions in the economy. In order to do it, entrepreneur has to be very well informed and interested in international and global envisioning of his business.

International competitiveness of entrepreneurial activities is highly related to traits of the entrepreneur, but other factors influence this important business feature. In order to understand well and use it to one's own advantage, international competitiveness needs to be analyzed and business model lends itself as one comprehensive and practical, though complex tool for this purpose. Therefore those looking into area of international competitiveness of entrepreneurial companies and entrepreneurs need to grapple with and make best use of business model concept if they are to analyze, envision, plan or research this complex phenomena.

REFERENCES

Amit, R. & Zott, C. (2001). Value Creation in E-Business, Strategic Management Journal, 22, 493-520.

Bjornskov, C. & Foss, N. (2013). How Strategic Entrepreneurship and the Institutional Context Drive Economic Growth, Strategic Entrepreneurship Journal, 7, 50-69.

Chesbrough, H. & Rosenbaum, R. (2002). The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies, Industrial and Corporate Change, 11(3), 529- 555.

Dosi G., Grazzim M. & Moschella, D. (2013). The determinants of international competitiveness: a firm-level perspective, in: Proceedings of the 25th Annual EAEPE Conference 2013.

Drucker, P.F. (1985). Innovation and Entrepreneurship, Heinemann, London.

Gordijn, J. & Akkermans, H. (2001). Designing and Evaluating E-Business Models, Intelligent E-Business, July/August, 11-17.

Fairlie, R. W. (2013). Entrepreneurship, economic conditions, and the Great Recession, Journal of Economics & Management Strategy, 22(2), 207-231.

Isaacson, W. (2011). Steve Jobs. Simon and Schuster: Kindle Edition.

Lu, J. & Tao, Z. (2010). Determinants of entrepreneurial activities in China, Journal of Business Venturing, 25(3), 261-273.

Morris, M., Schindehutte, M., & Allen, J. (2005). The entrepreneur's business model: toward a unified perspective, Journal of Business Research, 58, 726– 735.

Persinger, E., Civi, E. & Vostina, S. W. (2007). The Born Global Entrepreneur In Emerging Economies, International Business & Economics Research Journal, 6(3), 73-82.

Porter, M., E. (1996). What Is Strategy, Harvard Business Review, 74(6), 61 –78.

Sandberg, B., Hurmerinta, L. & Zettinig, P. (2013). Highly innovative and extremely entrepreneurial individuals: what are these rare birds made of?, European Journal of Innovation Management, 16 (2), 227-242.

Samila, S. & Sorenson, O. (2011). Venture capital, entrepreneurship, and economic growth, The Review of Economics and Statistics, 93(1), 338-349.

Schumpeter, J.A. (1934). The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle, Harvard University Press, Cambridge, MA, USA.

Schwab, K. & World Economic Forum (2013). *The global competitiveness report 2013–2014 - full data edition*, Geneva, Switzerland. Retrieved April 7 2014 from: http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf

Siggelkow, N. (2002). Evolution toward Fit, Administrative Science Quarterly, 47, 125–159.

Sofronijevic, A., Milicevic, V. & Ilic, B. (2012). Development of Internet Entrepreneurship in the World and in Serbia, *Tehnika – Menadzment*, 62(2), 292-297.

Viscio, A. & Pasternack, P. (1996). Toward a New Business Mode, Startegy & Business, 2(3).

Yanrong, W., Yu., L. & Kang, L. (2011). Evaluation on the Competitiveness of High-tech Entrepreneurial Enterprises, Energy Procedia, 5, 684-689.

Zott, C., Amit, R. & Massa, L. (2011). The Business Model: Recent Developments and Future Research, Journal of Management, 37(4), 1019-1042.

THE EVOLUTION OF THE PUBLIC DEBT IN ROMANIA AND SERBIA, DURING AND AFTER THE GLOBAL RECESSION

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***Abstract**: This paper describes the special evolution of debt of Romania and Serbia, during and after the recently completed global recession, with a focus on public debt. After a brief theoretical introduction and an equally short review of the recent literature devoted to the subject, the authors stress both the common elements and the particular aspects of the upward trends of borrowing in the two economies, concluding with some final remarks and a tentative anticipation of short-term and medium-term evolution.*

***Keywords:** external or foreign debt (ED), public debt (PD), governmental debt (GD), Gross Domestic Product (GDP), export (X).*

1. INTRODUCTION

Debt issues dominate economic history, and the economic history of the last three decades has dilated it in point of volume and impact, up to limits that are hard to accept and not in the least anticipated. Two concepts prevail in the language of this significant economic chapter: external/foreign debt and public debt, and in particular the last one has caught the attention of recent research.

External Debt (ED) means an amount in foreign currency payable, at a given point in time, by an economy to other economies and/or international financial institutions, in keeping with the loans received by the government and private companies, under the government's guarantee, and is to be paid over a period longer than one year. This sense is used in international statistics, and is understood as external public debt, not including loans with maturities under one year, which were contracted without the government's guarantee. Foreign debt can be gross or net, after deduction, from the gross external debt, of its own claims in relation to non-residents. In determining net foreign debt, only claims (rights) are taken into account, or those that can be easily mobilized (for which there is the perspective of collecting it from foreign debtors is clear).

Public Debt (PD) represents all the obligations that the state (government) assumes when contracting internal and/or external loans to finance public economy. Public debt is related to the financial intervention of the state (government) in the economy, which aims at forming public capital, stimulating investment, increasing employment. In its broadest sense, public debt also includes visible debt, resulting from cash deposits in public vaults, which is payable at any time by the depositors. In terms of material content, it can be of goods and values, in terms of its destination it may be of consumption and of production, and in terms of duration it may be long-term, short-term, etc. *Encyclopaedia Britannica* definition shows that "*public debt represents the obligations of governments, particularly those evidenced by securities, to pay certain sums to the holders at some future time, being distinguished from private debt, which consists of the obligations of individuals, business firms, and nongovernmental organizations.*"

The debt owed by national governments is usually referred to as the national debt and is thus distinguished from the public debt of state and local government bodies (http://www.britannica.com/).

Much of the literature on the topic of debt produced in recent years has tried, and it is still trying, to provide and present original solutions and new methods of reassessment of those phenomena and thresholds, and especially of forecasting external and public debt (Knedlik, Von Schweinitz, 2012), or even extends the analyses related to the same range of problems in geographic behavior areas (Hrvoje, 2013), considered similar in point of behaviour.

Contemporary theory continually redefines the essential role of foreign and public debt and the financial development of an economy, while delimiting a number of debt sustainability problems that are increasingly acute, so the tendency always appears of expanding the universe of financial research and enrich it with new instrumental or cross-disciplinary solutions – crossdisciplinarity being accepted today as the *application of field-specific methods and their recognized use in fields that are altogether different from the original ones*,

with special effects and an increased relevance in understanding the phenomena in question (Săvoiu, 2014). In this regard we can mention the identification and statistical quantification of certain limits through indicators having the nature of restricting debt by the budget, going as far as the maintenance, through close monitoring, low thresholds for reference interest rates, a phenomenon of quantification of incipient "financial repressions", through statistical indicators (Reinhart, 2012; Prabha and Savard, 2013), continually assessing and predicting a phenomena which is hard to achieve in practice, suggestively called *liquidation of public debt*, particularly aimed at *government debt* (Reinhart and Sbrancia, 2011).

A new approach to adjusting the level of public debt in a more sustainable manner is more clearly distinguishable, based on a slightly more stable fiscal measures, or on measures with no temporary character, there being constant monitoring and the analysis of results being conducted at an ever shorter time intervals, noting that tax recovery and reducing debt, however, require a long time, as process management activities (the current Eurostat indicators system operates, during the recession, and especially after recession, with quarterly periodicity). The attempt to scale, through innovative indicators, "the hidden areas of public debt" (IMF Survey, 2013) is another original solution for analyzing debt, stratified in keeping with the level of development of the economies.

Kenneth Rogoff and Carmen Reinhart, who analyzed and quantified the phenomenon of debt over nearly eight decades, between the two great historical recessions (starting in 1929, and in 2007), noting that, after more than three years of financial crisis of the system, plus another three years of recovery (basically, over a period of about six years, i.e. the duration of the latest recession in the Balkans), the debt of a country tends to increase, on average in the first three years, with 86 percent of its original level, and after six years it tends to double in relation to the volume of exports, because of these very hidden areas of the debt; the delimitation of the hidden area especially regards commitments for future budgetary payments related to the pension scheme, which is under the pressure of an aging population; thus, those thresholds or limits of debt are set, where its effects turn from positive to negative, and the debt itself becomes *unsustainable*. (Cecchetti, Mohanty, Zampolli, 2011).

In the European community the preference is maintained related to primarily evaluate public debt, and more especially government debt, whose theoretical limit amounts, in general terms, within the European Union (EU) and European Monetary Union (EMU), to 60% of GDP. In Romania, secular studies (Reinhart, Rogoff, 2010) place the alarm threshold even lower (at about 41%), while for Serbia, which has a much higher per capita income and a higher degree of development, the general alarm level remains that proposed in pre-accession (EU) and (EMU), i.e. the same 60%.

The intention and the originality of the present paper is to exploit the method of confronting, in statistical terms, the phenomenon of borrowing and the statistical indicators in the two Balkan economies (that of Romania, a member of the EU, and of Serbia, which is currently in the pre-accession phase), behaving in a relatively similar ways in their modern history of nearly one and a half centuries.

2. A BRIEF STATISTICAL ANALYSIS OF THE ALARMING UPWARD EVOLUTION OF PUBLIC DEBT IN SERBIA AND ROMANIA

Due to a series of social and geopolitical discontinuities in Serbia, analysis of public debt in the period before the year 2000 are not suitable. After that, the public debt of the Republic of Serbia shows two distinctly different trends:

- decreasing trend between the years 2000 and 2009, and
- increasing trend since 2009 until today.

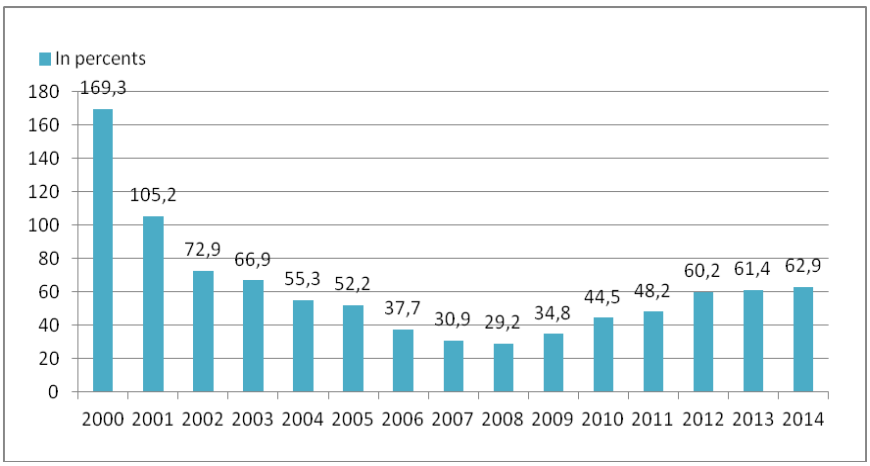

Figure 1: Public debt of the central government share of GDP%
Source: Uprava za javni dug, February 2014, page 9

If we analyze trend and base for the decrease of the public debt share of GDP in the period up to year 2008, we can carry out important conclusions. The most significant debt reduction occurred by the year 2004, based on agreements on writing off debts (66% of the debt to the Paris Club, 62% of the debt to the London Club of Creditors (until 2003)). Further reduction is a result of repaying a debt of 1.3 billion euros on the basis of old foreign currency savings and domestic debts based on delays. Since 2004, the acceleration of the privatization process and the use of privatization revenues to cover the budget deficit made it possible to achieve the low amount of new loans, and in 2008 Serbia was in the group of low-debt countries.

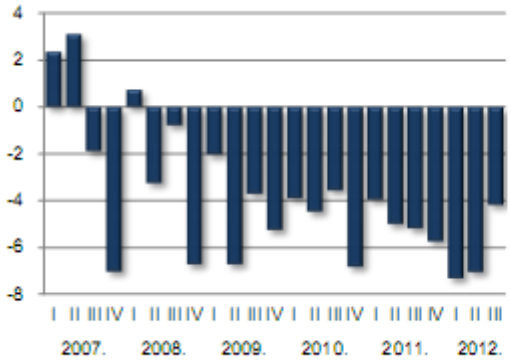

Figure 2: Fiscal budget deficit/suficit share of GDP% for Serbia, 2007-2012.
Source: Šljivić, S.,Jevtić, B., Šljivić, S. 2013. page 508

Since 2009, with the first effects of the global economic crisis, public debt starts to grow both in absolute figures, as well as a share of GDP. The main causes for this increase were: primary fiscal deficit which was financed by the loans, as well as the activated government guarantees for debts of public enterprises, but also a remarkable decline in net foreign direct investments. Correlation between budget deficits and public debt points to the key motive for borrowing, and that is maintaining the budget stability, while the relationship between the public debt trends and economic activity is negative.

For example, Romania can be extrapolated, as lying relatively close to the average trend of the South-Eastern European area, and especially the Balkans. Romania makes a relatively common instance for the two areas in point of overall trends in the phenomenon of borrowing. We exploit three waveforms that cyclically dismantle (in a Kondratiev manner) three similar historical periods in the two economies, defined by upward-downward repeatability, based on the visual support of the graph for a logical statistical thinking, the quality of which is recognized for the phenomenological approach to temporal variation (Figure 3)

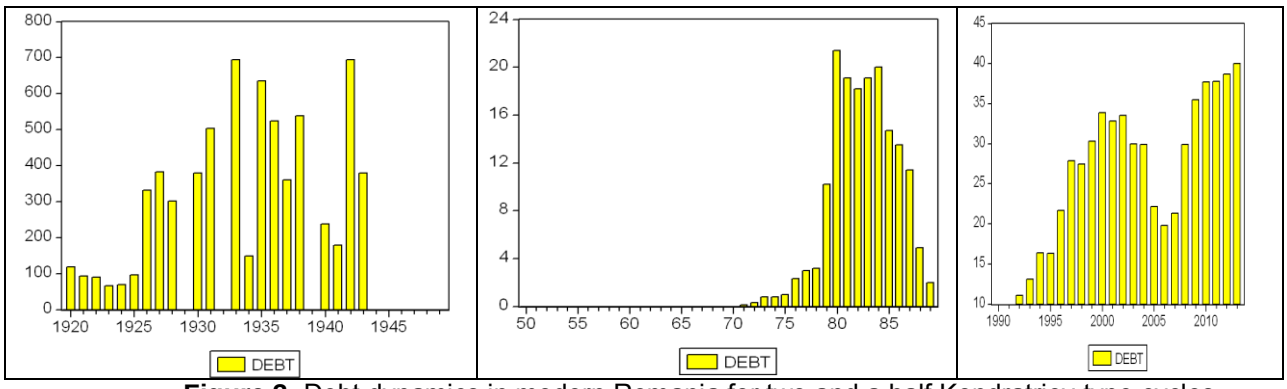

Figure 3: Debt dynamics in modern Romania for two and a half Kondratriev type cycles
Source: Săvoiu, G., (2014), figures 5-7 pages 5-7.

The main statistical indicators of public debt are the indicators of public indebtedness (PD, PD/GDP, PD/inhabitant and total annual change of PD in %), and, in separation, the indicators of public debt service or the annual financial burden of public debt repayment (PDS, PDS/GDP, and PDS/inhabitant) (Săvoiu, Apostol, 2013). A breakdown of the values of these indicators in the first category shows rising levels developments, and especially increasingly alarming dynamics.

Table 1: Major statistical indicators of the level of public debt of Romania and Serbia, during and after the crises

	Romania						Serbia					
	2007	2008	2009	2010	2011	2012	2007	2008	2009	2010	2011	2012
Public debt - PD – mil. USD	24863	33906	39704	45280	48645	55293	12526	12901	12908	14539	16105	18667
PD/GDP (%)	17.1	19.6	22.3	26.8	29.3	31.9	35.8	30.4	30.8	37.1	43.5	48.5
PD/Population - USD/inhabitant	1152	1576	1849	2108	2268	2580	1695	1748	1754	1985	2205	2567
Total annual PD change (%)	47.3	36.4	17.1	14.0	7.4	13.7	2.4	3.0	0.1	12.6	10.8	15.9

Source: *Economist Intelligence Unit,* available on-line at: http://www.economist.com/content/global_debt_clock.

Public debt in early 2013 was, according to World Bank data, 172.5% of Romanian exports, and 182.2% for Serbia, as the general theoretical limit accepted for PD/X is 200%. Much more serious, however, is the debt level reached after six years of analysis, i.e. multiplied by 2,224 times for Romania, and only 1.49 times for Serbia. At the same time, the negative legacy of debt (i.e. the debt inherited) rises from the parents to their children 2.24 times in Romania, and 1.52 times in Serbia. The GDP/inhabitant indicator in the two economies is totally different at the beginning, which appeared to require separate analysis thresholds, but is strikingly close at the end of the period analyzed. The most serious evolution remains the structural one: the share of public debt in GDP in Romania increased from 17.1% to 31.9%, and 35.8% to 48.5% in Serbia, in about six years of recession and post-recession, and the outlook becomes really alarming, asking for immediate concrete policies with major financial impact.

Table 2: Short-term and medium-term outlook for public debt indicators in Romania and Serbia

	Romania			Serbia		
	2013	**2014**	**2015**	2013	**2014**	**2015**
Public debt - PD – mil. USD	59481	**63670**	**67859**	21359	**24052**	**26745**
PD/GDP (%)	34.4	**36.9**	**39.4**	60.3	**72.2**	**84.1**
PD/Population - USD/inhabitant	2778	**2975**	**3172**	2950	**3333**	**3715**
Total annual PD change (%)	7.6	**7.0**	**6.6**	14.4	**12.6**	**11.2**

Source: *Economist Intelligence Unit* for public debt* (http://www.economist.com/content/global_debt_clock).

The question whether there is a statistical association between public debt and economic growth, or, to put it differently, if public debt is justified as a factor of development and, especially, as infrastructure investment support intended to change the economy, has a disappointing answer.

Table 3: Associable or correlated potential indicators characterizing public debt and economic growth

Year	Romania				Serbia			
	GDP growth (%)	PD(%)	GDP/ capita	PD/ capita	GDP growth (%)	PD(%)	GDP/ capita	PD/ capita
2007	6.3	47.3	8170	1152	5.4	2.4	5277	1695
2008	7.9	36.4	9949	1576	3.8	3.0	6498	1748
2009	-6.8	17.1	8069	1849	-3.5	0.1	5498	1754
2010	-0.9	14.0	8139	2108	1	12.6	5073	1985
2011	2.3	7.4	9064	2268	1.6	10.8	5964	2205
2012	0.4	13.7	8437	2580	-1.7	15.9	5190	2567

Source: http://data.worldbank.org/indicator

A correlation matrix, even considered for a very small number of terms, delimits both similar and different behaviours in the two economies according to the values of the determination coefficient in Table 4 (which contains the values of the correlation ratio, or of simple R resulting from the classic R squared):

Table 4: Correlation Matrix

	Romania				Serbia			
	GDP growth (%)	PD(%)	GDP/ capita	PD/ capita	GDP growth (%)	PD(%)	GDP/ capita	PD/ capita
	SER01	SER02	SER03	SER04	SER05	SER06	SER07	SER08
SER01	**1.000000**	**0.655422**	**0.644427**	**-0.457696**	0.907705	-0.062483	0.486256	-0.161364
SER02	**0.655422**	**1.000000**	**0.160833**	**-0.906713**	0.722941	***-0.628160***	0.178830	-0.666111
SER03	**0.644427**	**0.160833**	**1.000000**	**-0.068513**	0.405304	-0.089228	0.932734	-0.053051
SER04	**-0.457696**	**-0.906713**	**-0.068513**	**1.000000**	-0.660397	0.827000	-0.211983	0.897560
SER05	0.907705	0.722941	0.405304	-0.660397	**1.000000**	**-0.209301**	**0.318033**	**-0.414691**
SER06	-0.062483	-0.628160	-0.089228	0.827000	**-0.209301**	**1.000000**	**-0.371959**	**0.897362**
SER07	0.486256	0.178830	0.932734	-0.211983	**0.318033**	**-0.371959**	**1.000000**	**-0.271773**
SER08	-0.161364	-0.666111	-0.053051	0.897560	**-0.414691**	**0.897362**	**-0.271773**	**1.000000**

Source: Data from table 3. Software used: EViews

The analysis of the correlation between GDP growth (%) and PD (%) identifies an average connection between *public debt and economic growth*, visible and relevant in Romania, which has now a much more open economy under the impact of the crisis and the recession, and also under the impact economic of restarting growth, as a EU member, and a negative relationship, or almost a non-existent one, meaning at the limit of statistical testing, in Serbia (R= - *0.209301*).

Large inflows of foreign capital through credits, privatization and foreign direct investment (FDI) has been a major source for financing high consumption in Serbia in the period between 2005 and the middle of 2008 (Popovic, N. Jaško, O, 2012), which had the influence on economic activity, with the GDP growth rate greater than 5%. However, the economic crisis has refocused the use of these sources to cover the budget deficit, in which was observed, opposite of the required, permanent reduction of spending on infrastructure projects and the economy (up to 5% of the national budget), while the allocation for salaries in the public sector and pensions grants remained at the same level (about 55% of the national budget). On the other hand, FDI were almost stopped, given that many companies performed operations contractions during the crisis in order to fit these new circumstances.

Reduction or stabilization of the public debt is possible on the basis of reductions in public spending or through tax increases (budget inflows). In the short term, reforms in public sector in order to reduce budget expenditures may be sufficient to stabilize the debt of Serbia, while the long-term debt reduction needs tax policy that is associated with the stimulation of investments in the real sector and individual demand. Particulary acceptable operations are those that operate in both directions, especially Public Private Partnership (PPP), which do not increase public debt, and substitute public sector investment and increase demand.

On the other hand, after statistical confrontation between the two countries, the values of R highlight a strong positive relationship (having an evolving nature) between the dynamics of economic growth in Romania and Serbia, and between the debt dynamics per inhabitant, as well as a contradictory reversed, or staggered (R= *- 0.628160*) relation between the temporal trends of indebtedness of the two countries, according to their financial and monetary policies, which are distinctly separate at the moment, but are probably likely to be common in the near future, as EU member states. From this emerges an important remark, highlighting the advantages of EU integration, i.e. synchronicity and integration into the EU economic cycle can bring about, through "contagion", in addition to other advantages, some optimization in debt policies: public debt is much better correlated with economic growth and much more appropriate in times of recession in Romania, compared to Serbia; the remaining trends are similar for the two economies.

A tentative econometric modelling could only be achieved for the Romanian economy (Săvoiu, Apostol, 2013), where comparative data are available for a longer period of time (minimum 15 years or items in the model).

Table 5 summarizes two specified econometric models for Romania, parameterized and validated, with public debt as endogenous variable (a unifactorial and multfactorial model as possible examples).

Table 5: Two econometric models of public debt (PD) in Romania between 1997 and 2012

Dependent Variable: PD Method: Least Squares Specified models for the 16 – term series	R-squared	F-statistic
$PD_i = 31.90 + (- 2.41) \times FDI/GDP_i + \varepsilon_i$	0.621825	23.01993
$PD_i = 111.70 + (- 1.55) \times FDI/GDP_i + (-3.56) \times EUFCF_i + (-0.669) \times$ Savings in $EU_i + \varepsilon_i$	0.802784	16.28232

Software used Eviews. Source: (Săvoiu, Apostol, 2013a, page 25-26)
Note: Foreign Direct Investment as % of GDP = FDI/GDP_i; European Union Fixed Capital Formation as % of EU GDP = EU FCF_i.

The major conclusion of this analysis shows that econometric models can be made to simulate and estimate or predict the dynamics of public debt, as well as some aspects of the most important exogenous variables that contribute to an optimized and efficient debt service applied to various periods or horizons.

3. SOME FINAL REMARKS

The present paper started from the idea to emphasize the importance of public debt, of statistical confrontation on this issue between the economy of Romania and Serbia in general, and also the assessments and modelling which are possible, but did not limit tiself to the public debt, which requires a special, detailed treatment, exceeding the space of a midsize paper. The significance of public debt issues goes beyond many other important economic policy issues relating to accession and convergence processes, because of its effect on major economic equilibria, and especially on economic growth, optimizing the ability to consistently and sustainably manage the public debt process, turning it into a process of investment and development impact, in parallel with a process of inflation control.

Of course external debt is also important (i.e. at the beginning of 2013, Romania's foreign debt already exceeded the alarm level of 100 million, i.e. about ¾ of the official GDP), but the monitoring tools to do that are much more improved, and the solutions are much more efficient, and the experience of both economies is already relevant from the periods prior to transition, through the balance of payments and balance of trade analyses.

The aggravating prospects of global public debt, which is likely to exceed USD 55.802 billion no later than at the end of 2015, and the prospects of Romania's and Serbia's public debt, which at the end of the same year 2015 will be around USD 67.9 billion, and 26.75 billion respectively, require statistical analyses based on innovation both instrumentally and methodologically, foresight solutions and policies focusing on new econometric modelling and simulations. In the past six years, public debt has followed an upward trajectory

aggravating through its consequences speeding up, and even defining, a globalizing process. Public debt has relevant advantages and disadvantages. The first category includes help to the National Bank in the monetary policy, the ability to avoid the negative effects of taxes against incentives and increased government spending, finally managing to develop the economy of any country, but leaving an unsustainable legacy for next generations. However, when public debt exceeds the theoretically admissible limit, more and more long-term economic difficulties are generated, and this is what really happens in the case of Romania and Serbia.

If for the economy of Serbia, which is on the eve of EU accession, there are no previous secular studies, which induces the threshold of 60% of GDP as the natural limit of the moment, for the Romanian economy there are international researches. Thus, in a famous 2003 paper, which examined debt carefully in relation to GDP, a threshold of 41% of GDP was established, upwards of which the effects of debt start inducing not the economic growth required of an EU economy towards the EU-28 average, but rather to the diminishing of its economic growth (Reinhart, Rogoff and Savastano, 2003).

The analysis in that paper highlights, among other things, that both Serbia and Romania have exceeded it in the short and medium term, that is rapidly and dangerously approaching the *sustainability* limit the of public debt, i.e. 60% and 41% of GDP respectively, or the maximum level accepted by investors for these countries. The paper mentioned insistently emphasizes the importance of the phenomenon, and generating new economic policies that do not *neglect the signals provided by the general public debt indicators, and by internal debt, especially*, first, because "*internal debt is already nearly two-thirds of the public debt*" (Reinhart and Rogoff, 2011), and secondly, because the indicators are becoming ever more explicit and turning into increasingly lower warning thresholds, and thirdly, because the domestic market needs to be increasingly investigated and monitored, confronted with similar markets and simialr effective solutions, largely ignored in the literature on the complex phenomenon of public debt.

REFERENCES

Cecchetti, S., Mohanty, M.S., Zampolli, F., (2011). *The real effects of debt*, Symposium *Achieving Maximum Long-Run Growth*, Jackson Hole, (USA), pag. 1-34, available on-line at: http://www.bis.org/publ/othp16.pdf.

Hrvoje, J., (2013). *Comparative Analysis of External Debt Indicators in Croatia and Southeastern European Countries*,* Ekonomska Misao i Praksa, vol. 22 (1), pages197-220, available on – line at: http://search.proquest. com.ux4ll8xu6v.useaccesscontrol.com/docview/1400678213?accountid=15533.

Knedlik, T., Von Schweinitz, G., (2012). *Macroeconomic Imbalances as Indicators for Debt Crises in Europe,* JCMS-Journal of Common Market Studies, Vol. 50 (5), pages 726 – 745.

Prabha, A., Savard, K., (2013). *Financial Repression: Antidote for Depression or Prescription for Financial Trouble?,* pages 1-13, available on –line at: https://www.milkeninstitute.org/pdf/FinancialRepression.pdf

Popović, N. Jaško, O (2012). *Ekonomski predlozi i dileme*, SEC, Beograd, page 4-16

Reinhart, C. (2012). *The return of financial repression*, Financial Stability Review, Banque de France, issue 16, pag. 37-48, available on - line pe: http://www.banque-france.fr/fileadmin/user_upload/ banque_de_ france/ publications/Revue_de_ la_ stabilite_financiere/2012/rsf-avril-2012/FSR16-article-04.pdf

Reinhart, C., Sbrancia, B., (2011). *The Liquidation of Government Debt*, NBER Working Paper 16893, March, pag. 1-66, available on – line pe : http://www.nber.org/papers/w16893.

Reinhart, C.M., Rogoff, K. S. and Savastano, M., (2003), *Debt Intolerance*, William Brainerd and George Perry (eds.), Brookings Papers on Economic Activity, pp. 1-74, available on- line at: http://www.nber.org/papers/w9908.

Reinhart, C., Rogoff K., (2010), *From Financial Crash to Debt Crisis*, NBER Working Paper 15795, March 2010. *American Economic Review.* Available on-line pe: http://www.reinhartandrogoff.com/data/browse-by-topic/topics/9/ including data from Eurostat for 2011 and 2012.

Reinhart, CM and Rogoff, KS (2011). *The Forgotten History of Domestic Debt*, Economic Journal, 2011, Vol. 121 (552), pp. 319 – 350.

Săvoiu, G., (2014). The Kondrative type of cyclicality of Romania's economy, argued through three essential statistical indicators: GDP, CPI and debt, *Romanian Statistical Review*, vol. 62(1) forthcoming, (Conference to Scientific Seminar Octav Onicescu, Romanian Statistical Society on the 20th February, 2014, available on – line at: http://www.insse ro/cms/ro/content/seminarul-stiintific-octav-onicescu .

Săvoiu, G., Apostol, L., (2013). *Defining Public Debt and External Debt and Revealing Their Statistical Trends*

and Econometric Models, Romanian Statistical Review, vol 61 (Suplement 4) pages 93-104.
Săvoiu, G., Apostol, L., (2013a). *Econometric Models, Methodology and Trends Regarding Public Debt and External Debt, Romanian Statistical Review*, vol 61 (9): 24 - 35.
Šljivić, S., Jevtić, B., Šljivić, S.: *Fiskalna konsolidacija, ekonomski rast i socijalne nejednakosti u srbiji*, u zborniku: *Institucionalne promene kao determinanta privrednog razvoja Srbije*, Ekonomski fakultet Univerziteta u Kragujevcu, 2013. godine.
*** IMF (2013), *High Government Debt Threatens Growth Prospects*, IMF Survey, Washington, January, available on –line at: http://www.imf.org/external/pubs/ft/survey/so/2013/NEW010813A.htm
*** Encyclopaedia Britannica, available on-line at: http://www.britannica.com/EBchecked/topic/482318/public-debt
*** Economist Intelligence Unit available on-line at: http://www.economist.com/content/global_debt_clock.
http://www.javnidug.gov.rs/upload/Bilteni/Bilten%20CIR/2014/Mesecni%20izvestaj%20Uprave%20za%20javni%20dug%20-%20Februar%20cir.pdf

THE ECONOMIC CONVERGENCE PROCESS TO EUROPEAN UNION: SOME TRENDS AND CHARACTERISTICS OF ROMANIAN AND SERBIAN ECONOMIES

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Abstract: *This paper analyzes economic convergence of economies of Romania and Serbia. First part of the paper is dedicated to theoretical description of knowledge and its relation with other evolutionary concepts such as transition, convergence, teleonomy, semiconvergence, accession and integration. After that three hypothesis of convergence are analyzed and described in short. Economies of Romania and Serbia are descibed using convergence criteria, namely: price stability, sound public finances or a sustainable fiscal position, exchange rate stability and low long-term interest rates. Similarities are observed between those economies, and trends and characteristics are described. Paper concludes with evaluation of future prospects for sustainable convergence or economic divergence on the other side.*

Keywords: *Economic convergence, transition, EMU, public debt, budget deficit*

1. INTRODUCTION

This paper describes several evolutionary concepts (transition, convergence, emergence, teleonomy, semiconvergence, accession, integration), which are specific to the economies of Romania and Serbia, from the transition to a market economy to convergence, emergence, etc., focusing on real convergence of countries in Europe. After an introductory overview of the major concepts, from emerging convergence to teleonomy, devoted to the subject, the authors highlight and detail the concrete criteria for evaluation economies of Romania‟s and Serbia‟s according to the convergence criteria, ending with a few conclusions regarding semiconvergence rather than complete convergence.

An open economic system, analyzed as a specific structure, either static or dynamic, as in the national economies of Romania and Serbia interpreted in keeping with the systems theory, can become unstable and generate a new structure, through processes of self-organization, which reinstates, in a broad sense, the subsystems of the respective economies, through an adaptive evolution focused on survival and change, being also characterized by evolving complexity and non-linearity, and generating, in terms of the same systems theory, *order out of chaos* (Holland, 1998).

Convergence is: a) a circumstantial concept, defined by a state of similarity, either structural or complete, and also partial or incomplete, or limited, of a small number of parameters of level, which an economy, seen as a complex open system, must reach in over a certain period or range of time; b) a mainly process significance, containing at the same time components of the concept of similarity, and also complementary elements, finally generating a broader concept of harmonization; c) a term having a forecasting nature, which implies reaching a level or target, to which an economic phenomenon is converging, which is approached both spatially and temporally, as a gap or recuperation period (a time interval of development in advance, or a period of lag recovery); d) an instrumental concept of financial economics and financial statistics, intended to confront or compare, watching the coherent economic fusion of economic subsystems, or even economies, into a larger system or an economic union, by constant identification and ranking of developments and by dealing with a number of performance benchmarks, or values considered mid-level of a standard subsystem (an economy parameter, the average level of the aggregate, a modal or median value of a normalization phenomenon, etc.); e) an integrative phenomenon of a dynamic and systemic nature, involving pooling in order to achieve economic and social objectives that are assessed and updated regularly based on historical requirements.

Convergence systemically implies other phenomena as well, or at least some aspects of them, generally having a biological origin, such as *emergence* (Chalmers, 2006) and *teleonomy*. The former concept, *emergence*, defines *a complex phenomenon, part of a cycle of change* (Holman, 2010), *the result of a simple*

combination between low level mechanisms in simple ways, being an intrinsic property of open complex systems of any kind, or describes the appearance of a new organ, of new structures or some new properties of higher order, a form of change, and from that angle it is regarded as actual birth of something entirely new in an open environment (it is easier to illustrate it physically by radiations, bodies escaping an environment after travelling through it).

Emerging phenomena are related to meta-equilibrium, even if at the level of subsystems everything may seem unbalanced, from a global perspective the system can remain stable and orderly (hence *the theory of emerging evolution in the process of development* argues that the emergence of new qualities is absolutely spontaneous and unpredictable. Theoretical systems purely emerging as complex adaptive systems generate *novelty*, are *unpredictable*, ensure *consistency* and *integrity*, determine *self-maintenance* or relative stability against environmental variations and any changes that occur in their internal structure, also being *asymmetrically causal* – the newly acquired properties are determined only in the "bottom-to-top" direction, never the other way around).

The emergence of such systems takes the form of *weak emergence*, or emergence *explained in a deterministic sense* (a complex statistical causality that is measurable as direction and intensity), or *strong or indeterministic emergence* (Osberg, Biesta, 2007) based on a high degree of risk and uncertainty (the probabilities and their dynamics or their historicity outlining emergence scenarios, or scenarized emerging trajectories of an evolutionary type).

Convergence is not identifiable to transition, in terms of its significance, although apparently, or purposefully, it can be confused with that concept. The example raised for nearly half a century in the national economies of Romania and Serbia (1945-1990) was that of transition from capitalism to socialism, which was in fact *nothing more than the emergence of a system or regime of state capitalism under the leadership of a single communist party*, followed, for nearly a decade and a half or two decades, by the transition to a market economy in both Romania and Serbia, a post-communist transition inspired by (neo-) liberalism, in search of a structural, procedural and organizational end superior in economic efficiency.

Transition is in itself a transitory, temporary or transient phenomenon or process, a transformation phased as a *stage* or period, a transformation or a change in the economy, but *a radical and temporally limited one* (Dăianu 1997; Dinu, 2000). On organizational level, changes are dominantly implemented by interweaving periods of incremental changes with periods of radical transformation (Lewin, 1951; Dulanović&Jaško 2007). In the history of any economy there coexist a larger or smaller number of transitions and several ways to express these "sudden changes" or "paths of accelerated development" from one type of economic and social structure (form of government, economic organization, etc.) to another, which "accelerate" the natural phases, as are styled economic transitions in dictionaries or in an economic literature generating a genuine theory and various distinct patterns or models of transition (for example, writing about the transition in Romania, Joseph Stiglitz identified the main factors of a predominantly negative role as being the too restrictive fiscal policy, the legislation that kept changing, and the absence of programmes meant to create opportunities for business,).
A recent signification of convergence has dominated the last decade and a half, being in a visible expansion, both in frequency of terminology usage, and intensity and depth of statistical determinations; it is narrowing to the scope of the European Union, and conceptually characterizes the time course of a number of processes related to the conditions of pre-accession, accession and post-accession to this interstate union focused on regional componency, as well as and phenomena generated by ensuring economic and monetary stability concerning the criteria for accessing the Euro region, as a natural and constitutional consequence of state membership, derived from intra-community evolution towards higher stages of the integration process.

In this particular manner, and referring the vast and complex phenomenon that brings together both joining and integration into the EU, *economic convergence* grounds, in the new millennium, the macro-financial architecture of the countries or economies that are to become members of the euro area, and globally it concerns the very globalization process. The birth EU was conducted around three main axes, or three pillars: a) the pillar of the European Communities; b) the pillar of common security policies; c) the pillar of judicial cooperation in criminal and police matters. Later the concept of European citizenship was introduced, and the European Parliament"s powers were strengthened, to shape, as early as 1999, with the advent of the euro, an original economic and monetary union, within which the economic convergence of the component countries or states became the fundamental issue. The meanings of economic convergence multiplied suddenly: a) a phenomenon of transition and integration of economies within a common monetary area with internationalization trends, through economic stability-oriented processes (the euro currency is illustrative in parallel with the requirements of the Maastricht treaty, which became gradually financial criteria expressed in a rigorously statistical manner, maintained and subsequently consolidated at Amsterdam in 1997, institutionalized in Nice in 2001, legally customized in Lisbon in 2007, etc.); b) synchronization of business

cycles against asymmetric shocks (Frankel, 2004), felt integratively or community-wise, and anticipated and eased as impact limiting thresholds); c) the generally valid assumption that income per capita (GDP per inhabitant or national income available per capita, etc.) of the developing economies tend to grow faster and with higher rates than in developed economies, to finally find that all economies show a clear trend of convergence concerning income per capita (Le Gallo, Dall'Erba, 2006), due to the effect of recovery, in time and space, of the gap between economies, which is called the *catch-up effect*); d) similarity by gradual harmonization of the level of productivity and export share of non-tradables, in an aggregate context of trade integration of national economies (but also taking into account the Balassa-Samuelson effect, revealing faster productivity growth in tradable sectors than in the non-tradable sectors, in the economies of less developed countries)[1]; e) similarity of economic structures, which become synonymous with complementarity and harmonization of economies in an aggregate or intra-community space (the usual example starts from the shares of agriculture, industry and services in GDP), as pointed out in a recent study, in which a deeper analysis is conducted by another author (Dinga, 2008);

Extended economic convergence holds in practice as many as four dimensions: a) *nominal* or strictly monetary convergence, targeting economic stability and the transition to the single European currency; b) *actual* convergence, which is intended to diminish disparities (especially felt by income and productivity); c) *institutional* convergence, i.e. ensuring compatibility of institutions; d) *structural* or *complete* convergence (Iancu, 2006). There coexists, in the theoretical field, still other classification of convergence, one of an instrumental and parameter type: **β** (conditional on the initial state), **σ** (similarity GDP/capita), **γ** (business cycle synchronization), **δ** (similarity of convergence factors), **α** (similarity of the economy structure), etc., a classification which is frequently used in the structuring of the phenomenon and its distinct modelling instances. In essence, the neoclassical theory of economic growth postulates that all economies that are characterized by formal similarity of the basic parameters (of the production function) will achieve the same level of development, regardless of their initial position.

Based on these findings, three hypotheses of convergence were formulated in the convergence theory: a) *the absolute* (or unconditional) *convergence hypothesis*, according to which the level of income per capita across countries converge in the long term, regardless of their initial conditions b) the *conditional convergence hypothesis*, according to which the level of income per capita in countries having fundamentally identical structures converges in the long term, independently of the initial conditions; c) the *club or group convergence hypothesis* (Baumol, 1986), in which the GDP per capita in countries that have the same fundamental structure, converges in the long term either by an increase in GDP per capita, leading to clubs (groups) of nations with very high incomes, or by a decrease in GDP per capita, generating clubs (groups) of nations with very low incomes, assuming that the initial conditions are similar. Testing those hypothesis has led to the initial definition of several types of convergence:
a) *type* **β** *or "beta" convergence*, arguing that, in the long term, in the context of the absolute convergence hypothesis, according to its own regression equation and its own *regression coefficient* (Sala-i-Martin, 1996), developing economies tend to grow faster than developed ones, and in the context of the conditional convergence hypothesis, there is the same phenomenon, but with some altered parameters, depending on a number of determinants (focused on the link between classic convergence of the quantitative type, and contemporary convergence, which also includes qualitative aspects, also reflecting reducing disparities or processes of deletion of the *gaps* (whether *dimensional gaps* or gaps of macroeconomic correlation, gaps *of dynamics* in the real economic variables, and *simple structural* gaps, or structural differences that exist between two entities segmented methodologically), rather than the *catching-up* ones, defined as dynamic recovery, at different rates, on short and medium term, for the less developed economies and developing economies relative to developed economies (generating economic paradoxes or dilemmas, such as the Lucas type of paradox or the Tosovski dilemma);
b) *type σ or "sigma" convergence*, indicating a decreasing variation of income per capita in a group of countries; this type of convergence is expressed by the statistical indicator of the *coefficient of variation of GDP per capita*, and is fairly commonly exploited in analyses of convergence or economic studies, through the mathematical expression based on an indicator resulting from the classical statistical algorithm of the coefficient of variation (σ_t); its interpretation is quite straightforward when σ^2 or the dispersion of the phenomenon considered is decreasing over a certain period of time, or a transverse process (or in a certain

[1] In a study conducted on a total of 111 countries, and implicitly as many national economies, during the two decades between 1970 and 1989, Jeffrey Sachs and Andrew Warner (1997) concluded that the economies of the developed countries had increased by only 2.3% / year per capita, while developing countries had a 4.5% increase, and isolated countries or closed economies similar to an apparently closed system barely reached 2%.

spatial delimitation) of national economies (and even parts of these), or when the value of the coefficient of variance **σ** decreases, then a convergence process ($\sigma_{t+1} < \sigma_t$) is identified;
c) *type* **γ***, or "gamma" convergence* (quasi-real convergence), which can be described as synchronization of business cycles, is valid even in conditions in which, structurally, there are notable differences between the economies analyzed as open system or ensemble of open phenomena (synchronization of business cycles may have positive effects in terms of eliminating asymmetric shocks by making them symmetrical shocks, as exemplified by the general monetary policy in the euro area);
d) *type* **δ***, or "delta" convergence* (Dinga, 2008), which requires *similar levels of real convergence factors for two or more economies*, or at least an identical "list" of convergence factors, yet not necessarily also similar levels of these (once the convergence factors become similar in two economies, the convergence process would be an already completed one);
e) *convergence of type α or "alpha"*, which involves "the final target or ultimate destination type" of any economic development, and is emphasized by *a similar structure of the economies compared, although permanently raises important issues of methodology and dimensions that are hard to solve* (once solved, the idea of a process of convergence disappears as well).

2. CRITERIA, LIMITS OR THRESHOLDS OF CONVERGENCE, AND ILLUSTRATIONS FOR ROMANIA AND SERBIA

According to the Protocol and Article 109j.1 of the *Maastricht Treaty* (the original article was later renumbered to become Article 121.1 of the *Treaty of Amsterdam*, and later again renumbered as Article 140 of the Treaty on the Functioning of the EU), the criteria of nominal convergence and the explanatory elements, thresholds, limits and normal bands of variation (fluctuation) in the European Union refer to: a) *price stability* (the average inflation rate recorded during one year before the euro zone access must not exceed by more than 1.5 percentage points the inflation rate of three member states scoring the best results in terms of price stability); b) *sound public finances or a sustainable fiscal position* (limiting public debt below 60% of GDP; limiting budget deficit below 3% of GDP); c) *exchange rate stability* (respecting the ± 15% band as the normal band of variation (fluctuation) provided by the exchange rate mechanism for at least the last two years before the country‟s access to the EMU, and the absence of action of devaluation of the national currency against the euro during the same period); d) *low long-term interest rates* (achieving a level of long-term interest rates that does not exceed by more than 2 p.p. the average of the interest in the three countries with the lowest interest) Note: p.p. = percentage points.

In international economic literature, among the numerous opinions, an increasing clear conceptual similarity is identified between *the properties of optimum currency areas (points 1-5)* and the *real convergence criteria*, but other additional criteria are requisite, which have an increasing spreading and frequency of occurrence (6-10): 1) *high degree of economic openness*; 2) *synchronization of business cycles*; 3) *labour mobility*; 4) *flexibility of prices and wages*; 5) *high level of financial development*; 6) *high levels of foreign direct investment*; 7) *high rates of saving*; 8) *improving competitiveness*; 9) *high standards of education*; 10) *the flexibility of the economy as a whole*. The more flexible a national economy is, the easier real convergence is – and this criterion is rather an aggregate of the other nine previous criteria (Traşcă, 2007).

The international financial crisis has revealed *significant asymmetries* between the EU and EMU member states and the three candidate countries, and also *the need to review* and rethink them, starting from *their asymmetry* and the fact that *their standards are too ambitious* (Darvas, Pisani, 2009). In conclusion, the essential criterion of real convergence remains reducing the gap between incomes per capita, a real process conditioned by significant gains in productivity and relative price convergence. If all nominal convergence criteria relate to a set of financial, monetary, foreign exchange, tax policies, indicators are also more efficiently systematized compared with the same major typology of (actual, nominal, institutional) convergence, obviously following the same policies, from Moritz Schularick‟s original manner, presented as early as 2002 (Table no. 1).

The updated 2013 version stipulates six EU indicators of convergence for the Maastricht Treaty, structured according to Table 2: a) three based on money criteria, i.e. inflation (≤ IM3 + 1,5 p.p., where IM3 is the average inflation of the three EU member states that have the lowest inflation), *the nominal interest rate on long-term bonds* (≤ D3 + 2 p.p., where D3 is the average of nominal long-term interest of the three EU member states having the lowest inflation), and *nominal exchange rate* (keeping the nominal exchange rate within the band ±15% of the pilot); b) two having to do with taxation and the budget: *total public debt* (percentage of GDP ≤ 60%) and the *general government deficit* (percentage of GDP ≤ 3%); c) one of a legislative nature: *national financial legislation* (including the legislation for the national central bank – with emphasis on the status of the central bank).

Table 1: Baseline variables, turned into 16 official indicators, structured in the EU by convergence classes (Schularick, 2002), pp. 16-22.

CONVERGENCE		
Nominal= 6 variables	**Real** = 6 variables	**Institutional** = 4 variables
I. Degree of monetary and fiscal stability (3 variables): inflation, (3 variables) inflation, budget deficit and external government debt *II. External economic relations* (3 variables): current account balance, foreign direct investment and trade integration with the EU	*I. Level of economic development* (4 variables): GDP/capita, unemployment rate, share of agriculture in GDP and share of private sector in GDP *II. Dynamics of the real economy* (2 variables): GDP growth rate, growth rate of productivity	*I. Institutions and economic policies* (4 variables): legislative reform, competition policy, financial sector liberalization and liberalization of trade and foreign exchange markets

Table 2: Concrete monitoring of meeting the Maastricht criteria for Romania in 2011

Criterion	**Thresholds, limits and bands of variation, and level of fulfilment**		
Public debts	Maximum 60% of GDP	Fulfilled (33,4%)	**YES**
Budget deficit	Maximum 3% of GDP	**Shortfall (-4,9%)**	NO
Inflation rate	1,8%+1,5%=3,3%	**Shortfall (5,8%)**	NO
Nominale long-term interest rates (10 years)	2,4%+2% = 4,4%	**Shortfall (7,0%)**	NO
Exchange rate	2 years without devaluation of ERM* II	**Shortfall**	NO

Source: *** (2012), Academic Society of Romania (SAR), *Euro, mai devreme sau mai târziu?* (*Euro, sooner or later?*), accessible online http://www.romaniacurata.ro/spaw2/uploads/files/SAR-13-24.pdf. *Note: ERM II stands for Exchange Rate Mechanism. By 1999, the exchange rate (as an important element of the European Monetary System) was a multilateral system of parities which allowed each currency to fluctuate within a band limited in relation to each of the currencies included in the system, establishing also central parity rate in ECU. This was the first exchange rate mechanism (ERM I). When the single currency, the euro, was adopted in 1999, a new exchange rate mechanism, called ERM II, was adopted. Through this mechanism, the multilateral system was replaced by the bilateral one, whereby each participating national currency has a defined central parity rate expressed in euro.

Table 3: Analysis of the fulfillment of convergence criteria for Romania and Serbia, as of 31 March 2013

Country	Average inflation rate (in last 12 months)	Budget deficit as % of GDP	**Public debt as % of GDP**	Member country ERM II	Long-term interest rate (last 12 months)
Annual limits (thresholds / limits)	up to 2,5% (31 March 2013)	up to 3,0% (fiscal year 2012)	**up to 60% or fall (fiscal year 2012)**	minimum 2 years (31 March 2013)	up to 4,81% (31 March 2013)
Romania	**3.9**	**2.9**	**37.8**	**Not a member**	**6.43**
Serbia	**7.3**	**6.4**	**59.2**	**Not a member**	**No data available**

Source: http://appsso.eurostat.ec.europa.eu/ and http://en.wikipedia.org/wiki/Euro_convergence_criteria

As can be noted, the above variables cover the combined criteria, but only partly explain the factors of convergence, whose spectrum is very broad, as they appear in the econometric modelling dedicated to this phenomenon. To be sustainable, the European Monetary Union is structured based on a fiscal union, and this in turn implies the existence of a political union, as suggested by the so diverse convergence factors, such as: stability or economic balance, mobility of production factors, similarities in inflation and interest rates, comparable productivity, relatively equivalent economic structure, price flexibility within acceptable parameters, integrability of financial markets, comparable degree of economic openness, diversification in production and consumption, fiscal integration, and especially political integration.

3. CONCLUSION

The integration of the new states in the European economy involves, amomg other things, attaining socio-economic convergence targets, which are defined and updated periodically, in keeping with the imperatives of the historical moment, as the topic still holds an important place in the theory of economic growth. If the neoclassical theory of economic growth postulated that all economies characterized by uniqueness of their basic parameters can achieve the same level of development in time, regardless of their initial position, detailing the three major hypotheses of real convergence (absolute or unconditional, conditional and club), testing these hypotheses empirically confirms, with an acceptable error level, the quantitative definition of real convergence of the **β** type, which shows that, in the long term, in the context of the absolute convergence hypothesis, poor economies tend to grow faster than richer ones, and of real convergence of type **σ**, which stresses a decreasing variation of income per capita in a group of countries, and also convergence of type **γ**, which is aimed at synchronizing the business, **δ** – the similarity of the convergence factors, **α** – similarity of economy structure, etc.

In the context of the last global financial crisis, the European Union considered inappropriate to review the criteria stipulated by the Maastricht Treaty, but this is required from practical considerations, along three new dimensions (Darvas, 2010): a) anchoring the average EU criteria in order to avoid that the performance of small economies in the euro area affect the target level of criteria, and reducing disparities; b) criteria of inflation, interest rate and budget deficit should be covered within a variation interval as to the average euro area, provinding a wider decision-making solution for anti-cyclical fiscal policy; c) government debt to GDP should be limited to the same average of the euro area, or it should follow a downward course, decreasing at a satisfactory pace and reaching below the threshold.

Accelerating Serbia"s EU accession and Romania"s convergence to the European Union (EU), as a member state ranking in one of the last two positions in most indicators, are regarded both from the nominal angle, when time seems to be contracting, but also the real angle, when, quite on the contrary, time is much longer. From the first sight, two approach horizons co-exist and subsist, one nominal or short-term, obviously, and one real, i.e. longer. Finally, joining the EU and EMU, respectively an initial convergence and a final convergence, complete or of the structural type, involve a *favourable compromise* between real and nominal convergence, given that Serbia must fulfill the conditions of accession, and Romania, after two years of ERM II, must meet the Maastricht criteria in full. In reality, the current state of both economies certainly describes stages of real and criterial semiconvergence rather than full convergence.

However, convergence is not so easily achievable, if there are no open economies and macroeconomic government policies meant to stabilize excessive fluctuations. In the context of free competition, of real economic freedom and liberalized markets, all of the above can achieve the desideratum of convergence together. The problem of *sustainable convergence* cannot be solved in the short term because it depends on what was actually achieved in the past, and criteria have their essential role not to hinder this difficult process of convergence as a whole, by their level or timeliness, especially when, placing themselves above allowable thresholds, they may lead to an actual increase in disparities, virtually resulting in *economic divergence*.

REFERENCES

Aligică, D. P.,(2004). Tranziţii economice - Convorbiri cu Nicolas Spulber, Bucharest: Ed. Humanitas,.

Chalmers, D., (2006). Strong and Weak Emergence, în P. Clayton & P. Davies (eds), The Re-emergence of Emergence (Oxford, UK, Oxford University Press).

Dăianu, D., (1997). Transformarea ca proces real, Bucharest: Editura IRLI.

Darvas, Z.F. Pisani, J., (2009), The looming divide within Europe, VoxEU.org, page1, available online at: http://www.voxeu. org/index.php?q = node/2820.

Darvas, Z. F., (2010). The Case for Reforming Euro Area Entry Criteria, Institute of Economics, Hungary Academy of Sciences Discussion Papers 22, page 28, available on-line at: http://web.uni-corvinus.hu/ matkg/ working _papers /wp_2010_3_darvas.pdf

Dinga, E., (2008). Un set necesar şi suficient de criterii reale de convergenţă economică, pages 1-71, available on-line at: http://www.edinga.ro/files/studii/7_ro.pdf. Annex 1 page 21.

Frankel, J., (2004). Real Convergence and Euro Adoption in Central and Eastern Europe: Trade and Business Cycle Correlations as Endogenous Criteria for Joining EMU, Harvard University Press.

Holland, J., (1998). Emergence from Chaos to Order, Oxford University Press.

Holman, P., (2010). Engaging Emergence: Turning upheaval into opportunity. San Francisco: Barrett-Koehler Press.

Iancu, A., (2006). Problema convergentei economice. Theoretical and Applied Economics, 4 (499), pages 43 - 64.
Kober, G., (2005). Teleology's New Clothes: Teleonomy and the Notion of Program, International Society for the History, Philosophy, and Social Studies of Biology, [online] Available at: http://ishpssb.org/wp-content/uploads/2012/06/viewabstract_085.html [Accessed on February 10, 2014].
Le Gallo, J., Dall'Erba, S., (2006). Evaluating the Temporal and Spatial Heterogeneity of the European Convergence Process, 1980–1999*. Journal of Regional Science, 46(2), pages 269-288.
Lewin, K. (1951). Field Theory in Social Science, New York, USA: Harper &Row.
Dulanović, Ž. & Jaško, O., Organizaciona struktura i promene, Beograd, Srbija: Fakultet organizacionih nauka.
Dinu, M., (2000). Economie contemporană – Ce este tranziţia?, Bucharest: Editura economică.
Mayr, E., (1974). Teleological and Teleonomic, a New Analysis. Boston Studies in the Philosophy of Science, vol 14, pages 97-114.
Monod, J., (1971), Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology. NewYork: Alfred A. Knopf.
Osberg, D., Biesta, G., (2007), Beyond Presence: Epistemological and pedagogical implications of „strong" emergence, Interchange, vol 38 (1), pages 31–55.
Sachs, J., Warner, A., (1997). Fundamental sources of long-run growth. The American Economic Review, vol 87 (2) pages 184-188.
Sala-I-Martin, X., (1996), A Classical Approach to Convergence Analysis. The Economic Journal, vol. 106 (437), pages 1019-1036
Săvoiu, G., (2013). Modelarea economico-financiară, Ed. Universitară Bucureşti, pag. 14-16.
Schularick, M.,(2002). Six Months to Copenhagen: Convergence Process Supports Road Map for Enlargement, EU Enlargement Monitor, Economics, Deutch Bank Research, pages 16 -22.
Traşcă, L. (2007), O analiza asupra procesului de convergenţa în ţările din Europa Centrala şi de Est, Economie Teoretica si Aplicată, Supliment România în Uniunea Europeană. Calitatea integrării. Creştere. Competenţă. Ocupare, vol. 2, page 34.
William Baumol, (1986), Productivity growth, convergence, and welfare: what the long-run data show. The American Economic Review, pages 1072-1085.
Darvas, Z. F., (2010). The Case for Reforming Euro Area Entry Criteria, Institute of Economics, Hungary Academy of Sciences Discussion Papers 22, page 28, available on-line at: http://web.uni-corvinus.hu/ matkg/ working _papers /wp_2010_3_darvas.pdf

THE IMPORTANCE OF LEGAL AND FINANCIAL SYSTEMS FOR DOING BUSINESS IN INDIA

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Abstract: *This paper researches the importance of legal and financial systems for the functioning and development of an economy. In addition to the theoretical discussion on this issue, the paper draws on empirical research of legal and financial systems of India as one of the representatives of the emerging economies. The research has shown that the rapid and steady growth of the India's economy is largely owed to the development of informal institutions and their impact on the regulation of business operations in India.*

Keywords: *financial system, legal system, business, company, India*

1. INTRODUCTION

Analysis of legal and financial systems occupies an important place in the theory of economic growth and development of countries. In the scientific literature one can find numerous papers in which the high growth rates of developing countries are explained by the effective functioning of the legal and financial systems. The most important early works that deal with this issue come from a group of prominent scientists such as La Porta, Lopez - de - Silanes, Shleifer, and Vishny. In their papers in the field of law and finance they point out that the English common law countries provide stronger legal protection of shareholders , creditors and investors , which is achieved through the efficient functioning of the institutions, resulting in better financial and economic outcomes (Allen etal.,2007). The above views on the importance of legal and financial systems for the development of countries as well as the superiority of English common law were used to explain the high growth ratesof the India's economy since its liberalization in 1992. Later papers to have explored the causes of the high rates of Indian GDP growth highlighted the methodological shortcomings of previous studies and pointed at the possibility that the above conclusions on the high importance of English common law for the growth of India's economy might be incorrect.

For an objective and thorough understanding of any economic phenomenon, and therefore the growth of the India's economy and English common law as its factor, it is necessary to take into account a number of different approaches. For this reason the paper will present a theoretical discussion on English common law, India's financial system, and their importance for doing business, as well as the research into this topic based on empirical findings related to India.

2. THEORETICAL CONSIDERSTIONS OF ENGLISH COMMON LAW

The basic principle of common law is the principle of judicial precedent. Strict adherence to this principle ensures consistency of judicial decisions, which means that all decisions must be in accordance with the judges' decisions brought in the past. This creates a legal system with predictable results of litigation. In addition, many law schools have emphasized the superiority of common law compared to civil law when it comes to the regulation of business practice. In legal and economic literature this assumption is formalized through a *hypothesis on the effectiveness of common law*, which was first set up by Coase (1960) and later systematized and expanded by Posner. (e.g., Ehrlich and Posner 1974, Landes and Posner, 1994). According to this hypothesis, the rules of common law provide effective allocation of resources, where the efficiency implies Pareto's or Kaldor - Hicks 's effectiveness (Parisi , 2004) . This is explained by the fact that common law is based on the regulations and laws that are formulated by judges, based on the rules that have been already applied in practice. On the other hand, in the countries in which civil law is applied the laws and rules are passed by parliaments and they are not necessarily based on existing methods of dispute resolutions in real life. Hence it follows that English common law is easier to apply in practice. Besides, the application of this legal system provides greater certainty, as a parliament may decide to change the law at any time, while the rules of common law do not change.

The importance of a legal system as a factor of companies' business environment is reflected in the fact that numerous prominent theorists in the field of economy and law have been engaged in the analysis of efficiency in the regulation of business practices. This includes Nobel Prize winners F. Hayek and R. Posner

who came to the same conclusion: English common law manifests superiority when it comes to the regulation of the economic sphere. It is interesting that they both came to the same conclusion, even though their analyses were significantly different. Posner explained the conclusion of his research in two ways. His initial reasoning was based on the assumption that judges, who determine the law at common law, prefer effective to ineffective rules. These preferences are derived from judges' decisions to affirmatively choose to prefer efficiency as a normative value against other values (such as the redistribution of wealth or any measure of social egalitarianism), or because even though in theory judges may incline to other values, in practice they still tend to maximization of wealth, i.e. efficiency, as to a goal that can be achieved most easily, in contrast to other goals, which, due to the limitations of judicial processes , cannot be achieved (Zywicky and Stringham , 2010) . Posner gives an alternative explanation of a *hypothesis on the effectiveness of common law* which is based on the philosophy of utilitarianism. He believes that judges are guided by the utilitarian philosophy according to which the social welfare is getting maximized by attaining the highest possible utility of each individual. Since the utility is not directly measurable, judges try to maximize the usefulness of economic efficiency or wealth instead. In the analysis of English common law Hayek (1974) raises an interesting analogy of the functioning of common law and the market. In fact, in the same way on which market prices are formed as a result of millions of individual decisions, common law has been developed on the basis of numerous independently made judicial decisions. By analogy to the market prices that cannot be affected by any individual, no judge or lawyer can specify the basis of common law, but it is rather created by all citizens. Finally, in the same way that the free market operation leads to the achievement of Pareto - efficiency, the common law results in effective outcomes.

The general conclusion of a brief overview of theoretical views of English common law is clear: English common law leads to effective judicial outcomes and exhibits superiority to civil law when it comes to the regulation of business practices. Consequently, the countries in which the legal system is based on English common law, which includes India, should have an effective legal system, which involves a high protection of creditors, debtors, minority shareholders, legislative, and transparency in operations when it comes to business. However, theoretical considerations are often not fully in accordance with the actual state of affairs, and the legal system in India is just one example that proves the possibility of discrepancy between reality and theory.

3. APPLICATION AND IMPORTANCE OF FORMAL LEGAL AND FINANCIAL INSTITUTIONS IN INDIA

The India's economy has experienced high growth rates after gaining the independence in 1951. While the average growth rates from 1951 to 1979 were lower than 4 %, during the 80s they experienced accelerated growth. On the basis of annual data on the Indian GDP it has been calculated that from 1980 to 2004 the average growth rates for a five- year period were higher than 5 % (Kotwal et al ., 2010) . Based on this we can estimate that in the period after liberalization, despite the difficulties that India faced in the 90s, the Indian economy has had a steady growth. After 2004 a further acceleration of growth occurs with the economy achieving average annual growth rates of up to 11% (2010) and the average annual growth rate for the period 2004-2012 amounts to 7.64 % (World Bank data) .
Fast-growing economies are in the focus of a large number of scientists. Economists are especially interested in the cause of high growth, i.e. what initial assumptions must be met in order to gain the opportunity for a rapid economic growth. In literature a frequently cited precondition for economic take-off points out at the existence of an effective legal system. As the basis of the legal system in India is English common law, so the rapid growth of the India's economy is interpreted as the result of a well-established legal system and efficient functioning of financial institutions.

When it comes to research into the economic growth of India, great importance is attached to the India's legal system. One of the causes of high rates of economic growth is the fact that India is among the countries with the strongest legal protection of investors and creditors (Allen et al., 2007), according to official indicators. This conclusion follows from the comparison of the index values indicating the degree of legal protection of investors and creditors (Creditor Right Index, Anti -Director Index, etc.) in different countries. The values of these indices for different countries are presented in Table 1.

Table 1: Calculated values of the indices indicating the degree of legal protection of investors and creditors by countries

	Creditor rights	Anti-director rights	Corruption perception index	Legal formalism index	Legality index	Disclosure requirement	Earnings management score
Panel A: India and other large emerging markets (EMs)							
India (E)	**2 (4)**	**5**	**3.3**	**3.51**	**11.35**	**0.92**	**19.1**
Argentina (F)	1	2	2.9	5.49	10.31	0.5	N/a
Brazil (F)	1	5	3.3	3.83	11.43	0.25	N/a
China	2	1	3.3	3.4	N/a	N/a	N/a
Egypt (F)	2	3	3.3	3.6	10.14	0.5	N/a
Indonesia (F)	2	4	2.4	3.88	8.37	0.5	18.3
Malaysia (E)	3	5	5.0	3.21	13.82	0.92	14.8
Mexico (F)	0	3	3.3	4.82	10.79	0.58	N/a
Pakistan (E)	1	4	2.2	3.74	8.27	0.58	17.8
Peru (F)	0	3.5	3.3	5.42	9.13	0.33	N/a
Philippines (F)	1	4	2.5	5.0	7.91	0.83	8.8
Russia	1	4	2.4	N/a	N/a	N/a	N/a
S. Africa (E)	3	5	4.6	3.68	11.95	0.83	5.6
Sri Lanka (E)	2	4	3.1	3.89	9.68	0.75	N/a
Thailand (E)	2	4	3.6	4.25	10.7	0.92	18.3
Turkey (F)	2	3	3.8	3.49	9.88	0.5	N/a
Average of EMs[A]	1.47	3.64	3.12	4.07	10.25	0.61	16.61
Panel B:LLSV country groups							
English-origin Ave.	2.28	4.19	5.33	3.02	15.56	0.78	11.69
French-origin Ave.	1.31	2.91	4.39	4.38	13.11	0.45	19.27
German-origin Ave.	2.33	3.04	5.58	3.57	15.53	0.60	23.60
Nordic-origin Ave.	1.75	3.80	9.34	3.32	16.42	0.56	10.15
Sample Ave.	1.80[a]	3.37[b]	5.24	3.58[c]	14.98	0.60[d]	16.00

Source: Allen F, Chakrabarti, R.,De, S, Qian, J., Qian & M. (2012), Financing firms in India, Journal of Financial Intermediation, 21.409-415.

Based on the data presented in Table 1 it can be concluded that countries that during the colonial period were under the governance of England, i.e. English -origin countries, have on average higher values of all the calculated indices compared to the average of the total number of analyzed countries, i.e. former colonies of France, Germany, England and the Nordic-origin countries. As an individual country, India is also characterized by a high index value of protecting the rights of investors and creditors. It is particularly interesting to note that the calculated index value of protecting rights of creditors - Creditor Right Index for India is maximal, i.e. calculated index value is 4, which is the maximum value of the index). In terms of *Anti - Director Right index* whose maximum value is 6, the value of this index calculated for India is 5, which is the highest value of the index of an individual country amongst 100 analyzed countries. The survey was conducted in2007 by the already - mentioned authors Djankov, La Porta, Lopez-de-Silanes, and Shleifer, and it was the basis for the conclusion that India had a well-established legal system that undoubtedly contributed to the growth and development of its economy.

However, in the literature that examines the causes of rapid growth of the India's economy, there are also some alternative explanations. We can say that these viewpoints are somewhat controversial because they assess previously conducted research as methodologically incorrect, which implies that the conclusions obtained from them are wrong. Allen et al. (2012) advocate an alternative explanation for the growth claiming the following methodological shortcomings of previous studies:

- Most of the existing studies were carried out on the basis of data obtained by comparing different countries without taking into account essential differences between them, including differences in geographical size, population, level of GDP and so on. The differences between countries in research and interpretation of results should not be left neglected, because they determine the differences in the initial conditions of countries and have a great impact on the further growth of economy. On the other hand, in the existing research, countries such as

Singapore and India were treated as equal, which clearly indicates methodological flaws in research. To highlight why it is important to take into account the differences between countries, the authors give an example related to the implementation and effectiveness of legal and financial systems : taking into consideration the essential difference between India and Singapore, we can expect Singapore to have a more efficient legal and financial system, because it can be adapted to the conditions of economy at a relatively low cost, while any change in the legal or financial system of a large and diversified country entails high costs.

- Research based on a data comparison of more countries treats each country as a homogenous unit, omitting potentially significant variations in the efficiency of financial and legal institutions typical of different sectors, such as differences in the importance of financial institutions e.g. stock exchange for the operation of small and large companies and/or regions, which is particularly important when the research includes large countries i.e. India.
- In previous research, the focus of analysis refers only to formal legal mechanisms (courts) and formal financial channels (stock exchanges and banks), while it excludes other (informal) ways of financing enterprises and resolving business conflicts.

To overcome these shortcomings of previous research, the authors Allen et al. (2007) have used a different methodology. They focused on a study of legal and financial environment in which companies do business in India. The results have not been compared with those of other countries, but they only compared the differences in the results by different regions of India. What makes this study particularly interesting and important is the fact that the research subjects were not only formal institutions (courts, stock exchanges, banks, etc...), but also informal business relationships, rules, conventions, funding channels, etc. By analyzing the economy of India in this way the authors came to a surprising conclusion:

1. Formal legal system is little applied

Based on a number of theoretical findings, lawyers and economists consistently emphasize the importance and strength of the legal system in India, yet the country's citizens attach little importance to these theoretical findings. In fact, India shows great distrust of the legal system and the effectiveness and fairness of the judiciary. Numerous empirical studies have shown that people rarely turn to the judicial authorities when they encounter irregularities in business practice, because they do not believe that such a step would contribute to solving the problem. If the research is correct and the legal system does not work as efficiently as the previous scientific considerations claim, undoubtfully the following question arises: How is it possible for a large economy like India's to have achieved relatively stable and rapid growth for more than two decades without meeting basic preconditions for economic take-off such as the protection of property rights and contracts and the corresponding financial system. The group of authors has given the answer to this seemingly contradictory question based on the research into the business environment and business practices in India.

The authors have come to the conclusion that strong legal protection is not a necessary condition for a successful operation of an enterprise, and consequently the growth of the whole economy , as long as there are strong ' institutional ' substitutes for formal legal system such as fear of loss of reputation, partners, future business opportunities and alike. Social connections and informal institutions attached to them are of major importance for doing business in India. A famous economist P. Adler wrote and spoke about the importance of trust between market actors for the functioning of economy. He believes that trust is the key coordinating mechanism of a society (Adler , 2001) and that it can be seen as the third component of a cooperation mechanism of the capitalist economy as a whole, in addition to government and markets. In India, this type of coordination has a special place, as amid the lack of implementation of legal measures to ensure the execution of contracted obligations, the Indians rely heavily on mutual trust and established social norms.

2. Formal financial channels (banks and stock exchanges) are a key source of corporate financing

Companies in India obtain only 26 % of capital through formal financial channels (Allen et al., 2007).This includes large corporations, which means that small and medium-sized businesses are almost entirely financed from informal sources i.e. from their own savings, borrowing from friends, relatives, and alike. The main reason for the use of informal sources of finance lies in that bank lending is expensive and the terms of loans are too harsh. We might conclude that companies in India are in an extremely unfavorable financial position due to high funding costs, causing problems to the very production activity of companies. Specifically, companies which are facing difficulties in obtaining funds have little or no opportunity for growth. In western countries such companies are often forced to decrease production, employment, and sometimes to exit the market.

However, there are important differences between the companies operating in western countries and those in India. In Europe, banks finance about 2/3 of the total financial needs of companies (Chaldwell , 2001),

while in the United States about 60 % of the invested capital is acquired through issuance of shares or bonds,26 % of net investment comes from retained earnings, and only 17 % from other sources, including banks' financing(Gregory and Stuart , 2014). Thus, if banks tightened financing conditions in Europe, or if there was a deterioration of the situation on the stock exchanges in the U.S., the companies would be faced with a big problem because they finance business from formal sources, and finding new ways of financing requires time and additional costs. On the other hand, companies in India rely on bank financing to a much lesser extent, or financing by issuing shares, which makes their performances much less dependent on credit terms or conditions on stock markets. This can also explain why India was able to achieve relatively high rates of output growth although companies have had limited funding opportunities from formal sources.

3. Although a large number of companies operate outside the formal legal system and institutions, India has achieved high economic growth

Despite the poor investors' protection in practice, India's economy was growing faster than most other emerging economies of the 90s, which contradicts the belief that the key and unavoidable assumption of rapid progress lies in the stable financial system and the application of strong legal regulations in business. Proponents of the institutional theories of the development of capital markets consider the development of capital market and its successful functioning as a necessary condition for growth. If it is not developed, development costs can be high, which can lead to slower growth, or even to a change of this trend. High growth rates in India considerably weaken their conclusions. Other authors who hold the position that the developed and efficient legal system is primary conditions of growth, have very little opportunity to justify their claims on the example of India.

It should be noted that the assessment of the legal and financial system of India as "underdeveloped" does not imply a lack of legal and financial institutions, but is rather related to their poor implementation and therefore little significance for the development of economy. In fact, as it is said in the previous section of this paper, the legal system in India has its roots in English common law which is seen as superior. But citizens have little confidence in legal institutions, so that business irregularities are usually solved outside of judicial processes. When it comes to the financial system, the two major stock exchanges in India, according to the value of the market capitalization, the *Bombay Stock Exchange* and *National Stock Exchange* are of the world level significance. The total value of the market capitalization of the stock exchange in Mumbai is 67 443 983.8 INR, and the National Stock Exchange 65 907 848.1 INR (World Federation of Exchanges), which places these stock exchanges among the top twenty in the world. When it comes to the banking system, there is still a distinct dominance of state banks (state banks make up about 80 % of the total bank deposits). After the liberalization, several private banks have emerged, and several foreign banks entered the market. Private bank ICICI Bank is currently ranked the second by the size, while the state bank is ranked first. What is also important to note is that the banking system in India is characterized by much fewer non -performing loans thus making it more profitable and more stable compared to the banking systems of other countries in the region. However, the status of a "healthy" banking system is owed primarily to strict requirements set by the banks when issuing commercial loans; therefore, borrowing from banks is considered expensive and inappropriate to real possibilities of enterprises that need funding.

Despite the fact that India has two stock exchanges of the world significance, and the "healthy" banking system, the authors who deal with the entire financial system of India make the following conclusion (Allen et al . , 2007) : 1) stock exchanges , as well as the banking sector , are relatively small compared to the size and the needs of the economy , 2) the financial system is dominated by efficient (low overhead), but largely untapped (when it comes to providing loans) banking sector .

The results of the research conducted by Allen et al. (2007, 2012) may be summarized as follows: It is strong informal institutions that maintain India's economy steady; despite the results of previous research, formal institutions are under-utilized and have relatively little importance to the economy.

The support to the fact that the functioning of institutions in India is far from ideal is illustrated by the information on the rank of India by the Global Competitiveness Index and Index of Economic Freedom.

4. GLOBAL COMPETITIVENESS INDEX AND INDEX OF ECONOMIC FREEDOM

By the value of the Global Competitiveness Index (Global Competitiveness Index GCI) India ranks at 60th amongst 148 economies. Other BRIC countries (except Russia) have higher values of GCI, indicating the higher competitiveness of these economies compared to India's (World Economic Forum). We can conclude that India is ranked relatively low in terms of the total number, as well as in relation to the BRIC countries. According to the Global Competitiveness Report 2013-2014, a high level of innovation in an economy and a strong institutional environment have an increasing impact on the competitiveness of countries (PHD

Chamber), which is an alarming fact for India given its current performance in terms of the functioning of institutions . As India ranks at 72nd position by the efficiency of institutions, and at 110th by the benefits of the macroeconomic environment, it is not surprising that its competitive edge is relatively low. In addition, the three most significant problems companies face doing business in India are: 1. corruption; 2. inefficiency of state administration, and 3.In adequate infrastructure. From this follows that, according to the World Economic Forum, India is characterized by low efficiency of institutions and extremely unfavorable macroeconomic environment, which contradicts the results obtained by Allen et al. (2007,2012).
A similar conclusion can be reached on the basis of information that India is ranked 120 according to the Index of Economic Freedom (Index of Economic Freedom) constructed by the *Heritage Foundation* (2014). The report states that institutional shortcomings have largely a negative impact on long-term growth of the economy. The report also points out that India is characterized by a relatively stable democratic system, but that the size of the country and diversification of population are major challenges to effective and efficient governance/ management, or to achieve, what is known in economic literature as good governance. Excessive state intervention in the economy, and a relatively high level of state ownership, which has increased over the last years, contribute to the inefficiency of institutions and poor functioning of the whole economy. Companies are faced with a number of administrative barriers to business, while the private sector growth is largely prevented by a lot of non-tariff barriers and a high level of administrative regulations that burden the private investments (The Heritage Foundation, 2014).

When it comes to the rule of law, India has better protection of property rights than the average of the analyzed countries (53rd place), but, by the fight against corruption, it is well below the average and ranks at 97th place. Although the corruption is still one of the biggest obstacles to the development of India, there has been an increasingly strong pressure to reduce it in recent years. The executive branch of the judiciary system is considered to be independent, but trials are subject to political pressures, they are characterized by high costs, and individuals belonging primarily to political "elite" are protected from court charges. In order to facilitate a long-term growth and development of the India's economy, the primary task of the government must be committed to a resolute fight against corruption, given that the high level of corruption is said to be a major source of inefficiency of formal legal and financial institutions. Establishment of an effective judiciary and reducing bureaucratic barriers would provide significant opportunities for the development of India. Although the Indian government has strict measures in order to reduce corruption, the effectiveness of these measures are brought into the question due to the fact that little effort is made to reduce a large number of administrative and regulatory measures, as well as the state ownership of economy, and it is exactly the excessive administrative regulations and state owner ship that is recognized as the major sources of growth in corruption.

5. CONCLUSION

The development and effectiveness of the legal and financial systems of countries are key components of their macroeconomic environment. The way companies do business; their profitability and the possibility of further development are largely dependent on the general business climate in the country, which is defined above all, by the protection of property rights and contracts, bureaucratic restrictions on operations, the level of corruption in state institutions, access to finance, etc. The professional literature demonstrates the consent at countries with a legal system based on English common law have better regulations of business and more efficient functioning of legal institutions (e.g. Hayek 1974 Zywicky and Stringham, 2010). India, as one of the representatives of the BRIC countries, is characterized by a legal system based on common law and developed financial system, which involves primarily a sound banking system and developed stock market. According to official indicators (Creditor Right Index, Anti -Director Right Index) India has a particularly strong protection of investors and creditors (Allen et al., 2007). In the economic analysis of the Indian economy, a favorable macroeconomic environment, and a strong legal framework of business and a sound financial system in particular, are recognized as key factors of its high growth rates after the liberalization. However, later studies have pointed to the methodological shortcomings of previous studies, for which the conclusions drawn on the basis of them do not correspond to the actual state of the economy of India. According to the research conducted by Allen et al. (2007) companies in India are heavily reliant on informal institutions in their operations, such as trust, responsibility towards families and authorities, informal agreements, etc. The importance of informal institutions stems from the lack of confidence in the country's legal system, and a limited use of formal financial channels to raise the necessary funds. Although informal institutions are extremely important for the coordination of the market economy, they are still insufficient to establish a stable macroeconomic environment conducive to growth of competitiveness of the economy and its rapid progress. For these reasons, India is by the Global Competitiveness Index (60th place) and the Index of Economic Freedom (120th place) ranked relatively low as compared to the other BRIC countries, as well as in relation to the total number of analyzed countries . Excessive bureaucracy, high levels of corruption and the legal institutions subject to political pressures are the primary problems whose reduction is necessary in order to enable further growth and development of India's economy.

REFERENCES

Adler, P. (2001). Market, Hierarchy, and Trust: The Knowledge Economy and the Future of Capitalism, Organization Science, 12(2),215-234.

Allen, F., Chakrabarti, R., De, S,. Qian, J., & Qian M. (2012). Financing firms in India, Journal of Financial Intermediation, 21,409-415.

Allen, F., Chakrabarti, R., De, S., Qian, J. & Qian M. (2007). Financing firms in India, Brookings-Wharton Papers on Finantial Services, John Hopkings University Press.

Chaldwell, Ch.(2001).Europe's Social Market, Policy Review, Hoover Institution Press.

Coase, R.,H. (1960). The Problem of Social Cost, Journal of Law and Economics, 3, 1-44.

Ehrlich, I.. & Posner, R. (1974). An Ecnomic Analzsis of Legal Rulmaking. Jounral of Legal Studies, 3(1), 257-286.

Gregory, P., & Stuart R. (2014). The Global Economy and Its Economic Systems, South-Western, Cengage Learning.

Hayek, F.A. (1978). Law, Legislation, and Liberty: Rules and Order, Chicago, IL: University of Chicago Press.

Kotwal, A., Ramaswami, B., & Wadhwa W. (2010). Economic Liberalization and Indian Economic Growth: What's the evidence?, Bread Working Paper, Kaushik Basu.

Landes, W., & Posner, R. (1994). The Economics of Anticipatory Adjudication. The Journal of Legal Studies. 23(2), 683-719.

Parisi, F. (2004).The Efficiency of the Common Law Hypothesis, The Encyclopedia of Public Choice, Springer.

PHD Chamber, Retrived from http://www.phdcci.in/admin/admin_logged/banner_images/1378471933.pdf

The Heritage Foundation, 2014 Index of Economic Freedom, Retrived from http://www.heritage.org/index/pdf/2014/countries/india

The World bank data, Retrieved from http://databank.worldbank.org/data/views/reports/tableview.aspx

World Economic Forum, The Global Competitivnes Report 2013 -2014, Retrived from: http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf

World federation of exchanges, Retrived from http://www.world-exchanges.org/statistics/monthly-reports

Zywicky T., &Stringham E. (2010). Common Law and Economic Efficiency,Encyclopedia of Law and Economics, Francesco Parisi, Richard Posner, eds., George Mason Law & Economics Research Paper No. 10-43. Retrieved fromhttp://ssrn.com/abstract=1673968

KNOWLEDGE MANAGEMENT

KNOWLEDGE MANAGEMENT SOFTWARE APPLICATION IN ICE-CREAM COMPANIES

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Abstract : *In this paper will be explained the meaning of knowledge management software application and the importance of using this kind of software applications in companies. Also in this paper will be listed types of knowledge management software applications that can be used in the companies. In this part will be given some facts from the ice-cream industry and will be mentioned possibilities for using knowledge management software in this industry. After the theoretical explanation of knowledge management software applications, the practical research in this paper will be done in the biggest ice-cream company in the Republic of Macedonia. In this part will be explained why ice-cream companies should use knowledge management software application and what kind of benefits the companies can get by using this application. The aim of this paper is to contribute for raising the awareness of ice-cream companies to use this kind of software application through the example of the biggest and the most successful ice-cream company in the Republic of Macedonia.*

Key words: knowledge management software application, ice-cream company

1. KNOWLEDGE MANAGEMENT SOFTWARE APPLICATIONS

1.1. Definition and meaning of knowledge management software applications

Nowadays more and more companies are turning to modern and advanced operations. All working processes in companies are increasingly computerized in order to obtain faster, simpler and accurate execution of all work activities. In addition to work activities, companies start to computerize also the knowledge that they possess. This can be done by using the appropriate software that helps companies to use effectively their intellectual capital. The knowledge management software applications need to distribute and maintain knowledge of the company. The basic principle of knowledge management software applications is to disseminate knowledge in appropriate and easy to use format to the appropriate person and appropriate place in order companies to be competitive on the market and to have effective execution of all tasks.

The knowledge management software application is not a software application with standard size, shape and look. In fact, knowledge management software applications can be very different from one company to another. This is because of the different activities of the companies and different intellectual capital owned by each company. But whatever the differentiations between the companies, we can say that knowledge management software application in the companies can support generation, storage, update and distribution of knowledge.

The company's ability to learn and change, and more importantly to learn faster than other companies and to turn learned things into action, is the greatest power of a company. (Mašić and Đorđević, 2008). With the help of software knowledge management, company will be able to make changes in order to transfer knowledge and to improve processes, develop new products or services in order to meet the needs of customers, attract new customers and achieve all the company's goals.

Companies that want to use the knowledge management software need to know what goals want to achieve by using this kind of software. If companies start to use the knowledge management software that means these companies realized how precious are intellectual capital and knowledge which they possess.

The future of knowledge management software applications can be clearly predicted. As companies move into the age of knowledge, the need for proper software tools is increasingly growing because those tools will help companies to sort big quantities of data and information. Companies are inundated with e- mails, electronic newsletters, articles, graphs, customers' requests, prices etc. Regarding this issues companies spend a lot of time in sorting, filtering, answering and managing of all the things listed. (Kurucz, 2003). To avoid all this, companies should have a software solution that can properly handle with all electronic and written data, information, documents and knowledge and thus contribute companies to have constant progress and achieve their goals.

1.2. Types of the knowledge management software applications

Each company, depending on its business activity, can use different type of knowledge management software application. Knowledge management software application should fit and conform with the company's activities and tasks.
Companies can buy knowledge management software solution from software companies and also can order from them to create special software regarding their needs.
The most important goal of knowledge management software application is ensuring that data and information are collected and stored in proper way in order to be effective and efficient for use for the members of the company.
There are a variety of companies prepared to provide knowledge management solutions. Some of the leading providers are: Cobble Soft International Ltd, ePath Learning, Knowledge Powered Solutions, KANA Software, Inc., Overtone Software, Inmagic, Inc., LegalEdge Software, AHG, ICCM Solutions, Kanda Software, AccessData, Accusoft, Apple, ASG Software Solutions, Attensity, Brainware,Connotate, eTouch FTI Technology, Google, IBM, Oracle, Kana, Microsoft, K2, Kofax and many other software companies. Knowledge management has become increasingly important in a data-centric and service-focused economy. Regarding this the knowledge management software is also essential for company producers and service companies.

Knowledge management software can exist in many forms, including:

- Process-driven applications
- Automated data integration
- Data capture and workflow solutions
- Purpose-built databases
- Content life cycle management systems
- Automated document and classification solutions
- Document, content and imagine solutions
- Secure file sharing
- Optical character recognition
- Social analytics and engagement solutions
- Integration of enterprise search
- Business intelligence

Some of the already developed knowledge management software solutions are:[1]

- PHPKB (PHP Knowledge Base Software) is produced by PHP's leading knowledge management software bases, and offers assistance to companies through the support and management of their knowledge bases. PHPKB knowledge management software database provides statistical knowledge that is crucial for decision making in relation of existing and potential customers, and offers professional view using charts and diagrams that review all the information. The features of this software are especially suitable for companies that have a lot of information. With this software companies are able to process the information for potential customers and adjust their activities based on the processed information.

- SEM Knowledge Management software is produced by software company Kana and it is knowledge management software that allows access to all databases of the customers, as well as certain external databases of consumers made by another company or institution. This software can answer on demand estimated by the set of pre- entered contextual specifications. These specifications can be: setting value of the consumer, type of application, previous experience, number and type of the order etc.

- Safeharbor KMS is software developed by Safeharbor Knowledge Solutions. In the last decade, this software was used by more than 500 companies. It maximizes the management of knowledge in the company. Apart from storing data about potential customers, markets, prices, suppliers etc. this software offers several solutions, including: making assessments of the work, creating a strategy for attracting new customers, perform testing, analysis and compliance of information and creation of the best practices in the company in order for the company to meet the demands of the new customers and market.

- KBPublisher made by the same name manufacturer is a web-based software for managing knowledge. With this software companies can share the knowledge with other members and also they can publish and manage with articles, guidelines, processes, frequently asked questions and other information and items

[1] http://www.capterra.com/knowledge-management-software/

from the company. In order to use this knowledge based software, companies should have internet connection and web browser.

- Novo Knowledge Base Software is produced by software company Novo Solutions and this software allows quick and safe access to the entire knowledge of the company. This software is designed for companies that want to have a central repository of knowledge and all employees to have access on it. In this software has been implemented and training for employees.

- Archivd Research management knowledge software is produced by Archivd. Using this software, a company can collect and present all inquiries from potential customers that are made online. Furthermore they can easily be shared among the employees. This software is commonly used by production managers, sales managers and advertising agencies in order to process all the information obtained from the Internet for the new customers and to take actions that will contribute to satisfy their needs.

- Smart Support is produced by Safeharbor and it is software for knowledge management with main purpose to connect people with the proper answers. The software is intuitive, easy to integrate into web-based environment and offers advanced tools that can easily be managed and edited in knowledge base of the company. It should also be noted that this software offers templates for workflows, writing comments, documents etc. It is assumed that the return on investment of this software is in a period of six months or less.

- Akiva WebBoard Knowledge Base is produced by Aktiva and it is a software that collect and organize group information and content in the company. It has ability to collect, manage and query very large amounts of data, information, documents, photos and other contents. It performs fast and safe sharing of documents and verification of all data and information. Users can perform self-evaluation and management of content which are part of the company.

- Dezide Advisor is produces by Dezide and it is web based software that serves the employees and their existing and potential customers. If consumers have any questions or specific requirements, this software provides multiple solutions and answers of the questions. On this way customers get the most optimal answers in the shortest time.

- Traction Teampage is produced by Traction Software and it is software for knowledge management enabling seamless communication, collaborative work, quickly finding the data etc. This software allows monitoring of activities, discussions, collaboration between different sectors in the companies and control the execution of the employees' tasks.

- Column Case Management produced by Column Case Investigative is software that eliminates natural processes, increases efficiency, reduces errors, and thus the companies will be able to reduce costs and obtain better solutions. Through this software can be provided safe and secure management and sharing of information and processes, as well as cooperation between various sectors in the companies.

These and many other software solutions are developed and used by different kind of companies. Knowledge management software solutions are upgrading all the time in order to satisfy the needs and requests of the companies.

2. ICE-CREAM INDUSTRY AND USING OF KNOWLEDGE MANAGEMENT SOFTWARE APPLICATIONS

Ice-cream industry round the world takes great participation in global economy. The global retail ice cream industry revenue is estimated to reach $74 billion by 2018. Favorable demographic factors, rising consumer disposable income, and consumer's awareness toward frozen dessert mainly drive the demand. The retail ice cream industry includes retail sales of classic ice creams and frozen novelties. Classic ice cream includes special ice cream such as low-fat and non-fat, take home, and bulk ice creams. Frozen novelties include flavored ice, sorbet, and frozen yogurt.[2]

The industry is moderately capital-intensive as large numbers of players are competing with each other to maintain their place in the market. The classic ice cream segment contributed approximately 80% in global retail ice cream industry in 2012, whereas Nestle and Unilever, the two largest players captured one-third of the total market. New product development and innovation plays an important role as a growth driver for industry. Maintaining price and quality, brand loyalty, and consumer group retention are the biggest challenges for industry due to the large number of competitors in the market. (Euromonitor International, 2013). Also in Republic of Macedonia ice-cream industry has a big part of all the economy incomes. In

[2] http://www.idfa.org/resource-center/industry-facts/ice-cream/

Republic of Macedonia there are two big companies that produces ice-cream (classic and novelties of ice-cream), but also there are a lot of retails that sell ice-cream in the territory of Republic of Macedonia. That means that competition is on very high level. In order to be competitive on the market, to get bigger number of customers and to archive bigger profit, ice-cream companies should work regarding proper strategies in order to archive their own goals.

The proper work strategy can be done and helped by knowledge management software application.

With the help of knowledge management software application ice-cream companies can have proper execution of their tasks and can have effective usage of the knowledge they possess.

Knowledge management software application can help ice-cream companies to collect knowledge that they possess, to collect new knowledge, store all the knowledge, then process it, transfer it between all the employees and do update on the knowledge all the time.

On this way ice-cream companies will have proper view of all of their activities, their data, documents, employees' knowledge and they can manage with all of them much easier and faster. Also they can collect and proceed knowledge about their customers, their needs and wishes regarding different types of ice-creams, then knowledge about the market, competition, prices, new technologies for producing ice-cream, new ways of sales etc.

3. PRACTICAL RESEARCH - Cermat Doo – biggest ice-cream company in Republic of Macedonia

The research in this paper is descriptive and it is made by interview with the general manager and owner of the biggest ice-cream company in Macedonia and owner of the other ice-cream distribution companies in Serbia, Montenegro and Croatia.

Cermat Doo is an ice-cream producer company that have the biggest part of Macedonian ice-cream market. Cermat produces different kinds of ice-cream: impulse ice-cream (ice-cream on stick, cornets and ice-cream in cup), family ice-cream and horeka ice-cream (ice-cream for catering).

With all this assortment of ice-cream Cermat satisfy wishes and needs of a lot of customers from Macedonia and other European countries where this company sells: Germany, Austria, Slovenia, Croatia, Serbia, Montenegro, Albania etc.

Not only the rich assortment of ice-cream gives this company competiveness and biggest market share, but also its proper work strategy and its proper use of all the knowledge they possess through knowledge management software application helped this company to be biggest, innovative and advanced ice-cream company in Republic of Macedonia.

Cermat uses knowledge management software application which is created regarding the needs of the company, sectors in the company and needs of the employees.

The name of the knowledge management software application that Cermat use is "CFMA".

This software works with the large databases where are stored all the information and knowledge from the past years and from daily operations. All the stored knowledge go into the company server where they are stored one more time in order to have proper security of all of their knowledge and information.

With the help of this software Cermat has the information of each customer regardless if the customer is small shop, market, supermarket, restaurant, coffee bar etc. Also there are written all the purchases that each customers have done with the exactly articles and time of purchase.

Cermat gives refrigerators with codes to each customer and these codes entered into the database that is connected with the knowledge management software. With the help of this software, Cermat knows where is located each refrigerator that it possess.

Every customer has a different need, wish and opinion regarding the ice-cream quality, ice-cream price, ice-cream size, ice-cream package etc. Cermat on certain time period makes market research in order to collect information of customers on different market regions where it sells in order to discover what customers want and to adjust work strategies and production regarding their needs and wishes. All of this information are stored into the knowledge management software and there are possibilities to be done different analysis and reports. All of these reports and analysis allow Cermat to has a clear view of what kind of ice-cream should produce and sale on different market regions.

Also this software gives Cermat possibilities to make analysis regarding realized sales through the years and to make comparisons regarding the sales year by year.

In the database of this software are also stored information for all suppliers of the company and all the purchases that Cermat have done to them. The software gives opportunity for analysis of prices comparisons of the prices from the suppliers in certain time period.

With this software employees can write and print documents with standard size, look and characteristic which are suitable for the needs of the company.

In CFMA software are stored also all the information of each employee regarding the their education, skills, performance, experience etc. All this information allow managers to know how to allocate human resources to different work positions.

With this software are covered all the aspects of working of this company: sales, financials, human resources, production, customers etc.

4. CONCLUSION

From the theoretical part of this paper can be concluded that knowledge management software applications can help different kind of companies to have view of the knowledge, to work efficient and to reach their goals through proper using of the knowledge that they possess.

Also companies can use all the listed software applications if they are suitable for their needs. If they want, they can order from the software companies software applications that will fit with their needs.

Ice-cream companies also need to use knowledge management software application in order to produce ice-creams regarding the needs and wishes of the customers, to reach bigger market share, to have bigger profit and to adjust all the work process regarding the needs of the company and employees.

With the example of the biggest ice-cream company in Republic of Macedonia it can be seen that all the work process and activities are completely covered by knowledge management software application. All work tasks are very good organized which allows this company to have overview of all the situation on the market, on wishes of the customers, orders, documents, information, tasks, employees etc.

Cermat company should be sample for successful ice-cream producer company that use knowledge management software for all its work activities and tasks. All ice-cream companies should use this kind of software application if they want to be advanced, innovative and successful.

REFERENCES:

Cermat Doo company official website. (n.d.). . Retrieved , from www.cermat.com.mk

Euromonitor International (2013), Global Retail Ice Cream Industry 2013 -2018: Trends, Profits and Forecast Analysis, http://www.euromonitor.com/ice-cream

International dairy foods association, http://www.idfa.org/resource-center/industry-facts/ice-cream/

Knowledge management software . (n.d.). . Retrieved , from http://www.capterra.com/knowledge-management-software/

Kurucz P, (2003), The future of knowledge management software, http://www.kurucz.ca/

Mašić B. and Đorđević – Boljanović J. (2008). Menadžment znanja: Koncept za kreiranje konkurentske prednosti u novoj ekonomiji. Montenegrin Journal of Economics, 3(6), pp. 101-108

MEASURING IMPLICIT AND EXPLICIT KNOWLEDGE IN ORGANISATIONS

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Abstract: *This paper provides review of different approaches to measuring implicit and explicit knowledge in organizations. Based on review of existing literature, we combine theoretic view on measuring and variation with practical measurements suggested by other authors. We analyze the possibility of measuring such implicit and sometimes elusive organizational phenomenon as knowledge. Further we synthesize knowledge measuring methods and measurement units. Next, a set of knowledge indicators used in literature and practice for measuring organizational knowledge is presented.*

Keywords*: Knowledge, Measuring, Knowledge management, Learning organization.*

1. INTRODUCTION

Despite the attempts, there is still no consensus within the academics about definition of knowledge. Western epistemologists often start with Theaetetus, where Plato (2013) discusses "true belief with an account" as the closest acceptable definition of knowledge. Johannessen, Olaisen and Olsen (2001) define knowledge as "systematized and structured information of specific purpose". Dixon (2000) says that "Knowledge stands for important links between the information, that people make in their minds, and application of those links as actions in specific contexts". Suknović and Delibašić (2010) define knowledge as concept which "represents triplet of problem, context and solution". Authors offer the following definition of knowledge: "Knowledge is the system of patterns for information processing, which suggest a solution of a problem in particular context." Therefore, knowledge is defined by three components (Suknović (2010) p. 192, modified): ***context*** (current and desired state), ***problem*** (gap between current and desired state) and ***solution*** (selection of one of the possible ways of achieving the desired state from the current state).

The existence of the system of knowledge is based on several basic assumptions: 1) ***Absolute truth.*** There exists objective truth, which is the convergence of subjective perceptions of reality. (Borgatti and Carboni, 2007), 2) ***Encoded***. People represent the information and knowledge through various processes of encoding, therefore these structures are represented by the system of symbols enforced with particular meaning (Kanwar, Olson and Sims (1981) p. 122-127, modified), 3) ***Understanding***. People can understand the encoded knowledge and information (Reich, 1994), 4) ***Stored***. Knowledge is stored in the memory of the individual in more or less organized (structured) way and makes the network of more or less related concepts (Kanwar, Olson and Sims (1981) p. 122-127, modified), 5) ***Accessible*** (concept or set of concepts may be retreived from the memory as a result of attention focused on the external or internal impulses) (Kanwar, Olson and Sims (1981) p. 122-127, modified).

2. FEATURES OF THE SYSTEM OF KNOWLEDGE

By the term "desirable characteristics" this paper will involve features that it is good that a system has. Well structured knowledge is characterized by the following features: (features 1, 2 and 3: Rief (1984); Elio&Schaf (1990); De Jong and Ferguson-Hesstler (1995) p. 105-113), (features 4, 5 i 6: (Reich, 1994)): 1) ***Durability***. (continuance of acquired knowledge through time), 2) ***Accessibility***. (quick and efficient searching and knowledge finding process), 3) ***Modularity*** (easily adding new elements of knowledge without having to change the existing knowledge structure), 4) ***Transferability***. (knowledge can be shared between systems or reasoning mechanisms), 5) ***Cumulativity*** (knowledge of two quantities can be added to make the third greater), 6) ***Measurabilty*** (that is, it can be measured directly, by direct counting of the elements of structure).

Poorly structured knowledge can be characterized by the following features (according to: Possible anomalies of model and according to: Structural faults of system of knowledge (Ramaswamy, Sarkar and Chen (1997), Yang, Tsai and Chen (2003)): 1) ***Incompleteness***. Knowledge system does not contain all the

parameters (situations) that may occur or do not cover the whole set of possible solutions (Cheng and Huang, 2009). 2) ***Inconsistency***. Knowledge system contains a number of rules, which when applied lead to mutually contradictory consequences. These errors are difficult to identify in large knowledge bases. For details of the measurement and treatment of conflict if-then rules, see: (Cheng and Huang, 2009). 3) ***Ambiguity***. Within the knowledge system two or more actions should be applied, while their order is not defined. 4) ***Inaccuracy***. Model in the knowledge system does not match the real system, therfore the rules applied do not lead to correct conclusions. 5) ***Circularity***. Applied set of rules leads to the reuse of one of the rules in the sequence and creates a circle that has no beginning and no end, and from which it is not possible to get out using the rules in the knowledge base. 6) ***Redundancy***. The case when two or more rules lead to the same conclusion. By eliminating one of these redundant rules knowledge system would still be able to solve the problems. Redundancy usually occurs when different rules lead to a conclusion through a different number of intermediate results.

4. SPECIFICITY OF APPROACH TO MEASURING KNOWLEDGE AND ITS VARIATION

Measure is the homomorphic model (Reich, 1994), which in a formal manner expresses specified property of the real system. It carries information of a specific feature of the system, i.e. information about the quantity of the particular quality, while neglecting all other qualities. Measures have three important roles: 1) ***Informing***. Measures are the carriers of information, which are thus more accurate and complete. 2) ***Comparability***. Measures allow comparison of different systems on the observed features. They are a standard of comparison - etalon. 3) ***Integration***. As a medium of communication between people, the measure has a large effect on strengthening the integration between them, because, lowering transaction costs, facilitates communication and cooperation. Indead, the development of civilizations followed the development of the measurement system.

As the measure is a model of the real system, its quality is basically expressed as the quality of any other model. The following are the basic features that determine the quality of the model. (Radenković, Stanojevic, Markovic (2004), Culligan (2004), Kerzner (2009)): 1) ***Relevancy***. Contextual compatibility of measure, that is: relevance of the information carried by the measured values. We need to make sure that the measurement instrument actually measures what we want to measure. 2) ***Accuracy***. The degree of vicinity of the measured value to the actual value. How the measured value is close to the actual value after measuring. 3) ***Precision***. The consistency of the results over time, in the situations with the same circumstances; That is: the degree to which repeated measurings under the same conditions, give the same result. 4) ***Sensitivity***. If specific feature is measured, what is the probability that the system actually has this feature. 5) ***Specificity***. If the absence of some feature is measured, what is the probability that the system really does not have that feature. 6) ***Cost of measurements***. The total cost of the measurement process (in cash). 7) ***Measuring speed***. The time during which measuring can be performed. 8) The measure is ***valid*** if it is *accurate* and *precise* (Culligan, 2004). It follows that the test cannot be more than what is valid reliable, ie. reliability is the upper limit of validity .

First of all, anyone must measure in a scientific way, to find the variation limits, in any type of scientific knowledge and knowledge management. Appearing in philosophy as an antithesis to Socratic identity, *variation* is the natural consequence of the impossibility of there being several identical things: “How can several objects be identical if there are more of them?” An answer formulated in a purely philosophical spirit becomes the most pragmatic vision of variation: “They are not identical. I need to distinguish them by something. If they did not differ, we would not be able to perceive them as such” (Ionescu, 1993). Such multidimensional and implicit phenomenon as knowledge is very hard to be abstracted toward comparison among different instances. Identity, formulated by Socrates “ab initio” as an intrinsic quality of the object, evolves towards defining through comparing and relating, and generates the *stationary* or the “premise of variation”. Plato placed variation within two of the five universal concepts applicable to all things, viz. *difference* and *change*, which followed *existence* and *identity*, yet before *resistance*. The paradoxes of ancient Greece, generated by the absolutely special depth of ancient Greek thought, provided the essential delimitations between variable and constant, dynamic and stationary. Zeno’s arrow paradox can be answered, after nearly two and a half millennia, by modern statistical physics, through describing the opposition between wave and particle, since *what is in a point cannot be moving or evolving, and what is moving and evolving can be found at no point*, as the memorable formulation of Louis de Broglie runs (1966). The development of logic, along with the use of mathematical induction, had the final premise of *apparently limiting independent variation*. The very “aletheia”, or the visible truth of classical Hellenic logic, has the two faces of Janus and expresses *spatial and temporal variability*.

Identity in itself contains its opposite, in the concept of difference (variation)*, in the inimitable Hegelian spirit*. The logic of falseness and truth is transformed, by the paradigm of variation, into a simple *alternative type variable* (F/T). In Stefan Odobleja's philosophical thought (1938), against the backdrop of the logic of the apparent or related variables, as well as that of real or free variables, the "variability of species and natural selection" develops resonantly. Even Darwinism finds that variations occur without apparent cause, spontaneously, and distinguish three major types: a) defined variations, which occur when all or nearly all the offspring of individuals, subject to the influence of certain conditions for several generations, change in the same manner; b) undefined variations or changes, which occur in some individuals of a population and "can be regarded as indefinite effects of the conditions of life" (while effects appear as random in relation to the conditions, undefined variations are either useful, or indifferent, or even harmful); c) correlative variations, which are the result of the logic of the correlation between organs (causing virtually the modification of an organ in a certain way, and entail the modification of the organ it is correlated with).
Phenotypic variation, seen as the totality of all biological variations (Vp), is the sum of two components of the aggregate type, namely the variation caused by the influence of environmental factors (Ve, or the "environmental variation" component), and the variation caused by the contribution of segregating genes (Vg, or the "genetic variation" component):

Vp = Ve + Vg < – resonant or interfered – > $(\sigma_g^2)=(\sigma^2)+(\sigma^2)$ (1)

Similarity with the statistical rule of adding explained variance (the mean value of group dispersions) to residual dispersion (the average of group dispersions), the resulting amount being nothing else than the dispersion of the population or general community, confirms the existence of the *paradigm of variation* as *isomorphism*, the computing relations being resonant with the rule of adding dispersions, they finally indicate the calculation formula for the coefficient of determination (Săvoiu, 2009).
Heritability or the proportion of the total variation that is controlled by heredity ($H = h^2$) is a relation between the variation determined by multiple genes with additive effects (V_a) and phenotypic variation (V_p):

$$H = h^2 = \frac{V_a}{V_p} \text{ or } H = h^2 = \frac{V_a}{V_e + V_g} \quad (2)$$

hence:

$$h = \sqrt{\frac{V_a}{V_p}} = \sqrt{\frac{V_a}{V_e+V_g}} \text{ <- resonant or interfered – > } R = \sqrt{\frac{(\delta^2)}{(\sigma_0^2)}} = \sqrt{\frac{(\delta^2)}{(\delta^2)+(\sigma^2)}} \quad (3)$$

The two essential Darwinian categories, heredity, as a property of living beings to develop *the same* characters, and variability, i.e. the permanent emergence of *differences* between the individuals of the same species, are the support of evolution by selection (in the sense of transformation of species), and, englobed in a much more general biological notion, they represent the support of speciation (the emergence of new species from old ones, or the evolutionary development of a biological species, as by geographical isolation of a group of individuals from the main stock). Teleonomy has currently become the science of researching living organisms, due to their specific features, which include causality, finality, and especially due to their development towards higher *differentiated, functionally superior structures* (teleonomic capacity). The temptation of *lex*ification of biology, in the scientific manner of thinking (Săvoiu and Iorga Simăn, 2012), focused on the *paradigm of variation* in biology, is resonant with the scientific fields of logic and mathematics (as vague final influences of thermodynamics):
Prima regula: Variation (variability) does not exist alone, but it co-exists in a balanced manner along with stability (heredity).
Secunda regula: The total variation is the sum of two components, bringing together key / essential factors, which are explanatory and nonessential or residual.
Tertia regula: The proportion of the total variation, which is *controlled* by a key factor, is a determinable ratio.
Quarta regula: The various partial variations are correlative, and one can determine the existence, the direction and the intensity of the relationship between the partial variations in the total variation.
Quinta regula: Evolutionary processes contain both correlative and non-correlative variations, and, in so far as the system in which they occur is temporarily closed or static and there is a universal unit of measurement, the total sum of the variations becomes relatively constant, and the regressive evolution is irreversible (entropic). A final remark to the variation paradigm, as applied to social and natural sciences and scientific knowledge, is that biological variation can be considered the fundamental factor in the process of evolution, including knowledge and knowledge management evolution.

One of the main characteristics of knowledge that causes a specific approach to its measurement is the inability of measuring knowledge directly. In contrast to physical measurements, where certain features of the object can be measured directly (for example, length), knowledge measurement in most cases can not be performed directly (Kyburg, 1984). Therefore specific approaches need to be developed. In the first

category of approaches, knowledge is viewed in a static way, while in the second in a dynamic way. In the static perspective structural measures of knowledge are used, and in the dynamic perspective functional measures of knowledge are used. ***Structural measures*** include, for example, the number of models either in textbooks, computer programs, the college courses etc. Disadvantages of static perspective are as follows (Vukić, 2012): 1) The uncertainty in the prediction , 2) Separation from the experience, 3) Externalisation. On the other hand, the ***Functional measures*** include the Performance Measurement. The basic idea of performance measurment system has been expressed by modified composite score model, consisting of the following elements: time, resources, information, quality, quantity, performance and knowledge. Fixing of the five elements and measuring sixth, the seventh element (which in this case is knowledge) can be indirectly measured. For example, fixing the information, resources, time, effects and quality, reached quantity points to level of knowledge. In second case: fixing the quantity, quality, effects, time and resources, the amount of required information needed indicates the level of knowledge. By performing the analysis of the current practices in knowledge measuring methods, classification given in the following table can be made (Vukić, 2012):

Table 1: Knowledge measuring methods and measurement units

	Category	Subcategories	Examples	Possible unit
A	**SIMULATION**	***Readings***. ***Listening***. ***Training***.	*-Read literature-* -Lectures/Talks attended- -Computer simulation*, Real simulation-*	*-Number of characters-* -Number of hours- -Number of hours-
B	**EXPERIENCE** Implicit knowledge	***Cycluses***. ***Events***. ***Outputs***.	*-Project realized, Repeated activities-* *-Events/Situations carried out-* *-Generated outputs-*	*-Number of repeated cycluses, of standardized size/complexity-* *-Number of elementary events-* *-Number of generated outputs, of standardized complexity-*
C	**AKADEMISM** Explicit knowledge	***Patents***. ***Publications***. ***Speeches***.	-Papers*, Models, Tables, Formulas, Code, Patents-* *-Articles, Books-* *-Presentations, Talks-*	-Number of standardized papers, models etc- *-Number of characters-* *-Number of hours -*
D	**RECOGNITION** & RANKING	***Test***. ***Tournament***. ***Assessment***.	*-Questions, Assignments-* *-Competitions-* *-Performances, Interview-*	*-Number of standardized score points-* *-Number of standardized score points-* *- Number of standardized score points -*

Current challenges in measuring knowledge are numerous. Literature and research in this area is so fragmented that there is no widely accepted model or theory. (Fisher and White, 2000) . Therefore, humanity is limited to the lack of an integrated approach to the knowledge measuring (Boudreau, 2002). The following challenges in measuring knowledge had been identified (Reich, 1994) 1) ***Confusion***. Dispersion in understanding the concept and defining the term “knowledge”. 2) ***Chaotic state of measures***. Chaotic state of dimensions and indexes of knowledge, with the complete absence of system of them. 3) ***Nonmodularity of knowledge***. Inability to observe large blocks of knowledge as the sum of fundamental (unit) elements without significant loss of information. This is particularly true for the knowledge measuring, because the important feature of knowledge is a huge number of potential connections between those elements. Therefore, the binary operations are here critical and must be taken into consideration when establishing measures, and their preservation is essential to the validity of the measure. Therefore, a valid measure must guarantee preservation of binary operations (that is connections) of the real system. 4) ***Operationalization***. It is interesting to notice that there is a lot of attempts for conceptualization of cognitive structures, but very few attempts for their operationalization, that is practical application. Hardly anyone has attempted to directly measure those cognitive structures. (Kanwar, Sims and Olson (1981), and Borgatta Carboni (2007)).

5. KNOWLEDGE INDICATORS

Knowledge indicators (indexes) are measures that indirectly point certain *dimensions of knowledge* (Vukić, 2012). According to the authors, it is important to distinguish between the two. While on the one hand, the dimensions are describing certain features of the knowledge system (and they are permanent), on the other

hand indicators point to one or more of these dimensions (moreover indicators may change as better are adopted). The following are indicators proposed by different authors:

Bodreau (2002) had classified indicators of knowledge into three categories: indicators that indicate the knowledge stocks, indicators that indicate the knowledge flow and indications of knowledge enablers.

A) ***Knowledge stock*** refers to the current level of knowledge in the observed time. Next set of index should indicate the level of knowledge in the system at a given time: 1) *Accounting for Intangibles* (Nick Bontis, 2001). Knowledge assets are blocks of knowledge that are expected to generate added value for the company in a period of time that is difficult to predict (Boisot 1998). 2) *Financial Statement Augmentation* (Intellectual capital report). This report is neither standardized nor obligatory and what it will include varies from organization to organization. 3) *Patents, Publications, Citations*. Patents and publications are the product of knowledge while number of citations indicates the quality of knowledge. Spencer (2000) examined archival data on issued articles within the Japanese and U.S. companies. He was measuring the volume (number of articles), quality (number of citations from outside the organization) and breadth (number of different organizations whose scientists have cited the work). 4) *Education and Training*. Number of hours dedicated to education and training and assessment scores. 5) *Organizational Experience and Rivalry Patterns*. Experience includes the amount of output the system produced or time spent in producing particular type of product. According to this idea, the more time the system spends generating output, the more knowledge about it system has, as a consequence of selicting those decisions over time that give better effects. Experience is also measured according to the degree of exposure to competition and the degree of rivalry - competitive experience (Ingram and Braum, 1997). 6) L*earning curve* indicates the experience and thus the knowledge, by showing the dynamics of declining of product unit cost. Decline in unit cost comes with experience in the respective manufacturing process. 7) *Team performance* indicator is used to measure the knowledge of a team. Team performance is measured as a percentage of accomplishment of the mission, that is the proportion of tasks completed successfully and the total number of tasks. Another way to measure performance is to measure the time it takes to perform the mission and to devide that number with planned time. The third way is to calculate the number of tasks that are executed per minute. (Cooke, Preston, Kiekel, Salas and Stout, 2003).

B) ***Knowledge flow*** can be measured as the difference between two consecutive levels of knowledge (that are measured by previously defined indexes). 1) *The knowledge flow between individuals*: a) The degree to which individuals share information with each other - Does the staff provide information to their colleagues? b) The convergence of attitudes and perceptions (beliefs and mental models) is also one of the indicators of knowledge transfer among individuals. c) Degree of standardization - Consistency of terminology and formal models indicates transfer of knowledge. 2) The knowledge flow among teams: a) Change the observed performance of the team. b) Formal transfer of technology: procedures, techniques, tools, patents. 3) *Knowledge spillovers and the loss of knowledge in the system*: a) Number of patents and citations that took the competition. (Jaffe, Trajtenberg and Fogarty, 2001). b) Staff turnover ratio - In particular, key managers and professionals. (Deeds, 2003).

C) ***Enablers*** are the structures and processes established by the organization, which aim to change or maintain knowledge stocks or knowledge flows. Enablers facilitate changes in the knowledge levels. These include social networking, organizational structure, transactional memory, procedures, etc. However the very fact that they are present does not mean that their features are used and that the knowledge has been generated or modified. Therefore, this group of indexes only carries additional information about the potential and not the actual events in the system of knowledge. 1) *Geographical, Character, Political vicinity*. Several authors have studied the physical, character and political (attitudes, beliefs) vicinity (Maskell&Malmberg, Torstensson, Capello, Zahra) and concluded that those parameters have a positive impact on knowledge transfer. (Bordeau 2002). 2) *Organizational structure*. The organizational factors that can encourage or discourage the acquisition and use of knowledge are formalization, centralization, specialization, incentives, emphasis on scientific research and publications in the company etc. For example, high interdependence (specialization) requires a lot of contacts, which allows preconditions for an exchange of diverse knowledge. 3) *The number of joint ventures with other systems*. This indicator follows the next idea: The greater the number of joint ventures, the greater the chances of raising the level of knowledge. These include: alliance, joint ventures, franchises and the like. 4) *The costs of R&D* indicate how the organization deals with the generation of new knowledge that is innovation in a systematic way. (For more details see: Bitzer, 2005) 5) *Aquisition Capacity* stands for the capacity of a system to adopt new knowledge. 6) *Network*. The characteristics of the network within the system (individual or organizational network) are to be observed - The following network characteristics are important: Size, Scope (the contacts in different categories), Strength, Intensity (frequency, duration and intensity of interactions), Structure, Communication, Individual movement. 7) The degree of trust. The greater degree of trust between people is, the more open for learning system will be (Fiol, 1985). 8) *Tacitness*. (1/ knowledge formalisation that is 1/degree of knowledge formalisation). Tacitness indicates

the ease of knowledge transfer. The greater the degree of formalisation is, the transfer of knowledge is done with fewer losses and thus the potential spread of knowledge is greater. This is neither good nor bad by itself (tacitness is harmful in the context of cooperation, but it is useful in rivalry and competition context since it makes the knowledge copying process more difficult.

ICM group had classified the knowledge indicators in 5 categories: Customer capital, Structural capital, Human capital, Value creation and Value extraction. (Liebowitz and Suen, 2000)

Customer capital : 1) Market share, 2) Customer rating, 3) Satisfied customer index, 4) Number of new customers, 3) Annual sales/Customer, 4) Average customer size, 5) Average time from customer contact to sales response, 6) Ratio of sales contact to sales closed.

Structural capital. 1) Administrative expence/Total revenues, 2) Processing time, outpayments, 3) Computers/Employee, 4) Corporate quality performance, 5) Investments in IT, 6) Contracts filed without error.

Human capital. 1) Number of employees, 2) Number of managers, 3) Average years of service with the company, 4) Revenues/Employee, 5) Profits/Employee, 6) Employee turnover, 7) Average age of employees, 8) Percentage of company managers with advanced degrees

Value creation. 1) Training expence/Employee, 2) Average customer duration with the company, 3) R&D invested in the basic research, 4) R&D invested in product design, 5) R&D invested in applications, 6) Investment in new product support and training, 7) Satisfied employee index, 8) Relationship investment/Customer, 9) Training expence/Administrative expence.

Value extraction. 1) Profits resulting from new business operations, 2) Revenues resulting from new business operations, 3) RONA resulting from new business operations, 4) Total assets, 5) Return on net assets, RONA, 6) Market value, 7) Patents pending

Roos, Roos, Dragonetti, Edvinsson (1998) classify knowledge indicators into two categories: Human capital and Structural capital, which is also described by Liebowitz and Suen (2000):

Human capital. 1) Percentage of employees with advanced degrees, 2) IT literacy, 3) Hours of training/Employee, 4) Average duration of employment, 5) Hours spent in debriefing, 6) Hours spent by senior staff explaining strategy and actions – overlap expertise, 7) Leadership index, 8) Motivation index, 9) Savings from implemented employee suggestions, 10) New solutions or products or processes suggested, 11) Background variability index (both on individual and group level), 12) Company diversification index.

Structural capital. 1) Percentage of supplier/customer business accounted for, 2) Length of relationship, 3) Partner satisfaction index, 4) Customer retention, 5) Administrative expences/Total revenues, 6) Revenues from patents, software, data, databases, 7) Processes completed without error, 8) Cycle/process times, 9) Training Expenses/Employee, 10) Training Hours/Employee, 11) New patents, software etc, 12) Renewal expenses/Operating expenses.

Canadian Management Accountants (CMA) stated the following list of knowledge indicators in the organisations: 1) Number of new products, 2) Number of new customers, 3) Success ratio, 4) Percentage of customer business, 5) Productivity index, 6) Number of processes reviewed, 7) Number of processes changed, 8) Percentage rated acceptable at first review, 9) Numbers of patent filed, 10) Number of ideas implemented from the suggestion box, 11) Ratio of temporary/total employment, 12) Traditional quality indicators, 13) ISO and customer satisfaction. (Liebowitz and Suen, 2000). **Leif Edvinsson i Michael Malone** The two authors offered a set of indicators in a report on intellectual capital (Universal Intellectual Capital Report). Indicators are classified in five categories: Financial focus, Customer focus, Process focus, Renewal and development focus, Human focus. (Liebowitz and Suen, 2000)

Jay Liebowitz i Ching Suen (2000) sugested several new indicators as as a complement to the ones previously mentioned: 1) Number of new collegue to collegue relationships spawned, 2) Reuse rate of freequently accessed-reused knowledge, 3) Dissemination of knowledge sharing (distribution of knowledge to apropriate individuals), 4) Level of knowledge sharing profficiency, 5) Interactions with academicans, consultants and advisors, 6) Number of apprentances that one mentors in the company, and the sucsess of the apprentances, 7) Number of patents/trademarks produced, Number of articles/books written, Number of talks/workshops given, 8) Number of lessions learned and best practices applied, 9) The number of new ideas gennerating new products or services.

6. CONCLUSION

The main advantage of the indicators is that they can be easily obtained. Most of them are already available because of their wide use for other purposes. The main limitation of these indicators is their stochastic nature. They do not measure the dimensions of the knowledge directly, instead they only can (but need not)

to point some of them (Liebowitz and Suen, 2000). This brings a significant amount of uncertainty in decision making based on knowledge indicators. Moreover, some indicators have narrow scope of application, that is, they are constrained to certain industries. Examples which may be mentioned are numerous, and the following is to name a few: 1) Patents and citations are not applicable in most industries . Their absence does not mean lack of knowledge. 2) R&D investments are reflecting the invesments into knowledge but not the knowledge itself. As the generation and accumulation of knowledge depends on the process of acquisition (it is highly “path – dependent”) this characteristic makes it almost impossible for precise approximation with this indicator (Bettis and Hitt, 1995). 3) Intellectual capital, which is calculated as the difference between market value and book value (Edvinsson , Malone, Sveiby) cannot be a valid indicator of knowledge. Otherwise, the intellectual capital could be expressed as a mathematical function of accounting methods. Detailed review is presented in the Larsen, Bukh and Mouritsen, 1999). Therefore, humanity is in the initial stages of establishing a system that will successfully measure their knowledge . This "young" system of measures, naturally, is not sufficiently integrated nor consistent. However, current measures, although insufficiently integrated and therefore suboptimal, are a good starting point for both operational measurement of knowledge, and for the further development of measures.

Further work of standardizing units of measure for different listed indicators, as well as integrating indicators and model them as regressional models (or other statistical models), proposing their contribution to the features of knowledge is to be taken.

REFERENCES

Bettis RA, Hitt MA. (1995) – The new competitive landscape – Strategic Management Journal, Special Summer Issue 16: 7–20.

Bitzer Jurgen (2005) – Measuring Knowledge Stocks: A Process of Creative Destruction – Kyklos, Vol. 58, No. 3, pp. 379-393, July 2005. Available at SSRN: http://ssrn.com/abstract=771703

Boisot M.H. (1998) – Knowledge Assets – New York NY: Oxford University Press.

Bontis Nick (2001) – Assessing Knowledge assets: a review of the models used to measure intellectual capital– International Journal of Management Reviews, Volume 3, Issue 1, pp.41-60.

Borgatti Stephen, Carboni Inga (2007) – On Measuring Individual Knowledge in Organizations – Organizational Research Methods July, vol. 10 no. 3 pp 449-462

Boudreau John W (2002) – Strategic Knowledge Measurment and Management – Center for Advanced Human Resource Studies, Cornell University. Available at: http://www.ilr.cornell.edu/cahrs

Cheng Min-Yuan, Huang Chin-Jung (2009) – A Novel Approach for Treating Uncertain Rule-based Knowledge Conflicts – Journal of information science and engineering 25, 649-663.

Cooke Nancy J., Kiekel Preston A., Salas Eduardo, Stout Rene´e (2003) – Measuring Team Knowledge: A Window to the Cognitive Underpinnings of Team Performance – Group Dynamics: Theory, Research, and Practice, Vol. 7, No. 3, 179–199.

Culligan Brent (2004) – Item responce theory, reliability and standard error – Aoyama Gakuin Women‟s Junior College. Downloaded from: http://www.wordengine.jp/research/pdf/IRT_reliability_and_standard_error.pdf

De Jong Ton and Ferguson-Hesstler Monika G.M. (1995) – Types and qualities of knowledge – Educational psychologist, 31(2), pp 105-113

Deeds, D.L. (in press). Alternative strategies for knowledge-based competition: Acquiring knowledge from beyond the boundaries. In S. Jackson, M. Hitt, and A. DeNisi (eds.). (2003) – Managing knowledge for sustained competitive advantage: Designing strategies for effective human resource management. John Wiley & Sons.

Dixon N. (2000) – Comoon Knowledge – Harvard Business School Press.

Fiol, C.M. (in press). Designing knowledge work for competitiveness: About pipelines and rivers. In S. Jackson, M. Hitt, and A. DeNisi (eds.). Managing knowledge for sustained competitive advantage: Designing strategies for effective human resource management. Fiol, C. M., Y Lyles, M. (1985). Organizational learning. Academy of Management Review, 10 (4), 803-813.

Fisher, S. R. & White, M. A. (2000) – Downsizing in a learning organization: Are there hidden costs? – Academy of Management Review, 21 (1), 244-251

Georgescu – Roegen, N., (1971), The Entropy Law and the Economic Process, Harvard University Press.

Ingram, P. & Baum, J. A. (1997) – Opportunity and constraint: Organizations' learning from the operating and competitive experience of industries – Strategic Management Journal, 18 (Special issue), 75-98.

Ionescu, N., (1993). Curs de istorie a logicii, Bucharest: Humanitas.

Louis de Broglie, (1966). Certitudes et incertitudes de la science (Certitudes and Incertitudes of Science). Paris: Albin Michel.

Jaffe, A. B., Trajtenberg, M., & Fogarty, M. S. (2001) – Knowledge Spillovers and Patent Citations: Evidence from a Survey of Inventors – National Bureau of Economic Research Working Paper.

Johannessen J. Olaisen J. Olsen B. (2001) – Mismanagement of Tacit Knowledge – International Journal of Information Management, Vol. 21, No.1.
Kerzner Harold (2009) – Project management, A systems approach to planning, scheduling and controling – John Wiley and sons.
Larsen Heine Thorsgaard, Bukh Per Nikolaj D., Mouritsen Jan (1999) – Intelectual Capital Statements and Knowledge Management: Measuring, Reporting, Acting – Australian Accounting Review Vol. 9 No. 3.
Liebowitz Jay, Suen Ching Y. (2000) – Developing knowlege management metrics for measuring intellectual capital – Journal of Intellectual Capital, Vol. 1 No. 1, pp 54-67. Available at http://www.emerald-library.com
Kanwar Rajesh, Olson Jerry, and Sims Laura (1981) – Toward conceptualizing and measuring cognitive structures – Advances in Consumer Research Volume 8, Pages 122-127
Kyburg, H. E. J. (1984). Theory and Measurement. Cambridge University Press, Cambridge, UK.
Plato (2013) Theaetetus. Reprint by Project Gutenberg. Retrieved from http://itex.coastal.cheswick.com/report/pg/1726/src/iPad/huge/l/ipad-lh.pdf
Odobleja, Ş. (1938). Psychologie Consonantiste, Paris: Ed.Libraire Maloin, Vol. I.
Radenković Božidar, Stanojević Milorad, Marković Aleksandar (2004) – Računarska simulacija – FON, Beograd.
Ramaswamy M, Sarkar S, and Chen Y.S (1997) – Using Directed Hypergraphs to Verify Rule-Based Expert Systems – IEEE Trans. Knowledge and Data Eng., vol. 9, no. 2, pp. 221-236, Mar.-Apr.
Reich Yoram (1994) – Measuring the value of knowledge – Tel Aviv University.
Roos, J., Roos, G., Dragonetti, N. C., & Edvinsson, L. (1997). Intellectual capital: navigating the new business landscape. New York, USA: New York University Press.
Săvoiu. G., (2009). Paradigma şi prioritatea acesteia în raport cu metoda, în cadrul gândirii statistice, Limbaj şi context vol 1(2), pages 79-89.
Săvoiu. G., Iorga Simăn, I., (2012). Variables in the Specific Thought of Multidisciplinary Research: The Importance of Epsilon, vol. 2(2): 29-35.
Spencer, J. (2000) – Knowledge flows in the global innovation system: Do US firms share more scientific knowledge than their Japanese Rivals? – Journal of International Business Studies, 31 (3), 521-531.
Suknović Milija, Delibašić Boris (2010) – Poslovna inteligencija i sistemi za podršku odlučivanju – FON Beograd.
Yang S.J.H, Tsai J.P, and Chen C.C (2003) – Fuzzy Rule Base Systems Verification Using High-Level Petri Nets– IEEE Trans. Knowledge and Data Eng., vol. 15, no. 2, pp. 457-473, Mar./Apr.
Vukić Ivan (2012). Merenje tacitnog i eksplicitnog znanja u organizaciji . Fakultet organizacionih nauka, Beograd.

MARKETING MANAGEMENT

CONSUMERS´ ATTITUDES TOWARDS PURCHASING FASHION COUNTERFEITS

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Abstract:*The rapid growth of counterfeiting can be attributed to the increase in world trade, emerging of new markets, technology advancements and the increasing number of product categories that can be counterfeited. Copies of luxury fashion brands represent themost common category, as they incur low manufacturing costs and are easy to be solddue to growing consumer demand.Reason for the expansion of counterfeiting around the worldis based on consumers' attitude that there is nothing unethical about buying or acquiring fakes. In order to supress this activity, greater efforts should be put on creating consumers' awareness about multiple negative social and economic effects that counterfeiting actually have.*

Keywords*:fashion counterfeits, consumers, attitudes, motives, demand, negative effects*

1. INTRODUCTION

The phenomenon of counterfeiting,which is the general name for production, distribution and consumption of counterfeit goods,has significantly arisen during last two decades, expanding globally and affecting both developed and developing countries and, therefore has become a serious social and economic problem. Today, counterfeiting trade accounts more than 7% of the global trade and grows at the rate of 15% per annum (Ergn, 2010). Republic of Serbia, as developing country, represents one of the markets suitable for selling and buying such products, due to poor state of the economy and low purchasing power. China is the main producer of the counterfeit products in the world (Hung, 2003). Other sources of counterfeits are Russia, Argentina, Chile, Egypt, India, Israel, Lebanon, Thailand, Turkey, Ukraine, Venezuela, Brazil, Paraguay and Mexico (Chaudhry and Zimmerman, 2009).

Counterfeiting has been expanding due to strong worldwide and national demand (Amendolara, 2005). Therefore, greater interest has to be put on understanding consumer behaviour with regard to motivation for purchasing counterfeit goods. Legal consequences and consumer education are most effective options for addressing the demand side of the counterfeit issue (Norum and Cuno, 2011). Berman (2008) stated that companies that produce genuine brands should contribute to the reduction of the counterfeiting problem through the development of consumer education programs that emphasize the personal, social and economic dangers it causes.

Chaudry and Zimmerman (2009) noticed that the types of products being counterfeited are broadening (Figure 1). Although there is a huge number of product groups that can be copied, products with a high brand image and low production technology are the preferred targets of counterfeiters (Penz and Stöttinger, 2005). That´s why branded or luxury fashion counterfeits represent the most common group of counterfeits (Pollinger, 2008). The OECD (2008) reported that fashion items (clothing, jewellery, accessories and footwear) represent the largest part of counterfeit trade, taking into account that textile sector and jewellery together make up 66,2% of all interventions by European Customs.

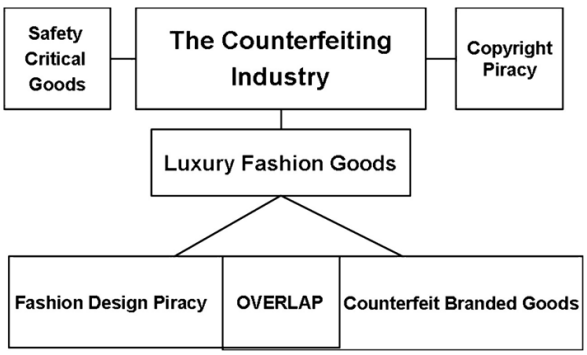

Figure 1. Mapping out counterfeiting (Wall and Large, 2010)

2. TYPES OF COUNTERFEITS

Generally, counterfeits are defined as reproduced copies that are identical or substantially indistinguishableto the legitimate articles, including packaging, trademarks and labelling(McCarthy, 2004). Theyattract consumers as they clearly look like the genuine brand, yet ”cost only a fraction of the price of the original” (Rathet al., 2008). According to Yang and Fryxell (2009), counterfeiting represents the unlawful imitative manufacturing of products and services that are protected by owners' intellectual property rights with the goal to earn profit. The definition proposed by Staake et al. (2009) is following: “Counterfeit trade is the trade in goods that, be it due to their design, trademark, logo, or company name, bear without authorization a reference to a brand, a manufacturer, or any organization that warrants for the quality or standard conformity of the goods in such a way that the counterfeit merchandise could, potentially, be confused with goods that rightfully use this reference”.

As suggested by Yang and Fryxell (2009), generally, there are two main kinds of counterfeits - the counterfeiting of commodities and the counterfeiting of symbols attached to products. One of earlier studies, made by Phau and Prendergast(1998), divided counterfeits into six categories. In case of first category,high-quality fakes, both stores and consumers can be misled, by confusing them with originals. Second category, called “piracy”, considersthat the customer is aware of the faked object which is usually sold at a significantly lower price. Third, imitations or ”knock-offs” are not identical to the original, but they are similar in substance, name or form with a widely known product (Berman, 2008). Fourth category represent so called”grey products” that factories, contracted by the genuine brand manufacturers, produce in greater quantities than required and then sell as overruns illegally (Vida, 2007). Fifth category, custom-made copies or ”super fake” products are replicas of trademark designs of branded products made by legitimate craftsmen and the only item missing from the original is the logo or brand name(Hilton et al., 2004). Goods that are similarly packaged or with similar trademarks and labellingare also considered counterfeits and represent the sixth group (Phau and Teah 2009).

Regarding the consumer’s perspective, counterfeits can be either deceptive or non-deceptive. Deceptive counterfeiting involves purchases where consumers believe they have bought a genuine article when in fact it is a counterfeit (Staake et al., 2009), as is often the case in categories such as automotive parts, consumer electronics and pharmaceuticals (Vida, 2007). In other cases, however, consumers are typically aware that they are purchasing counterfeits, which is non-deceptive form of counterfeiting. It is particularly prevalent in fashion brands (Nia andZaichkowsky, 2000) where consumers are ”often able to distinguish counterfeits from genuine brands based on differences in price, the distribution channels, and the inferior quality of the product itself”. Nevertheless, the quality of fashion copies has improved dramatically during recent years, even resulting in the existence of ”super copies” (Wilcox et al., 2009). Gentry et al. (2006) also supported that the quality of counterfeit luxury products has improved over the years thus it is harder and harder to differentiate the counterfeitsfrom the genuine luxury brands.

3. NEGATIVE EFFECTS OF COUNTERFEITING

Empirical and academic evidence show that counterfeiting is a harming and risky business (Lewis, 2009). It is more than evident that counterfeiting causes general negative influences on government tax revenues, market order and fair competition, as well as on overall economic development. Counterfeiters participate in the economic black market, because they pay no taxes, causing states to lose legitimate revenue (Ha and Lennon, 2006), so their damaging effect on businesses, national economies, consumers and on society as a whole is more than obvious. Consumers who purchase counterfeited articles risk funding nefarious activities, contributing to unemployment, creating budget deficits and compromising the future of their country in the global economy(UNICRI, 2009; Santos and Ribiero, 2006). The negative effects include loss of goodwill of brand names,lowering consumers’ confidence in legitimate brands and company reputations which further lead to loss in sales or elimination from the market (Monirul and Han, 2012).Furthermore, there are increasing cases of health hazardsand threats to consumer health and safety and severe economic anxiety for some developing countries that can be linked to counterfeiting (Gessler, 2009).

Gessler (2009) divides ”the true costs of counterfeiting” - the consequences of the phenomenon, in six categories: the cost to brand owners, government burdens, the effects counterfeiting has on consumers, child and forced labour issues in the production of these counterfeits, organised crime and terrorist funding activities and the moral cost of counterfeiting. Some authors differentiate between two types of harm caused by the purchase of counterfeit goods: personal and societal harm. Personal harm means that the individual itself is affected by purchasing counterfeit products, whilesocietal harm implicates that counterfeit trade affects the society as a whole. Thompson (2004) posit that ”the average consumer does not consider overall societal issues when faced with the option of purchasing an original or a counterfeit product”, which is the main reason for expansion of counterfeiting.

4. ATTITUDES TOWARD COUNTERFEIT FASHION PRODUCTS

In the case of explaining counterfeit purchase behaviour, Veloutsou and Bian (2008) and De Matos et al. (2007) suggest that the attitude towards buying fake products depends on the overall perceived risk, which is the most important variable to predict consumer attitude toward counterfeits. If it is moderate, it is highly likely that consumer will do the purchase. Bian and Moutinho (2009) found evidence that perceived risk is a factor that negatively influences the purchase intention of counterfeits. A person's overall perceived risk consists out of six different risk dimensions: financial, performance, psychological, physical, social and time risk (Veloutsou and Bian, 2008). Social risk can be defined as the negative outcome one attaches to "being caught by significant others" when possessing or purchasing a counterfeit. Time risk is seen as the time one might lose searching for a counterfeit article. Financial risk involves the potential loss of money when buying a counterfeit. Physical risk is the possibility of bodily harm or health hazard. Performance risk refers to the chance of malfunctioning of the fake product that is bought. In explaining psychological risk, the most appropriate definition is given by Penz et al. (2009): "psychological risk refers to the experience of anxiety or psychological discomfort arising from anticipated postbehavioral affective reactions such as worry and regret from purchasing and using the product".

As consumers obviously play a leading role in the maintaining of counterfeit trade (Yoo and Lee, 2009; Bian and Moutinho, 2008), it is important to gain a deeper insight in potential motives of consumer's willingness to purchase non-deceptive counterfeit products. Vida (2007) concluded that a consumers' attitude toward counterfeit luxury products refers to the degree people are able to rationalize counterfeiting practice with respect to the costs, pricing and quality of genuine with counterfeit products. The attitudes could be divided into two specific issues: attitudes towards counterfeiting and attitudes towards market practices. If a person's attitude towards counterfeiting is favourable, it is likely that he or she would consider the purchase of counterfeit products. The attitude towards market practices actually represents person's beliefs and feelings towards the operations of some organization. If a person holds an unfavourable attitude towards the high-profile operations of branded goods manufacturers and the snob appeal of their products, it is less likely that person would purchase the branded originals. Rather, these people are more likely to purchase the counterfeit version of branded goods(Wee et al., 1995).

The two major reasons why consumers develop positive attitudes toward buying counterfeits are economic benefits and hedonic benefits. The most obvious factor that motivates purchases of counterfeit brands is their relatively low price. In cases when consumers cannot afford to buy original fashion designer products because they are too expensive,but want to possess something that look alike, they are likely to decide on buying counterfeits. Consumers are not affected by low quality and poor materials because they do not see counterfeits as inferior choices when they experience such budget constraints. On the contrary, most of these consumers appreciate the economic benefits counterfeits provide them (Penz et al. 2009; Ang et al.,2001). Consumers believe they will have the identical appearance whether they wear or carry a counterfeit or an original brand, so they will get the prestige/status of the original brand without paying for it (Penz and Stottinger 2005). The hedonic benefits of counterfeit purchases impose that consumers buy counterfeit brands because they want to demonstrate that they can afford branded goods, to show that they belong to a particular social group, or to use the product for symbolic self-extension. They view that the brand names, labels, various design characteristics such as logo, colour etc. are valuableby themselves and they satisfy a desire for symbolic meanings such as social and financial status, recognition and superiority (Wee et al., 1995).

When it comes to the selection of fashion-related goods, some very specific factors determine buying behaviour. Determinants on intention to purchase counterfeit goods have been classified as psychographic (attitude toward counterfeiting, brand status and novelty seeking), demographic (age, educational attainment and income) and product-attribute (appearance, image, perceived fashion content, purpose and perceived quality) variables(Rath et al., 2008).Smith et al. (2008) found self-reported past buying behaviour as a strong predictor of future purchase intentions. Also Ouelette and Wood (1998) suggest that the frequency of performing certain behaviour in the past has a direct impact on future behaviour.

In literature, following factors are mentioned as major determinants of person's attitude towards counterfeiting and purchase intentions: fashion consciousness, public self-consciousness, ethical judgment and ethical obligation.

Fashion consciousness refers to a person's degree of involvement with the styles or fashion. An individual does not have to be either a fashion opinion leader or a fashion innovator to be considered fashion conscious. Fashion involvement represents a consumer's perceived importance of fashion clothing (O'Cass,

2001). Previous researches had demonstrated that fashion involvement influences consumer behaviortowards purchasing fashion products (Penz and Stottinger, 2005; Bertrandias and Goldsmith, 2006). Penz and Stottinger (2005) found that fashion involvement had a strong influence on an embarrassment potential and weakens the attitude that purchasing counterfeit products is a desirable behaviour. On the other hand, Wee et al. (1995) revealed that ”for fashion related counterfeit products, purchase intention is determined by the similarities in appearance, quality and image projected by the counterfeit version compared to the originals”, which means that those who are more fashion consciousare more likely to seek for ”perfect counterfeits”. Gentry et al. (2006) also found that consumers consider counterfeits as a relatively cheap way to keep up with the latest fashion trends.

It has been shown that consumers form positive attitudes toward things that help them define their social and personal identities, express who they are, who they want to be and how they want others to see them. Fashion-related goods may be seen as an especially effective product category in this regard (Dodd et al., 2000). Individuals who have a rather vague and uncertainself-concept tend to possess low self-esteem, which renders them less certain that they will be able to meet what they believe are others' standards for worthiness and make them more exposed to the outside influences on their self-concept. When people move on social scale, they may adopt new patterns of consumption to symbolize their new social position. Consumers who are buying branded products may be described as self-conscious and especially concerned about the impressions that they make (Penz and Stottinger, 2005). According to Roux and Korchia (2006), consumers who choose buying counterfeitsover a genuine product are similarly concerned about impressions they leave on other people, although those projected images sometimes seem to create a tension or conflict between an original identity and a borrowed appearance.

The desire to possess various things can lead to a consumer acting unethically. ”Consumer ethics can be defined as the moral rules, principles and standards guiding the behaviour of an individual (or group) in the selection, purchase, use or selling of a good or service”(Penz and Stottinger, 2005). The perception of an ethical issue is an important basis of the ethical decision-making process. A person who perceives an ethical problem tends to behave more ethically than an individual who does not. Ethical obligation represents an individual’s internalized ethical rules, which reflect personal beliefs about appropriate behaviour (Shaw et al., 2000). According to Trevino (1992) ethical judgment is a cognitive process in which an individual judge which course of action is moral and form behavioural intentions based on that. In other words, if an action is judged as ethical, one is more likely to form an intention to perform it. Oppositely, if an action is judged as unethical, one is less likely to form an intention to engage in the action (Nguyen and Biderman, 2008).According to Penz and Stottinger (2005) the ethical perception plays an important role in the consumption behaviours, as it may have a self-binding effect on the individual. Consumers who have a higher ethical disposition would be more embarrassed if they were discovered wearing counterfeits and, therefore, most often choose not to buy such products.

5. STRATEGIES TO FIGHT COUNTERFEITING ACTIVITIES

Although governments and manufacturers of genuine brands, who experience both economic and noneconomic losses, take some action to protect their products from being copied, it is difficult to protect intellectual property rights in many countries, especially in less developed countries like Serbia, due to weak legal structure, their implementation and corruption. Law enforcement strategies, based on legal issues and concerns, in the form of more stringent penalties for convicted counterfeiters should been implemented by states authorities. Some manufacturers introduce product and packaging changes in the form of magnetic codes and special inks, holograms and implanting high technology “fingerprints” on parts of the articles as a symbol for authenticity (Figure 2). Retailers are most commonly blamed for the proliferation of counterfeits (Prendergast et al.2002), as they perceive the selling of counterfeits as risk and cost free and those counterfeiters rarely go out of business (Green and Smith, 2002). Olsen and Granzin (1992) stated that retailers would accept the responsibility in fighting counterfeits only if the government and manufacturers share the obligation. If they feel that it is a trivial problem, they will neither share the responsibilities nor support the manufacturers and the governmental authorities.

But, law enforcement targeted at counterfeit manufacturers and retailers may not solve the entire problem, as its root derives from the consumers’ willingness to purchase copied products. Manufacturers of original brands, together with the countries’ policy makers,should more intensively expand public awareness of the harm of counterfeiting through advertising, public forums etc. Marketing campaigns designed to evoke public awareness of counterfeiting may have a positive echo and change the attitude towards buying such products. Especially successful can be integrated marketing communications campaign that has a goal to directly influence the behaviour of a heterogeneous target public (Kostic – Stankovic, 2011). Synergy of various communication channels should be used for informing the consumers about the societal

consequences of counterfeiting, in order to lower purchase intentionsof counterfeit products. Penz et al. (2009) found that ”informing consumersabout the business practices of counterfeiters may change their attitudes toward thephenomenon”. Thus, it is needed to change consumers’ attitude in order to reduce demand for such counterfeit luxury products and reverse this growing trend.

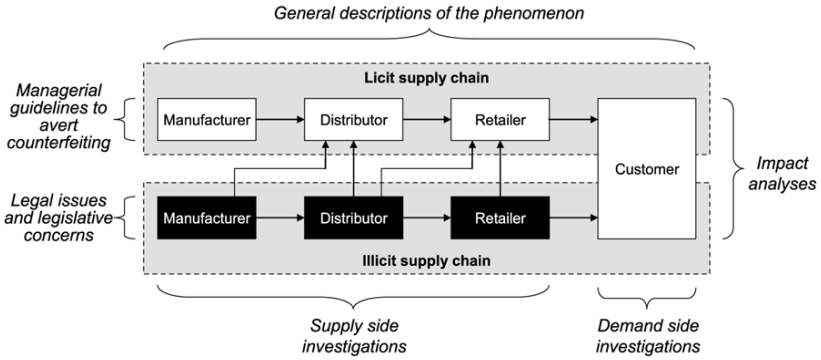

Figure 2. Strategies to suppress counterfeiting (Staake et al., 2009)

6. CONCLUSION

Despite the general favourable attitude of those consumers who believe that fashion counterfeits bring benefits such as cheaper price and luxurious image, negative effects of purchasing copied products are nowadays more than obvious and serious.Therefore, it is necessary to change consumers’ attitude in order to reduce demand for counterfeit fashion products and. Besides imposture of legal restrictions, it is important to create public awareness that purchasing fashion counterfeits is unethical activity that holds certain risks, such as poor quality, loss of time and money, potential social embarrassment, as well as participation in the economic black market.

REFERENCES

Amendolara, L. (2005). Knocking out knock-offs: effecting the criminalization of trafficking in counterfeit goods. Fordham Intellectual Property, Media and Entertainment Law Journal,15, 789-836.

Ang, S.H., Cheng, P.S.,Lim,E.A.C., &Tambyah, S.K. (2001). Spot the difference: Consumer response towards counterfeits. Journal of Consumer Marketing, 18(3), 219-235.

Berman, B. (2008). Strategies to Detect and Reduce Counterfeiting Activity.Business Horizons, 51, 191-199.

Bertrandias, L.,&Goldsmith,E. (2006).Some psychological motivation for fashion opinion leadership and fashion opinion seeking. Journal of Fashion Marketing Management, 10(1), 25-40.

Bian X.,&Moutinho, L. (2009).An investigation of determinants of counterfeit purchase consideration.Journal of Business Research, 62, 368-378.

Chaudhry, P.E.,&Zimmerman, A. (2009).The Economic of Counterfeit Trade.Berlin: Springer – Verlag.

Dodd, C.A., I. Clarke, S. Barson, &Houston, V. 2000.Looking the part: Identity, meaning and culture inclothing purchasing-theoretical considerations. J. Fashion Market. Manage., 4(1): 41-48.

Ergn, E.A. (2010). The rise in the sales of counterfeit brands: The case of Turkish consumers. African Journal of Business Management, 4(10), 2181-2186.

Gentry, J. W.,Putrevu, S.,&Shultz II, C. J. (2006).The Effects of Counterfeiting on Consumer Search. Journal of Consumer Behavior, 5(3), 245–256.

Gessler, C. (2009). Counterfeiting in The Luxury Industry: The True Costs of Counterfeit Goods, Germany: VDM Verlag.

Green, R.T.,&Smith, T. (2002).Executive Insights: Countering Brand Counterfeiters. Journal of International Marketing, 10 (4), 89-106.

Ha, S.,&Lennon,S. (2006). Fashion intent for fashion counterfeit products: Ethical ideologies, ethical judgments and perceived risks. Clothing and Textile Research Journal, 24(4), 297-315.

Hilton, B., Chong J. C., & Chen, S. (2004), The Ethics of Counterfeiting in theFashion Industry: Quality, Credence and Profit Issues, Journal of Business Ethics, 55 (4), 345-354.

Hung, C.L. (2003).The business of product counterfeiting in China and the post WTO membership environment. Asia Pacific Business Review, 10(1), 58-77.

Kostic – Stankovic, M. (2011).Integrated Business Communications. Belgrade: Faculty of Organizational Sciences.

Lewis, K. (2009). The Fake and the Fatal: The Consequences of Counterfeits. The Park Place Economist, 17 (1), 47-58.
McCarthy, J.T. (2004). McCarthy's Desk Encyclopedia of Intellectual Property, Third Edition. Washington, DC: Bureau of National Affairs.
Monirul, I., &Han,H. J.(2012).International Journal of Physical and Social Sciences Cross Cultural Counterfeit Characteristics and Anti-counterfeit Strategy, 2 (7), 341-359.
Nguyen, N.T., &Biderman,M.D.(2008). Studying ethicaljudgments and behavioural intentions using structural equations: Evidence from the multidimensional ethics scale. Journal of Business Ethics. 83, 627-640.
Nia, A., &Zaichkowsky, J.L. (2000).Do Counterfeits Devalue the Ownership of Luxury Brands?Journal of Product and Brand Management, 9 (7), 485-49.
Norum, P.,&Cuno, A. (2011). Analysis of the demand for counterfeit goods. Journal of Fashion Marketing and Management, Emerald Group Publishing, 15 (1), 27-40.
O'Cass, A.(2001). Consumer self-monitoring, materialism and involvement in fashion clothing. Australian Marketing Journal, 9 (1), 46-60.
OECD (2008).The Economic Impact of Counterfeiting and Piracy Organisation for Economic Co-operation and Development.Paris: The Economic Impact of Counterfeiting and Piracy.
Olsen, J.E,&Granzin, K.L. (1992).Gaining retailers' assistance in fighting counterfeiting: Conceptualisation and empirical test of a helping model, Journal of Retailing, 68 (1).
Ouelette, J. A.,&Wood, W. (1998).Habit and Intention in Everyday Life: The Multiple processes by Which Past Behavior Predicts Future Behavior. Psychological Bulletin, 124 (1), 54-74.
Penz, E., &Stottinger, B. (2005). Forget the "real" thing, take the copy! An explanatory model for the volitional purchase of counterfeit products. Advances in Consumer Research, 32(1), 568-575.
Penz, E., Schlegelmilch,B.B., &Stöttinger, B. (2009).Voluntary Purchase of Counterfeit Products: Empirical Evidence From Four Countries. Journal of International Consumer Marketing, 21 (1), 67-84.
Phau, I., & Prendergast, G. (1998).Counterfeit Products - Riding the Waves in the New millennium. Business and Economics Society International Conference, Rome, 1, 45–55.
Phau, I., &Teah, M. (2009).Devil Wears (counterfeit) Prada: A study of Antecedents and Outcomes of Attitudes Towards Counterfeits of Luxury Brands, Journal of Consumer Marketing, 26 (1), 15-27.
Prendergast, G., Chuen,L. H., &Phau, I. (2002).Understanding Consumer Demand for Non-deceptive Pirated Brands.Marketing and Intelligence Planning, 20 (7), 405-416.
Pollinger, Z. A. (2008).Counterfeit Goods and Their Potential Financing of International Terrorism. The Michigan Journal of Business, 1 (1), 85-102.
Rath, P.M., Bay, S.,Petrizzi,R.,&Gill, P. (2008). The Why of the Buy: Consumer Behaviour and Fashion Marketing. New York: Fairchild.
Roux, D., &Korchia, M. (2006). Am I what I wear? An exploratory study of symbolic meaning associated with secondhand clothing. Advanced Consumer Research, 33(1), 29-35.
Santos, J.F.,&Ribiero,J.C.(2006).An exploratory Study of The Relationship Between Counterfeiting and Culture.Polytechnical Studies Review, 3 (5/6), 227-243.
Shaw, D., Shiu,E., &Clark, I. (2000). The contribution ofethical obligation and self-identity to the theory of planned behavior: An exploration of ethicalconsumers. Journal of Marketing Management, 16 (8), 879-894.
Smith, J. R., Terry, D.J.,Manstead, A.S.R.,Louis, W.R., Kottermanand, D.,&Wolfs, J. (2008).The Attitude-Behavior Relationship in Consumer Conduct: The Role of Norms, Past Behavior and Self-Identity. The Journal of Social Psychology, 148 (3), 311-333.
Staake, T., Thiesse, F., &Fleisch, E. (2009).The Emergence of Counterfeit Trade: A Literature Review. European Journal Of Marketing, 43 (3/4), 320-349.
Thompson, N. (2004). Bootleg Billion. The Impact of the Counterfeit Goods Trade on New York City. New York: Office of the Comptroller.
Trevino, L.K.(1992). Moral reasoning and business ethics:Implications for research, education and management. Journal of Business Ethics, 11, 445-459.
UNICRI (2009).Counterfeiting: A Global Spread, A Global Threat, Trens. Organized Crime, 12, 59-77.
Veloutsou, C., &Bian, X. (2008).A Cross-national Examination of Consumer Perceived Risk in The Context of Non-deceptive Counterfeit Brands. Journal of Consumer Behaviour, 7 (1), 3-20.
Vida, I. (2007). Determinants of Consumer Willingness to Purchase Non-Deceptive Counterfeit Products. Managing Global Transitions, 5 (3), 253-270.
Wall, D.S., & Large, J. (2010).Jailhouse Frocks: Locating the Public Interest in Policing Counterfeit Luxury Fashion Goods, British Journal of Criminology, 50 (6), 115 – 128.
Wee, C. H., Tan S.J., & Cheek. K. H. (1995). Non-Price Determinants of Intention to Purchase Counterfeit Goods - an exploratory study. International Marketing Review, 12 (6), 1-20.
Wilcox, K., Kim, K. M., &Sem, S. (2009). Why Do Consumers Buy Counterfeit Luxury Brands? Journal of Marketing Research, 46 (2), 247-259.

Yang, D.,&Fryxell,G.E. (2009).Brand positioning and Anti-counterfeiting Effectiveness: A study of Managers, Perceptions of Foreign Brands in China. Management International Review, 49, 759-779.
Yoo, B., &Seung-Hee, L. (2009).Buy Genuine Luxury Fashion Products or Counterfeits? Advances in Consumer Research, 36, 280-286.

APPLICATION OF CROWDSOURCING IN MARKETING

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Abstract: *Nowadays, a growing number of companies is focusing on cost optimisation and lowering labour expenses. In this climate, companies are turning to talented and educated individuals who are ready to participate in their projects. Whether it is for profit or non-profit purposes, or it is done by using online technologies or without them, this new business model is called crowdsourcing. This term is used for describing outsourcing process that focuses on the power of people for solving different types of tasks. The aim of this paper is to define crowdsourcing and its difference from similar models such as open innovation, user innovation, open source and outsourcing. The authors put focus on the application of crowdsourcing in marketing, particularly in market research, product development and promotion, as well as on examples of successful practice in these areas. Finally, the conclusions regarding further use of this model will be presented by taking a closer look at its advantages and limitations.*

Keywords*: crowdsourcing, business model, marketing, market research, product development, promotion*

1. INTRODUCTION

The introduction of Web 2.0. opposite to the traditional Internet has marked the beginning of new business era that companies are currently adapting to. Le Deuff (2007) and O'Reilly (2005) describe Web 2.0 as "the utilisation dimension and not to the physical network that supports it", which tends to encourage sharing between users and collaboration that opens many new options for everyday business. By using Web 2.0, a company can switch from outsourcing activities to other countries or firms specialised in certain field to engaging individuals in its everyday activities (Nešković et. al., 2012). This model enables companies to gather ideas and suggestions regardless of the person's location. Crowdsourcing is one model of using people's ideas for improving everyday business, as well as gathering ideas for future projects of the company.

The concept of crowdsourcing has been present for a while, but the first use of the term was in an article published in Wired magazine in 2006 and written by Jeff Howe and Marc Robinson. Since 2006 the word "crowdsourcing" has been mentioned many times in the growing Internet community, in magazines and books. The term "crowdsourcing" has been discussed by Dahlander and Magnusson, (2008), and Agerfalk and Fitzgerald, (2008) and it has only been mentioned as an example of Web 2.0 by Tapscott and William (2007) and Albors et al. (2008). "The power of the crowd" (Howe, 2006) is related to many different versions of the contribution that a crowd makes, as well as different areas of use. Therefore, it is very important to distinguish crowdsourcing from similar models of using the contribution of a crowd. Most commonly, the terms mistaken for crowdsourcing are open innovation, user innovation, open source and outsourcing.

Open innovation and user innovation start from the same point as crowdsourcing – in the world of distributed knowledge, companies should not rely on their own research and development, but they should decide to gather some of their ideas and R&D functions from other companies and individuals. Open innovation is related to cooperation between firms, and user innovation is focusing on cooperation between product users who are solving issues with final products. Both open and user innovation are focusing on innovations and originality, while crowdsourcing is not restricted to innovations and often provides solutions that are not innovative at all. Open source can be explained as the application of crowdsourcing in IT industry. Howe (2008) describes crowdsourcing source as "an application of the open source principles to other industries". Brabham (2008) adds to that by saying that "it is obvious that crowdsourcing is not restricted to software development". While it is obvious that there are undisputable similarities in the business model of open source and crowdsourcing, crowdsourcing is a wider area and has a wider application than solely IT industry. The basic process of crowdsourcing and outsourcing is the same, with a client company that is seeking help from another subject. The basic difference between these two is that outsourcing is mainly focused on getting support and help from institutions, while crowdsourcing focuses on getting ideas from individuals.

2. DEFINITION OF CROWDSOURCING

Crowdsourcing is composed of two words: crowd and outsourcing and basically it means outsourcing to the crowd. It was first used on an Internet forum, but it was widely popularised by Howe and Robinson after they published an article in Wired magazine. Howe (2008) gives definition of crowdsourcing: "Simply defined, crowdsourcing represents the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call." He adds that "the crucial prerequisite is the use of the open call format and the wide network of potential labourers". In a book he recently published and in posts on his blog (2008 and 2009), Howe gives two more precise definitions of crowdsourcing – *The White Paper Version*, and *The Soundbyte Version*. In *The White Paper Version* he describes crowdsourcing as "the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call", while *The Soundbyte Version* describes crowdsourcing as "the application of Open Source principles to fields outside of software".

This is the basic process of crowdsourcing: First of all, a company identifies processes and activities that need to be improved by outsourcing them. Instead of turning to another company for help, or trying to complete these actions within a company, they are "released to a crowd of outsiders who are invited to perform the task on the firm's behalf for a stipulated fee" (Whitla, 2009). It can be done in two ways: by limiting the crowd to a group of people with qualifications of previous experience in the area, or by issuing an open call to all interested parties. These two options can be combined by limiting the call to the people from the area of expertise or to people who are most likely to have skills for successfully completing the task. Whitla (2009) notices that "sometimes a single task can be completed by many different users and each can be paid if they successfully complete the task". This sentence sums up the idea of crowdsourcing – enabling talented individuals to get paid for the jobs they do in their own dynamic and by using available resources. It also explains why crowdsourcing is becoming widely used: companies are able to get the solutions they need by paying less and being able to choose who they are hiring for the job.

Whitla (2009) describes the crowdsourcing process by using an example of Amazon's Mechanical Turk. Amazon's Turk was named after Hungarian nobleman Wolfgang von Kemplen who invented "the Turk" - the first machine capable of beating human at a chess game. Mechanical Turk is a platform that provides simple tasks - HIT's (human intelligence tasks) to individuals. These tasks require very little time and effort to complete, but they cannot be done by computers. Therefore, individuals are solving them and getting paid from couple of cents up to a US dollar, depending on their effort. Whitla (2009) uses HIT's to describe the process of crowdsourcing.

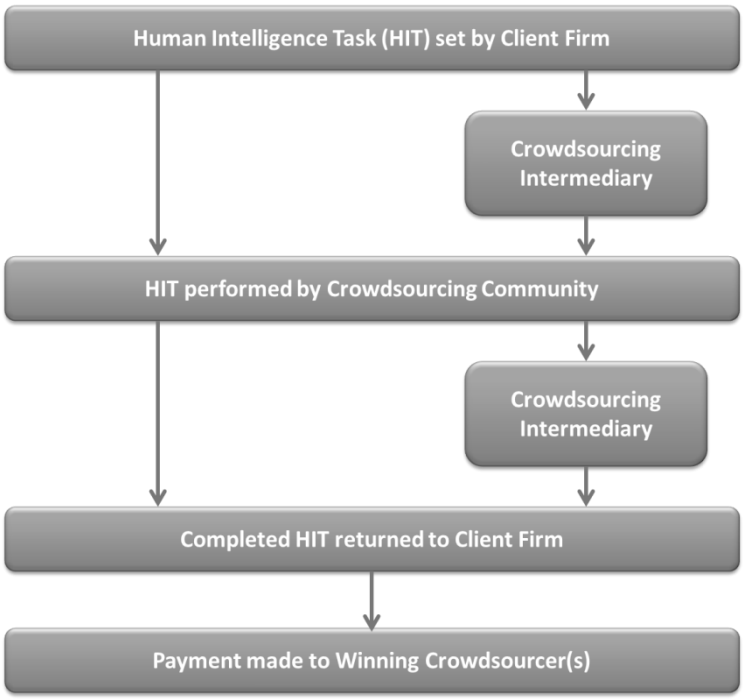

Figure 1: Crowdsourcing process

The basic model of crowdsourcing is the same and it is shown in Figure 1. There are alterations to this model depending on the industry and the type of tasks, but the idea of paying the crowd to complete certain processes remains as previously explained.

3. APPLICATION OF CROWDSOURCING

A call for crowdsourcing can be published in form of an open call or it can be limited to a certain number of people, as was previously mentioned. The question that arises is: What types of tasks can be crowdsourced? There are three types of tasks that can be outsourced to a crowd: routine tasks, complex tasks and creative tasks (Schenk and Guittard (2009)).

Routine tasks are a type of tasks that can be done very quickly and easily while requiring minimum time, such as data collection or marking text and images. This type of effort is usually awarded by micropayments. A perfect example of this routine are ReCaptcha, Open Street Map (OSM) and TxtEagle. ReCaptcha is widely used by websites for text recognition, when it is necessary to distinguish virtual robots from humans. OSM is used for collecting geographical data for creating a world map. Finally, TxtEagle helps mobile phone users to complete tasks by sending a text message. Routine tasks are, in most cases, published as an open call, given that almost anyone can participate in solving them.

Complex tasks that require more skills and knowledge are often limited to a closed group of people. This type of tasks can be solved in both profit and non-profit sector, and the companies pay more due to the effort required to complete the task successfully.

Finally, the third group of tasks are creative tasks. This is the earliest type of crowdsourcing which started long before the Internet, in the form of designer contests and competitions.

Companies usually crowdsource creative tasks with limitations only in the form of the solution that is required. This way the original and creative solutions are provided to the company. Monetary compensation for these tasks depends on the type of task, but usually these tasks are paid the most, varying from couple of hundred to couple of thousand US dollars.

4. APPLICATION OF CROWDSOURCING IN MARKETING ACTIVITIES

Even though there are many areas where crowdsourcing can be used, this paper will focus on the application of crowdsourcing in marketing. The main reason to do so is due to the fact that a growing number of firms is turning to customers and focusing on their requirements and preferences. The best way to do it is by turning to crowds for inspiration and ideas by using crowdsourcing.

According to Dawson (2011), there are several ways of applying crowdsourcing in marketing. These are shown in Table 1.

Table 1. Marketing application of crowdsourcing

Application	Description
Content creation	Generating marketing content such as videos, images or copy.
Idea generation	Creating ideas to identify or develop marketing initiatives.
Product development	Identifying insights to enhance existing products or develop new ones.
Customer insights	Gathering customer perspectives on current or potential products or marketing initiatives.
Customer engagement	Building greater participation and affiliation with the brand and company.
Customer advocacy	Tapping customers to spread word to their personal networks about products or services.
Pricing	Gaining insights on attitudes to possible pricing strategies.

Content creation is widely crowdsourced by giving customers a chance to provide content in different forms. Idea generation has been one of the most useful applications of crowdsourcing, given that there is a number of companies that benefited from having creative ideas coming from the crowd. One of the best examples is Starbucks's portal My Starbucks Idea, which has generated over 100.000 ideas for different aspects of business. Some of these ideas are related to the third area of application – product development. Dell's IdeaStorm portal is another great example of company benefiting from its loyal and creative customers, as

well as people with good ideas for new products. Customer insight, engagement and advocacy are a type of crowdsourcing primarily focusing on a narrow crowd – the customers, given that it is required to be a user of a product/service to be able to contribute in these areas. Finally, the question of pricing is often resolved by asking the people how much are they willing to pay for a certain product or a service.

Whitla (2009) was researching Human Intelligence Tasks (HIT's) and he identified the fields of marketing that are most suitable for their use, taking into consideration the nature of the tasks. By reviewing literature and already published HIT's, he singles out marketing research, product development and advertising and promotion as areas of marketing where crowdsourcing is most successfully used.

4.1. Use of crowdsourcing in market research

The most common form of applying crowdsourcing in market research is collecting data through surveys and questionnaires. Respondents are given a number of simple questions and the results are later used for creating product strategy. Given that these surveys provide monetary compensation to respondents, there is one big problem when using crowdsourcing for research: providing false data. Whitla (2009) notices that firms may restrict online surveys to a targeted population and that there is no way to prevent someone from imitating demographic to earn extra money. The payment may affect responses in another way – by keeping in mind that the company is paying them, many respondents may provide responses that represent an unrealistic image of a company or so called "desired responses". The best way to prevent this from happening is by using complex questionnaires that require some fields to be filled in own words, as well as requiring a minimum number of words. Poynter (2013) argues that, in recent years, many companies are researching the market by placing projects on crowdfunding sites to see if people are willing to back it with their money. The clear distinction between people's opinions and their will to pay for something can be noticed, which is a very useful pointer for future success of the project. A popular example of using crowdsourcing in market research is Springwise, a company that keeps a network of over 8.000 professionals who contact the firm when they discover an interesting product, service or a business model. The company later sells the trend predictions to interested parties. Kaggle.com is another popular example, as the website gathers information from the crowds and does predictive analysis based on it.

4.2. Use of crowdsourcing in product development

Product development based on crowdsourced ideas is a constantly growing branch. Even though open innovation is most commonly used in product development, as companies are looking for innovative solutions to their issues, crowdsourcing is widely used as well. Von Hippel (1998, 2006) states that firms have been using consumer inputs for a long time and that manufacturers have been collecting inputs for developing new products for years. In crowdsourcing for product development there are three key differences to open innovation. Firstly, it is not limited only to customers, but includes potential customers or anyone willing to assist and provide their ideas. Secondly, in enables companies to get direct feedback, without the third party (such as distributors) involved in the process. Finally, companies can select specific areas where the improvements should be made and limit enquires to these areas. There are numerous examples of applying crowdsourcing in product development, including a crowdsourcing company InnoCentive, specialised in offering solutions to R&D problems to companies. Their clients include Proctor and Gamble, Boeing, DuPont, and they offer up to 100.000 US dollars as a winning prize for best solutions.

4.3. Use of crowdsourcing in advertising and promotion

Third most common use of crowdsourcing is in advertising and promotional activities. This model of crowdsourcing has become very popular in the past couple of years, given that its main advantage is enabling companies to save a lot of money and use the crowd to spread their message. The companies with bigger advertising budgets have been collaborating with the crowds for a while by including them in projects in the form of an open call, or even by paying them to post positive comments on blogs and websites. In a recent article, Kirby (2013) mentions six new modes of advertising for the future, and crowdsourcing is one of them. Her article focuses on a successful example of Oreo's campaign "Daily Twist". The campaign was based on launching a 100-day series of cookies inspired by the news nominated by the crowd. The campaign resulted in 4.400% rise in sharing Oreo's Facebook page in just three months, with a significant rise in sales.

Crowdsourcing can be used in promoting or re-building brand identity of an institution, or even a location, as was the case with Connecticut (Birkner, 2013). With limited marketing budget and expensive media markets in targeted areas (especially Boston and New York City), the Office of Tourism switched to a creative approach by inviting locals to take part in a campaign "What's Your Connecticut Story?" in February 2012. The campaign focused on getting personal experiences from Connecticut and promoting them on a website

and a Facebook page. Following a success of this campaign, a new campaign “Still Revolutionary” was launched in May 2012. These two campaigns generated a total of 1.1 billion media impressions, 140.000 Facebook fans and 18% increase in awareness of Connecticut as a place to visit among neighbouring states. The successful campaign tends to become a tradition, given that another Fan Favourite campaign was launched in April 2013.

5. CONCLUSION

This paper presented many areas where crowdsourcing can be applied, even though it is a business model that is still in its developing stages. The increase of competition and limited budgets are some of the drivers that will help crowdsourcing become widely applied and popular model in the future. The authors presented successful examples of application of crowdsourcing in marketing; however, there are downsides to this model as well, and in the future the improvements must be taken into consideration.

First and the biggest problem arises from the sample – even though it is common to believe that more people guarantee better results, it may not be the case, especially when applying crowdsourcing in market research. This can prevent relevant information from getting to the companies. That is why it is important to work on improving mechanisms for filtering information and choosing participants. There are issues and limitations regarding the areas of expertise and qualifications required to successfully participate in crowdsourcing. Further research should focus on participants and better segmentation and profiling, so that results they provide can be improved.

Further use of crowdsourcing in marketing is heading towards social media and the use of social networks, as the source of the crowd, as well as the channel for placing a message and implementing marketing activities.

REFERENCES

Agerfalk, P, Fitzgerald, B. (2008), Outsourcing to an unknown workforce: exploring open sourcing as a global sourcing, MIS Quarterly, 32(2), (p. 385-409)

Albors, J, Ramos, J.C, Hervas. J.L. (2008), New learning network paradigms: Communities of objectives, crowdsourcing, wikis and open source, International Journal of Information Management, (p. 194-202)

Birkner, C. (2013), A “Revolutionary” Rebrand, Marketing News, May 2013, (p. 8-10)

Brabham, D. (2008), Crowdsourcing as a model for problem solving: An Introduction and Cases, Convergence, The International Journal of Research into New Media Technologies, 14(1), (p. 75-90)

Dahlander, L, Magnusson, M. (2008), How do firms make use of open source communities?, Long Range Planning, 41, (p. 629-649)

Dawson, R. (2011), Getting Results From Crowds: The definitive guide to using crowdsourcing to grow your business, Advanced Human Technologies Inc, ISBN-13: 978-0984783809

Hempel, J. (2007, January 18), Tapping the wisdom of the crowd, Business Week, retrieved from http://www.businessweek.com/innovate/content/jan2007/id20070118_768179.htm

Howe, J. (2006), The rise of crowdsourcing, Wired, 14(6)

Howe, J. (2008), Crowdsourcing, Crown Publishing Group, New York

Kirby, J. (2013), Creative That Cracks the Code, Harvard Business Review, March 2013

Neskovic, E, Pavicevic, S, Dadic, J (2012), Crowdsourcing as a platform for innovative business and marketing approaches, Symorg 2012 proceedings, ISBN 978-86-7680-255-5, (p. 1150-1155)

Poynter, R. (2013), Crowdsourcing lessons for market research, retrieved from http://www.research-live.com/opinion/crowdsourcing-lessons-for-market-research/4009537.article

Schenk, E, Guittard, C. (2009, December), Crowdsourcing: What can be Outsourced to the Crowd, and Why?, halshs-00439256, version 1-8

Tapscott, D, William, A.D. (2007), Wikinomics, Pearson Education

Vivacqua A.S., Borges M.R.S., (2012) Taking advantage of collective knowledge in emergency response systems, Jurnal of Network and Computer Aplications, 35, (p. 189-198)

Von Hippel, E. (1998), The Sources of Innovation, London and New York: Oxford University Press

Von Hipplel, E. (2006), Democratising innovation, Cambridge, MA: MIT Press

Whitla, P. (2009), Crowdsourcing and its application in marketing activities, Contemporary Management Research, Vol. 5, No. 1, (p. 15-28)

METHODOLOGY FOR EXPLORING FACTORS THAT AFFECT PEOPLES INTENTION TOWARDS COSMETIC SURGERY

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Abstract: *In this work authors developed methodology for exploring factors that contributes to peoples intention towards cosmetic surgery. From the available literature, one could not find the method to follow throughout process of analysing different factors that could contribute to formation of intention to undergo cosmetic intervention. Authors have proposed that methodology presented in this work could significantly contribute to revealing and understanding these factors. Methodology was developed applying the Theory of Planned Behaviour which provides good basis for empirical research on attitudes, subjective norms, and perceived behavioural control that together influence peoples' intention. Proposed methodology is applied on domestic – Serbian market, and the results are shown in further text. According to the results of conducted statistical analyses, authors created three scales for measuring intention of patients to undergo cosmetic surgery, namely attitudes toward cosmetic surgery, subjective norms, and perceived behavioural control, as main constructs of intention towards undergoing cosmetic surgery. Methodology presented in this work provides an excellent guide throughout the process of revealing and understanding factors that affects intention towards cosmetic surgery. At the same time, this methodology can be applied in different fields of contemporary business issues in the process of understanding behaviour of a modern customer.*

Keywords*: Methodology, Theory of Planed Behaviour, intention towards cosmetic surgery, attitude towards cosmetic surgery, subjective norms, perceived behavioral control.*

1. INTRODUCTION

In society, where celebrities are presented as extremely good looking, where information technologies and new ways of doing business are dominating, peoples look at each other more critically, and aesthetic improvements of the body are more and more fashionable. In such a society, cosmetic surgery is another one of alternatives in choices during life, besides fashion, recreation, and different kinds of therapy (Elliott, 2008).

There are opinions that the increase in cosmetic surgical procedures leading to a dangerous direction and fulfilment of themselves should be closely linked with a perfect physical appearance, but it can be acquired through spirituality, art, nature, love, learning and other activities (Lusted, 2010). On the opposite side are opinions that the existence of cosmetic surgery has many positive aspects. Correcting birth defects, burns, wounds, physical characteristics help the man to restore confidence and the ability to patients to feel more attractive and confident (Lusted, 2010).

In the past, people who were born with defects such as cleft lip, cleft palate and other deformities, were forced to live with it. These people were sentenced to others lifelong staring at them, to hide them or, in some cases, to be held in the circus. Cosmetic and reconstructive surgery can improve many of these birth defects, thus the children spared from teasing, and then have more confidence. The benefits of cosmetic surgery also have people with minor deformities, such as droopy ears, which can be corrected, or large and ugly marks, that may be utilized.

Aesthetic procedures depend on the age, gender and ethnicity of the patient. Women usually opt for interventions that will rejuvenate them and made them more attractive. Among women, the most common cosmetic procedures are breast enlargement, liposuction, eyelid surgery, abdominoplasty (removal of excess skin from the abdomen), and breast reduction. Men undergoing procedures that will make them younger and more handsome with them is the most common hair transplantation, liposuction, eyelid surgery, nose surgery and breast reduction. Among teenagers, the most common operations are corrections of the deficiencies, which others laugh at, and the most common operation is nose reshaping (Lusted, 2010). Belonging to a certain ethnic and cultural environments can also have an impact on whether someone will have cosmetic surgery. Some people will undergo surgery to make them look less ethnic, for example. Asian women are

doing the surgery of the eyelids to make their eyes were round and large, some American Jews and African-Americans are changing shape of the nose to make it smaller and more rounded and more like the nose of the Western nations.

Many of researches shows that, in temporary culture and society, people that looks younger and more pleasant, progress faster at work and earn more money than their colleagues who are less attractive and look older (Rinzler, 2009). Beautiful people are seen more positively than others (Lorenzo et al. 2010). Cosmetic surgery produces psychological effects that could be quantified by quality of life, self-confidence, satisfaction with personal appearance, less weight dissatisfaction, and increased psychological well-being (Rankin et al. 1998). To the extent that people are exposed to messages about the importance of attractiveness, they should be more concerned with their own appearance and, perhaps, more open to using the various means through which cultural standards can be achieved.

Despite the expectations of some authors that cosmetic intervention are becoming a common practice in achieving the cultural norms of appearance and the way to restore or gain beauty, youth, sex-appeal, reputation and happiness, (Lusted, 2010), a large part of the population has not yet accepted this type of intervention and does not intend to undergo cosmetic surgery.

From the available literature, one could not conclude what factors affect patients during the formation of one's intention to undergo cosmetic surgery. Some authors have attempted to identify factors that influence the decision of the patient to undergo cosmetic intervention. Among these factors stand out dissatisfaction with some parts of the body, feeling unattractive, lower self rating, gender, education and culture, aging anxiety, and previous experiences among friends (Brown et al. 2007; Davis, 2013; Von Soest et al. 2006, Haas, 2008; Slevec and Tiggemann, 2010; Delinsky, 2005).

In addition to undeniably important role played by these factors in the determination of the subjection of aesthetic interventions are omitted some important factors relating to subjective norms and perceived behavioural control, as important factors preceding behaviour.

As noted by Sarwer et al. (2004), numerous factors may be contributing to this increase in popularity, including advances in surgical procedures, lower costs and higher disposable income of patients, and increased emphasis on physical appearance. Moreover, individuals are increasingly exposed to the possibility of cosmetic surgery through their social networks. Media coverage of cosmetic surgery is now commonplace, as advertisements promise enhanced attractiveness, magazines tout the latest developments in surgical procedures, and television reality shows celebrate physical makeovers. Psychological research on cosmetic surgery has focused on patients' expectations and satisfaction regarding surgical outcomes. However little is known about attitudes regarding cosmetic surgery more generally. Questions about cosmetic surgery attitudes among the general population, the degree to which they are changing over time, and the factors related to such attitudes, remain largely unexplored. In this paper, we present the development of the methodology for exploring factors that affect people's intention towards cosmetic surgery that will allow researchers to more readily pursue this issue.

2. METHODOLOGY

The Theory of Planed Behavior, proposed by Ajzen (2006) was applied. The Theory of Planned Behavior – TPB, (Fig. 1) offers a framework for understanding and predicting behavior based on three constructs that influence behavior (Ajzen 1991; Ajzen and Fishbein, 1980). The TPB has been used extensively to predict various kinds of behaviors, including health behaviors. Godin and Kok (1996) made a review application in explaining the different behaviors in the medical field including screening, eating, exercising, addictive behavior, use of condoms, HIV/ AIDS, and oral hygiene.

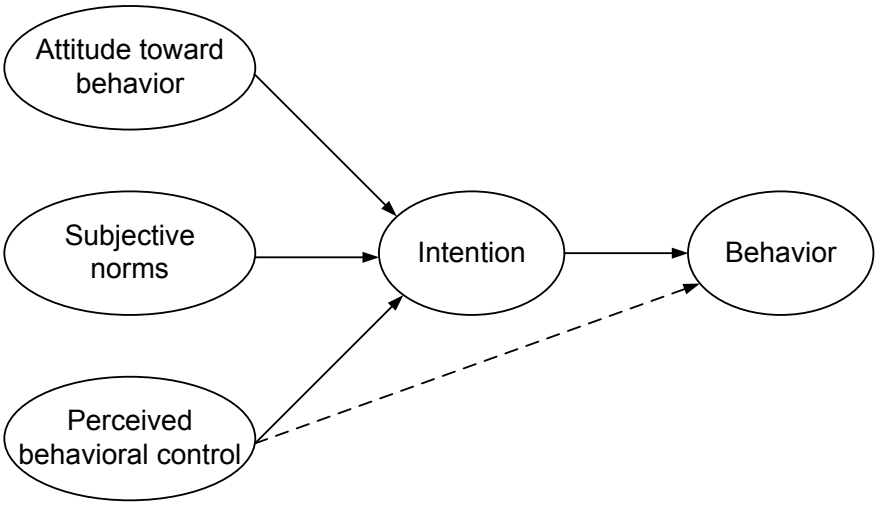

Figure 1: Theory of planned behavior (Ajzen 1991; Ajzen and Fishbein, 1980)

The theory of planned behavior postulates three conceptually independent determinants of intention: (1) attitude toward the behavior - refers to the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior, (2) subjective norm - refers to the perceived social pressure to perform or not to perform the behavior, and (3) behavioral control - refers to the perceived ease or difficulty of performing the behavior and it is assumed to reflect past experience as well as anticipated impediments and obstacles (Ajzen 1991; Ajzen and Fishbein, 1980).

Authors developed questionnaire in order to measure direct constructs of TPB related to the intention to use cosmetic surgery services. Questionnaire was distributed to 631 people in period from February to March of 2014th. Of all respondents, 53.7 percent were woman and 46.3 percent were man (M = 1.46, SD = .499), years between 20 and 63 (M = 31.61, SD = 10.139). Most of them (93.2%) never had cosmetic surgery before (M = 1.93, SD = .252), but 81.2 percent, knew someone who had (M = 1.19, SD = .394). For the analysis of data obtained from the questionnaire was used SPSS software.

Respondents attitude toward cosmetic surgery services was measured using nine semantic differential scales (Undergoing cosmetic surgery would be healthy; Undergoing cosmetic surgery would be useful; Undergoing cosmetic surgery would be profitable; Cosmetic surgery would help me feel more satisfied; Cosmetic surgery would help me feel more confident) scored from -3 to +3 (α = .913).

Subjective norms was measured using four items (Opinion of people close to me is important when deciding on cosmetic surgery; I think that my family and close friends would support me to undergo cosmetic surgery; I think that my partner would support me to undergo cosmetic surgery) scored from -3 to +3 (α = .775).

Perceived behavioral control was measured using two items (If I had the money, I would undergo a cosmetic surgery; I expect to be able undergo some cosmetic surgery in the future) scored from -3 to +3 (α = .909).

Intention to undergo cosmetic surgery was measured using twelve items (i.e. I would like to undergo cosmetic surgery; I intend to undergo cosmetic surgery; I would like to undergo cosmetic surgery soon; I intent to undergo cosmetic surgery soon; I would undergo cosmetic surgery in order to remove some congenital defect) scored from -3 to +3 (α = .904). The variable score was calculated for each construct by obtaining the mean score for all questionnaire items included under that construct. On fig. 2 is represented by the structural model intentions to undergo cosmetic intervention.

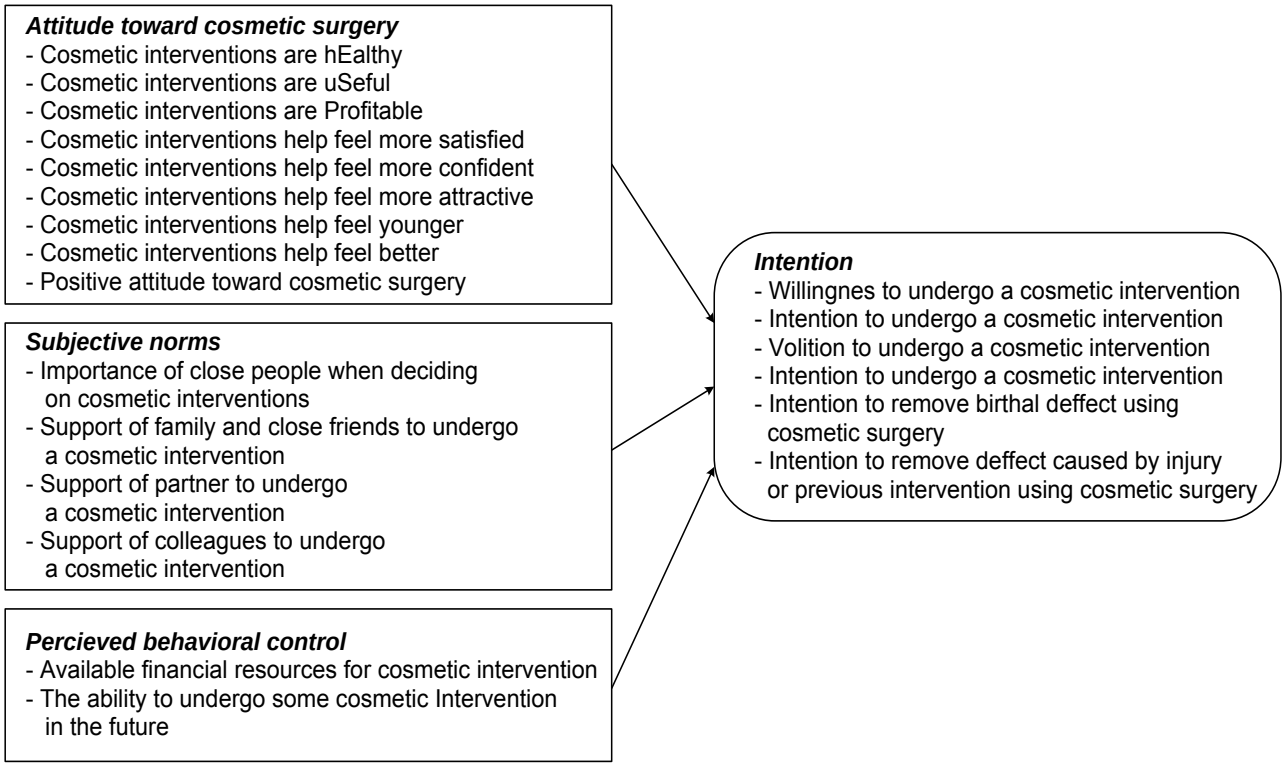

Figure 2: Structural model of intention to undergo a cosmetic intervention

3. RESULTS

To the test the model, and examining how the combination created scale that can predict (attitudes toward cosmetic surgery, subjective norms, and perceived behavioral control) intention to undergo cosmetic surgery, was used linear multiple regression (Fig. 3). Preliminary analyses were conducted to ensure no violation of the assumptions of normality linearity, multicollinearity, and homoscedasticity.

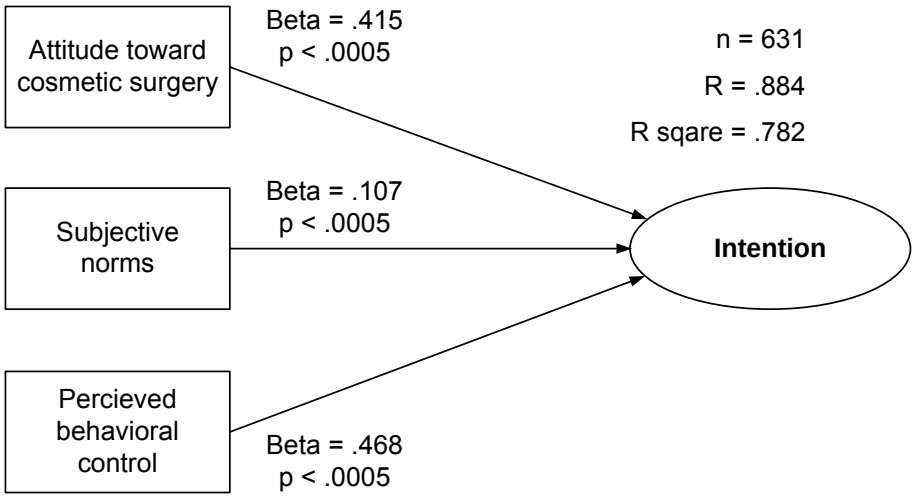

Figure 3: Results of multiple linear regression

The model reached statistical significance (F [3, 627] = 748.658, p < .0005), and explains 78.1% variance of the intention toward cosmetic surgery (R square = .782). Perceived behavioral control had the greatest influence (Beta = .468, p < .0005), followed by attitude toward cosmetic surgery (Beta = .415, p < .0005), and subjective norms (Beta = .107, p < .0005).

4. CONCLUSION

Analysing the previous works dealing with the factors that influence undergoing cosmetic interventions, it can be concluded that the majority focused on motivational factors that drive people to think and want this type of intervention. Von Soest et al (2006) think that body image, teasing history, acceptance of cosmetic surgery in the individual's environment, and self-monitoring are in relation to motivation for undergoing cosmetic surgery. Brown et al. (2007) emphasize that factors that affect the likelihood of undergoing cosmetic surgery lower self-ratings of physical attractiveness and the vicarious experience of cosmetic surgery. Haas (2008) stands the importance of education and culture, as predicting factors in the decision to undergo cosmetic surgery. Slevec and Tiggemann as the main factors that influence the position of the plastic surgery point body dissatisfaction, appearance investment, aging anxiety, and media variables.

All these factors are primarily involved in the formation of attitudes towards cosmetic surgery as an option that gives them the opportunity to rectify their shortcomings, and to restore youthful appearance and beauty. These authors are the factors looked at in isolation and analyse their individual impact on the acceptance of cosmetic surgery, with the lack of a comprehensive approach to the analysis of behaviour in deciding subjecting aesthetic interventions.

It can be concluded that they were not analysed some of the most important factors that influence the intention to undergo cosmetic surgery such as subjective norms, which constitute an important dimension in the psychological process that precedes behaviour, as well as a perceived behavioural control, or the availability of these services to potential patients.

In this work, the authors present an analysis of previous reference works, dealing with the factors that influence the acceptance of cosmetic surgery and, following the example of Theory of Planned Behavior, developed a model for exploring factors that affect peoples' intention towards cosmetic surgery. According to the authors' knowledge, this is the first application of Theory of Planned Behaviour in the field of cosmetic surgery, and the results contribute to the understanding of the intentions of people to undergo cosmetic interventions.

The present study contributes to identifying and understanding numerous factors that together influence one’s intention to undergo a cosmetic surgery. That way the results provide the valuable basis for creating strategies and tactics to increase the intention of people to undergo cosmetic surgery.

REFERENCES

Ajzen, I. (1991). The theory of planned behaviour. Organizational behaviour and human decision processes, 50(2), 179-211.

Ajzen, I. (2002). Constructing a TPB questionnaire: Conceptual and methodological considerations. Retrieved from: http://chuang.epage.au.edu.tw/ezfiles/168/1168/attach/20/pta_41176_7688352_57138.pdf.

Ajzen, I., & Fishbein, M. (1980). Understanding attitudes and predicting social behaviour. Englewood Cliffs, New Jersey: Prentice Hall.

Brown, A., Furnham, A., Glanville, L., & Swami, V. (2007). Factors that affect the likelihood of undergoing cosmetic surgery. Aesthetic Surgery Journal, 27(5), 501-508.

Davis, K. (2013). Reshaping the female body: The dilemma of cosmetic surgery. New York, United States: Routledge.

Delinsky, S. S. (2005). Cosmetic Surgery: A Common and Accepted Form of Self-Improvement? 1. Journal of Applied Social Psychology, 35(10), 2012-2028.

Elliott, A. (2008). Making the cut: How cosmetic surgery is transforming our lives, London, United Kingdom: Reaction Books.

Godin, G., & Kok, G. (1996). The theory of planned behaviour: a review of its applications to health-related behaviours. American journal of health promotion, 11(2), 87-98.

Haas, C. F. (2008). Motivating factors for seeking cosmetic surgery: a synthesis of the literature. Plastic Surgical Nursing, 28(4), 177-182.

Lusted, M. A. (2010). Cosmetic Surgery. Edina, Minnesota: ABDO Publishing Company.

Lorenzo, G. L., Biesanz, J. C., & Human, L. J. (2010). What Is Beautiful Is Good and More Accurately Understood Physical Attractiveness and Accuracy in First Impressions of Personality. Psychological Science, 21(12), 1777-1782.

Rankin, M., Borah, G. L., Perry, A. W., & Wey, P. D. (1998). Quality-of-life outcomes after cosmetic surgery. Plastic and reconstructive surgery, 102(6), 2139-2145.

Rinzler, C. A. (2009). The encyclopedia of cosmetic and plastic surgery. New York, United States: Facts on File Inc.
Sarwer, D. B., & Crerand, C. E. (2004). Body image and cosmetic medical treatments. Body image, 1(1), 99-111.
Slevec, J., & Tiggemann, M. (2010). Attitudes toward cosmetic surgery in middle-aged women: Body image, aging anxiety, and the media. Psychology of Women Quarterly, 34(1), 65-74.
Von Soest, T., Kvalem, I. L., Skolleborg, K. C., & Roald, H. E. (2006). Psychosocial factors predicting the motivation to undergo cosmetic surgery. Plastic and Reconstructive Surgery, 117(1), 51-62.

KEY ACCOUNT MANAGEMENT - STRATEGIC IMPERATIV IN POSTAL SERVICES

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Abstract: *Many modern companies around the world are trying to maintain competitive advantage through development of modern Relationship marketing (RM) program and other programs which provide customer loyalty. Because of the specific characteristics of postal traffic and postal services, one of the recommended programs and strategies for maintaining and nurturing long-term profitable relationships with selected group of strategic customers/users of postal services is a modern marketing management strategy of Key Account Management (KAM). It is a strategic decision and the imperative to improve competitiveness and business performance success of contemporary participants, both at the global postal market and the postal market in Serbia. In this paper we present the framework of the modified KAM model in postal traffic, which has not yet been exploited. Marketing management research, testing the possibilities its application were performed in the selected company, PE Post of Serbia, the undisputed leader in the postal market in Serbia. Developed and presented KAM methodology for the postal service can be one of the best solutions that contribute to the successful future development and transformation of the postal sector.*

Keywords*: strategic model, key account, postal services, marketing management*

1. INTRODUCTION

The process of KAM, combined with a comprehensive Customer Relationship Management (CRM), will provide increased sales from 20 percent of customers who represent 80 percent of revenues to organisation, and more importantly, will ensure a key basis for the successful development Key Account Management (KAM). KAM is not a matter of choice of management company already strategic imperative of modern business. However, many companies still do not understand how to develop a strategy for working with key customers, as well as which tools to use in order to ensure the delivery of complex solutions to key customers and develop and improve long-term profitable partnerships (Filipović and Kostić, 2003).

The main point of view of science and practice today, represent the activities directed towards the establishing, developing and in maintaining successful business relationships with customers. In the early 1980s, parallel to the development of new marketing paradigm – the relationship marketing, the concept of KAM was also developed as a specific relationship marketing program that is focused on selected group of strategically significant customers, key account. In the context of development and advancement of the concept of KAM in the postal services in the Republic of Serbia, the application of modern and modified strategic management scenarios, models, techniques and tools is proposed (Ožegović et al. 2013).

In this paper, KAM was viewed as a multi-phase strategic management process, while its application is based on the postulates of *Project Management*. The primary objective of this study is to develop a modified multi-phase strategic model Key Account Management in the postal services. The model presented in this paper is called “***PostAIM”*** *(Ožegović, 2010).* This multiphase and multidisciplinary model approaches the problem from analytical, organizational and technological aspects. The model implies that the focusing of strategy and activities is performed before, during and after the process of sale. This approach has not been used yet and, with it, “***PostAIM”*** can be considered as the original model for key account management. The applicability of this model in the postal services has been confirmed during the research in the Republic of Serbia. This paper presents the results of the application of “***PostAIM”*** model as well as the model of “customer value" to the postal services, dubbed “***PostPPA”.*** Model “***PostPPA”*** (Ožegović, 2010) was used during the realization of selection process and categorization of customers in postal services. Testing the proposed modified model for key account management was performed in selected postal services company, PE Post of Serbia, using data from four main sources: data from the company's business reports, managers and sales teams, data obtained on the basis of the survey and interviews with managers at all levels and the data collected based on interviews with managers responsible for customer care and sales teams, goals and views of strategically important customers involved in the research which was conducted in the period from 2010 to 2012 in order to create a solid basis for building the proposed model for key account management in

postal services. During the research to identify critical success factors of KAM, the study identified the special importance of the quality of services, personnel responsible for care of customer, support of top management, while in contrast to studies done in Taiwan (Chun et al., 2009) a very small influence of geographic factors was observed (p.803).

2. RESEARCH METHODOLOGY

The primary objective of this research is to improve current models for managing key account in postal services. KAM methodology, with whose research dealt McDonald M, Rogers B, Woodburn D, Capon N, Pardo C, Cheverton P, Kotler Ph, Millman T, Wilson K, so far did not have an important application in the postal services. Based on the research, analysis and comparison of the results obtained and presented in the works of these authors, a modified model for key account management in terms of management process was proposed. Such modified model can be applied to the postal services. The outline of proposed Ožegović and Šarac (2012) point out that modified KAM model is based on the methodology of project management. In order to verify the implementation of the new model, a case study method was used. We came to most findings in the research using the test methods, conducted through structured interviews and surveys, which are often used in research on the behavior and attitudes of customers, markets, customer and seller relationship, as well as all relevant information to cause or result from these relationships.

The purpose of the research in the selected company postal services was to make a ranking of key customers at market elements and the level of profitability that is achieved, as well as investment in building long-term relationships with key customers of postal services. Based on the results of research and comparative analysis of existing models of management to key customers was developed a model of key account for postal services.

For the purpose of research conducted in the period 2010-2012 was established three representative samples: The first established the pattern (systematic, stratified) included 106 managers at all levels of management in the selected company postal services. This pattern is formed so that it has the basic set (all managers) previously divided the membership manager management level (top, middle, operational) to be followed by each of the three strata (randomly) selected by 50% of the total manager of that level in the sample for the management level. The second sample (systematic, deliberate, quota-sample) participated in 53 companies (customers) based on the percentage of participation in the annual income of sales. In this study used a semi-standardized interview *face to face* as a method tests. The aim of this study was to determine the attitudes of selected customers group to the importance of certain factors of success offered by KAM for the purpose of their comparison and cross tabulation of the results that were obtained, the same issues in the company's vehicles postal services. Conclusions which have been adopted are (the resulting conclusions are presented) a significant starting point for the formulation of methodologies and models for managing key accounts in the postal traffic. The third sample (systematic) included 56 companies of customers of postal services, with areas of southern Banat. In this study, we used a modified questionnaire UPU, and data collection was done by mail (Self-completion Questionnaires and Mail). The aim of this study was to determine the level of satisfaction of the user groups, as well as their views on the quality and competitiveness of the postal service used. The results of this research support the claim stated confirming the hypotheses, the formulation and development of management strategies to key customers based on customer satisfaction and profitability. All questionnaires were processed using specially developed software solutions in line with the objectives of these studies, on the basis of terms of reference drafted by the author of this paper.

3. THE NEED TO MANAGE KEY ACCOUNT IN POSTAL SERVICES IN THE REPUBLIC OF SERBIA

Majority of large postal service organizations are mainly divided into business units established on the basis of their subject criteria or territorial criteria. Managers of modern organizations are challenged to successfully coordinate the activities of these units and use their knowledge and business skills for the benefit of the organization as a whole. Very often the work of these business units is not in sync and in line with the mission and purpose of the organization. Key account management is one of the most important changes in selling that has emerged during the past two decades. KAM is a radically different organizational process used by business-to-business suppliers to manage their relationships with strategically-important customers, and it produces measurable business benefits" (Lynett, 2012).

KAM in postal services represents a modern strategy and marketing management approach that is based on building and nurturing long-term profitable relationships with strategically important customers in order to achieve mutual benefit for companies involved in this business relationship.

Due to the prevailing competition in the market of communication and distribution of goods, many companies build stronger and closer relationships with key customers. However, many companies still do not sufficiently understand how to develop strategies for working with key customers and which tools have to be used in order to achieve and improve their competitiveness. Key account management assumes consideration of mutual interest of both customer company, and on the part company of the seller as well as inter-organizational coordination at all levels, Table1.

Table1: Mutual key benefits of key account management in postal services

Key benefits for the vendor company in postal services	***Key benefits for key customers***
Long-term increase in profits and competitiveness	Better information on postal services
Joint appearance – joint bid with customers	Increase of delivered value
Improving knowledge about customers	Better understanding of the level of charges for postal services
Close business relationships	The reduction in input costs
Better information about the competition	Better knowledge about the benefits of service for the customer
Measurable levels of objectives achievement	Capacity to build individual customer profiles
Association of business plan and strategies	Guaranteed execution of services in cases of limited resources of the seller company
Creating complex business solution s to identified problems of key customer	

Ožegović (2010) emphasize the importance creating the mutual long-term benefits for related companies (p.85). According to the results of conducted research during the development of the model in the selected company of postal services, Post of Serbia, the public postal operator and leader in the postal services in the market of the Republic of Serbia, it is concluded that there is a need for key account management in the postal services because:

- Less than 5% of customers generate about 79% of revenue;
- Competition develops modern strategy for key account management;
- About 70% of total customer servicing cost generate customers who earn less than 20% of revenue;
- There is a need for allocation of company's available resources;
- Strategically important customers of postal services belive that single postal and other services intended for mass customers do not constitute an adequate response to their needs, etc.

The power of the small number of major market participants is notably increasing. Well known Pareto principle, 80/20, can be applied in postal traffic. Namely, approximately 20% of participants achieve about 80% of total turnover in one branch, that is, the postal sector. They require special treatment.
In this balanced inter-organizational relationship value, **key customers should not be identified with "big buyers"** who, with planned management activities, can over time be converted into a group of potential key customers. Key customers are strategic partners with whom the success is achieved and shared. There cannot be many, neither that type of relationship can be determined in advance.

Key account management in the postal service using the above definitions, is a modern business concept based on building and nurturing long-term profitable relationships with strategically important customers, in order to improve the competitive power and increase profitability, both on the side company of postal services and on the side of company's key customer.

4. METODOLOGY OF KEY ACCOUNT MANAGEMENT IN POSTAL TRAFFIC

In accordance with the primary objective of this study and presented key research results, the proposed methodology for KAM in the postal services, whose function is to formulate the framework of the strategic model for key account management.***„PostAIM"*** developed by Ožegović (2010) is the result of modeling and essentially defines key account management as a single whole. It is designed on the basis of scientific knowledge on the management of key customers and "good practice" to be enforced widely, primarily with

the postal service, as well as in other activities of service sector. This model is based on the fact that key account management is a multi-stage strategic management process.

In accordance with this methodology and based on we present only the framework of developed model for KAM in postal services, named **„PostAIM“** which is based on the application of the same. Framework of this model is presented through 3 key management processes: Analysis and planning, **I**mplementation and monitoring, Figure 1.

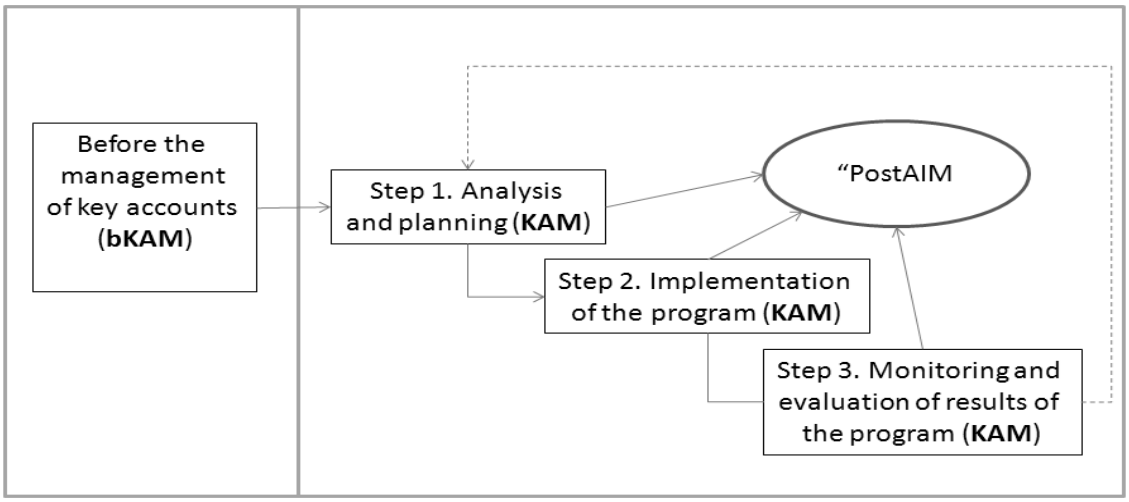

Figure 1: Suggested framework of modified strategic multiphase management model of KAM in postal traffic “PostAIM” (Ožegović, 2010)

In addition to these three key management processes (**A**nalysis and planning, **I**mplementation and **M**onitoring) that occur by the **“**step by step” system, the proposed methodology for key account management, based on a multiphase model of key account management, defines and conditions the progress of the following processes:

- adoption and management of ethical issues and norms of relations and possible conflicts,
- establishment and analysis of management accountability in the process of key account management, primarily based on developing and maintaining successful, profitable and lasting relationships with key customers, and
- establishment of accountability and the creation of management models for managing the cost and benefits in order to ensure achievement of optimum effects in the of key account management.

During the process of modeling „PostAIM“, another model of “***customer valu***e" has been developed, called “**PostPPA*”*** (Ožegović, 2010) which was used as a new approach for the realization of the process of identification, selection and categorization of key customers in the postal service, as one of the key processes of KAM, because its application is to determine which potential customers will obtain the status of key account, as well as the strategies that will be applied based on the portfolio of key customers towards a certain categorie of customers (Ožegović and Šarac, 2012).

A preliminary categorization of customers in the selected area could be carried out by customer classification into A, B and C category by using the known Pareto 80/20 rule. In determination of criteria of identification, selection and categorization of strategically important customers, key customers, that is customer value for the selected company we have used the following criteria: profitability of key customer, share in revenue from sales, attractiveness. Identification of key customers as customers with the highest value level, that is, the highest impact on performance indicators and competitiveness. In formulating the model for segmentation of customers, we started from the fact that the value delivered to key customer is critical for KAM (Pardo et al, 2005). The proposed model **“PostPPA”** a general **model for calculating the total value of the customer (Vk**) as the basis for segmentation of customers in the postal services companies, can be represented by the following expression:

$$Vk = \sum_{i=1}^{n} ti \cdot pi \qquad (1)$$

ti- weight of i-th element

pi- coefficient (calculated or estimated value)

$$Vk = tup \cdot pup + tpfk \cdot ppfk + tpak \cdot ppak \qquad (2)$$

Where are:

Vk – coefficient of customer value

pup- % share in total income

ppfk-% of customer profitability

ppak- % of assessed customer attractiveness

tup- weight factors of customer participation in the total income

tpfk- weight coefficient of customer profitability

tpak- weight coefficient of the estimated customer attractiveness

$$t = 0{,}3;0{,}5;0{,}2 \qquad (3)$$

$$Vk = 0{,}3 \cdot pup + 0{,}5 \cdot ppfk + 0{,}2 \cdot ppak \qquad (4)$$

During the implementation of complete process of identifying key customers, as well as on the basis of obtained results, it can be concluded that the biggest customers are often not the most profitable customers, because the distribution of customers in the ranking, following the procedure of their selection using the proposed model **"PostPPA**" has considerably changed. Most profitable customers are usually a little behind the biggest customers because they cause lower costs. Based on received indicators, ranking of preliminary categorized customers has finally been made and identifies 25 potential key customers in selected postal services company, Figure 2. The results of numerous studies suggest the conclusion that the optimal number of key customers is between 20 and 30 (Ryals and Rogers, 2007; McDonald and Woodburn, 2007; McDonald et al, 2000; Pardo and Ivens, 2008).

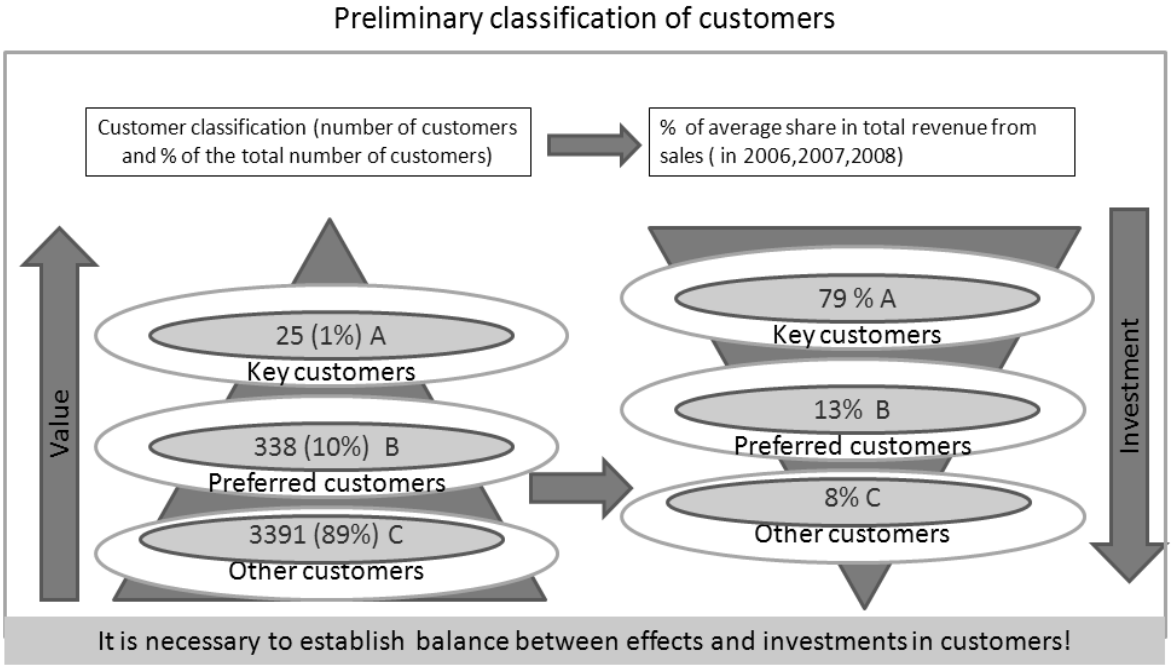

Figure 2: Pyramid of customers in the selected postal services company in B2B market and the Pareto principle 80:20

Identified a number of potential key customers during the research complies with best practices and research results published in the world for the number of key customers. The reason for this situation is contained in the fact that KAM is much more than a dedicated business relationship. In order to meet key buyers, it usually means supply them with highly customized business solutions, rather than existing products and services, which require significant investments throughout the organization. In addition to the proposed method for determining the cost of customers, same can also be determined by cost per process/activity

specific to customers with an essential condition, namely the existence of systems for accounting costs based on activities (*Activity Based Costing – ABC System*).

In accordance with the adopted methodology, testing the application possibility of the proposed modified model of the author,"PostPPA" was conducted in the Post of Serbia on identified potential key customers. After application of the model "PostPPA" positions of key customers in the ranking have changed significantly compared to the previous one, which was the aim and purpose of the same.

KAM as a strategy represents an integral part of RM concept. This is also strategic approach used by companies to implement the principles of RM into their policy and strategy towards customers**.**

5. CONCLUSION

"The Post is starting rank awareness and knowledge of the human mind, a means for the exchange of material and cultural goods, a supporter of of peace and goodwill among people and nations, the messenger of sympathy and love, a mediator between separated friends, the Comforter the bereaved and the lonely soul, the connection between separated family members, a reflection of the joy of of society in which we live." (Jullus Juhlin, president of the VIII Congress of the UPU (Universal Postal Union - UPU), Stockholm, in 1924).

Postal service companies should establish management activities for key customers through the process of planning strategic business relationships that will provide insight into the status of a key customer, collecting and analyzing data, setting measurable goals and accountability. After developing criteria for identifying key customers, we decided to adopt and develop the concept of key account management, based on the proposed model, to ensure that other key elements of the strategy (systems, processes, organization) are aligned. The organizational structure should allow flexibility and creativity of professional managers for key customers in the application of modern business concepts. The role of top management should be directed at understanding the benefits that can provide the application of key account management concept, while at the same time understanding their own opportunities and risks. The implementation of continuous training and training of personnel while implementing the system of incentives would create the essential preconditions for supporting and improving the key account management. Managers of key customers are expected to be flexible, intelligent, stable, open to customers, skilled in communication and able to avoid conflicts. Strategy for key account management in postal services may be effective only in situations where there has been inter-organizational alignment of requirements and expectations of key customers and the organization of postal services. We have come to the conclusion that the proposed KAM model is applicable in the postal service and that it provides the following key results:

- Provides efficiency and effectiveness in the process of segmentation and categorization of customers;
- Provides identification of key customers based on marketing criteria and profitability;
- Contributes to lowering of risks as a result of wrong choice of customers in which should be invested;
- Allows definition of objectives and choice of optimal strategies for each key customer, as well as their alignment with corporate strategic objectives and capabilities of the company;

Results of the research possibilities of the proposed modified model of managing key accounts in the postal service, confirmed the hypothesis that effective governance model key customers based on the performed segmentation and categorization of customers based on pre-established criteria and the level of marketing profitability.

The growing importance of key accounts, and the question of how to realize mutual benefits of partnership relations, suggests that the management of relationships with key client area of vital importance for further marketing research management.

REFERENCES

Chun, H., Chi, H., Yenhui, O. (2009); A study of critical factors of the job involment of finacial service personnel after financial tsunami, Take developing market (Taiwan) for example, African Journal of Busines Management Vol. 3 (12), pp 798-806

Filipović, V., Kostić, M. (2003): Marketing menadžment, FON, Beograd

Lynett, R., (2012); How to Succeed at Key Account Management, http://blogs.hbr.org/2012/07/how-to-succeed-at-key-account/; ac.; 01.01.2014.

McDonald, M., Woodburn, D., (2007). Key Account Management-The definitive guide, (2nd ed.). Elsevier

McDonald, M., Rogers, B.,Woodburn, D.,(2000). *Key Customers: How to Manage Them Profitably*, Oxford: Butterworth-Heinemann

McDonald M., Woodburn D., (2007): Key Account Managemen t-The definitive guide, Second edition, Elsevier Ltd.

Ožegović, S. (2010); *Key Account Management in postal services*, Unpublished doctoral dissertation. Faculty of Organizational Sciences (FON), Belgrade

Ožegović, S., Šarac, D. (2012); Exploring the possibilities of application of the modified multiphase strategic model for Key accaunt management in postal services, African Journal of Business Management, Vol. 6(14), pp. 4964-4973

Ožegović, S., Šarac, Kujačić, M. (2013); The Oraganizational Aspects of Key Account Mamagement in Postal Traffic, Tehnics, special edition,pp.97-103.

Pardo, H, Ivens. B.S (2008), Key-account-management in business markets, Journal of Business & Industrial Marketing, Vol. 23 , Number 5 , pp.301–310

Pardo C., Henneberg S., Mouzas S., Naude S., (2005): Unpicking the meaning of value in Key Account Management, Unversity of Bath school of Management, Researh 2005.02.

Ryals L, Rogers B (2007), Key Account Planning, Benefits, Barriers and Best Practice, Journal of Strategic Marketing, Volume 15, Numbers 2-3, May 2007, pp.209-222

ROLE OF MARKETING COMMUNICATION IN CANCER PREVENTION

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Abstract: *Considering the current statistics, it can be concluded that Serbia is one of the countries with a high rate of incidence of different cancer types, which represents the alarming problem nowadays. Innovative marketing campaigns and promotional activities can successfully contribute the improvement of public health by raising level of general knowledge about health issues and benefits that change of habits, eradication of undesirable behaviour and regular checks and controls have. The focus should be on continuous marketing campaigns that include mass communication through various media - television, radio, print, internet or direct communication between medical staff and patients.*
Keywords*: promotion, marketing communications, health care, cancer prevention, information, education, media*

1. INTRODUCTION

Current statistics indicate that, worldwide, every two minutes one woman dies of cervical cancer. Globally, cervical cancer is the third most common cancer type in women - every year approximately 500 000 women are being diagnosed with it, and more than half of that number die from that disease (Ferlay et al., 2010). The disease is especially common (80% of the overall number of diagnoses) in less developed regions where there is no organized prevention programs. According to the data pertaining to Serbia, cervical cancer represents the cause of 6% of all deaths in women in Serbia. Serbia has the highest incidence of cervical cancer (24.3 to 100 000) in relation to all the other republics of the former Yugoslavia and one of the highest prevalence among the countries of South Eastern Europe. The incidence of cervical cancer in Serbia is two times higher than the incidence in Western Europe (10.43 per 100,000 women) and about three times higher than in the EU countries (where the figure is 8.1 per 100,000 women). Age representation of cervical cancer shows a typical increase after the age of 30, with the most common detection in the age groups from 45 to 49 and from 70 do74 years. When it comes to breast cancer in the world, each year about 400,000 women are being diagnosed with it and about a million of them die from it. In Europe, about 129,000 die each year, and about 370,000 women are diagnosed. Breast cancer is the most common malignant tumour in women in Serbia. There are about 4,000 new cases every year and about 1,600 of them die, which makes 18% of overall number of deaths from all cancers types. Statistics indicate that one in eight women either already has breast cancer or will become ill during lifetime (Jankovic et al., 2004).

Such prognoses indicate the necessity of introducing marketing communication into the area of public health in order to inform and educate public about methods of prevention and early detection of cancer (Plsek and Wilson, 2010). Although developed countries place greater attention to intensive and continual media campaigns dedicated to health promotion, in Serbia still dominate conventional approaches, which are related to the rehabilitation and cancer treatment rather than to disease prevention. By creating awareness about the possibilities and ways of application of certain preventive measures, the mortality rate of certain types of malignancies, including breast and cervical cancer, would be significantly reduced. The focus of activities in health care should switch from reactive to proactive activities - health promotion and prevention activities in which marketing communication can have significant role.

2. PREVENTION AS A BASIS FOR IMPROVING PUBLIC HEALTH

Significant political, economic and social transformation at the global level that have taken place in recent decades, have caused major changes in the conception and organization of health care. One consequence of the above mentioned transformation is making increasing efforts to improve and enhance public health. There are three main aspects of prevention activities. The first aspect focuses on preventing or reducing the incidence of risky behaviour (such as poor eating habits, smoking, heavy using of alcohol and the like) and requires education of the public about the possible consequences. The second aspect relates to the promotion of health-protective behaviours, such as screening, immunization and regular check-ups or acquiring certain skills, for example, ways how to perform breast self-examination. The third approach involves the impact on legal authorities, in order to ban some dangerous issues (smoking in public places to

protect non-smokers from the effects of passive smoke inhalation, banning of GMO food, ecologically unfriendly products etc.) (Killoran and Kelly, 2004; Kelly et al., 2004).
The goal of improving public health is enabling individuals to gain greater control over their health and its determinants. For example, many activities in the area of health improvement are directly related to (Watson and Platt, 2002):

- Communication and health education - strategies that are used to increase knowledge and awareness of the public so that individuals can make rational decisions regarding their own lives and health. Evles and Simnett (2003, p.27) emphasize the necessity of using mass media to inform the general public about health practices; distribution of flyers and leaflets on health care, conducting of special programs for vulnerable social groups, etc.
- Training and consulting – ways of how medical practitioners can enable patients to develop the necessary skills for early detection of some diseases.
- The development and involvement of the wider community and capacity building - the fundamental forms of social organization and collective action aimed at improving public health.

Rifkin (2003), one of the well-known theorists of improving of public health, identified the five most important aspects in this process:

- The development of personal communication skills of medical staff (for successful education of patients or working with marginalized groups);
- Creating a supportive environment (which provides confidence and respect, especially in schools and workplaces);
- Strengthening actions within the community;
- Construction of adequate public policy that supports initiatives to improve public health;
- Transformation of health services from a reactive to a proactive sphere of action (better balance of resources in order to promote preventive action).

Practice has shown that the problem of improving public health is closely linked to the informing and education and of the population (Labonté and Schrecker, 2007). At the international level, it has been shown that investments in marketing communication about prevention are more significantly associated with improved general health of whole population than economic growth and investment in other social spheres (Labonté and Laverack, 2008). The results suggest that higher awareness level about prevention can lead to improved health outcomes in developing countries (Bratt et al., 2002), such as Serbia.

3. MARKETING COMMUNICATION ON HEALTH PREVENTION

Marketing communication on health prevention includes providing health information with the aim of influencing the behaviour and attitudes of the public and raising awareness about ways to prevent various diseases and potential hazards of unhealthy behaviour (NCHEC, 2007). Roman et al. (2003) indicated that effective communication is the key to prevent disease and reduce health care costs on national and global levels. Marketing communication on prevention involves conveying messages to target groups about the potential risks and nature of diseases, whereby the target group should receive and correctly interpret the message and use information in decision making on individual health care. Messages can be transmitted through direct communication of medical staff with patients or through the mass media if communication demands wider audience (Pérez and Raffy, 2008). If properly planned and implemented, marketing communication in the field of prevention can be very effective, with a tendency to influence the general public and policy-makers and to promote positive change in the community, ways to improve the quality of health services and to attract sponsors and donors from the private sector and create the stimulating partnerships. As the public becomes more informed, changing the social consciousness and recognition of the health problems would arise in the community. In addition to initiating behaviour change or the introduction of new legislation on health care, marketing communication can help other positive changes in the community, such as changes in the physical environment. Such examples include the provision of public space for physical activity and recreation, building bike paths or sidewalks that will allow people to walk more and use transportation means that does not pollute the environment and so on (Pokhrel and Sauerborn, 2004).

There are four factors to be considered when planning and implementing marketing communication campaign about health issues (Nicholson, 2001): the level of health literacy of the target group (ability to receive and understand health information), the level of knowledge and awareness of health and disease, the current attitudes of the target group towards health, disease and prevention and structural barriers (limited access to health care, lack of funding, lack of health insurance, insufficient number of health workers and the like). Cheng, Kotler and Lee (2009) defined following phases through which a promotional campaign aimed at creating awareness about prevention must pass:

- Defining of health problem(s) and the ways of its suppression:

When defining prevention campaigns, it is essential to identify public health problems and summarize the factors that led to the decision on creating that type of campaign. Reasons for the decision may be based on the various research results, epidemiological or scientific data that can quantify defined problem and explain prevention possibilities.

- Analysis of the situation:

By conducting SWOT analyses, some conclusions based on internal factors such as the level of funding support from government and relevant institutions, current partners and sponsors of the campaign, can be drawn. Also, it is necessary to define how to take advantage of opportunities and to eliminate or avoid threats to the implementation of the campaign. In this phase, situational analysis of environmental factors - demographic, psychographic, geographic, economic, cultural, political, legal and technological, is also of essential importance. At this stage it is also necessary to analyse the results of current and previous campaigns, particularly those with similar goals and summarize the main activities that have been conducted, achieved results, positive or negative experiences etc.

- Identification of target group(s):

The selection of target group(s) is done by the segmentation of the public based on certain common demographic, psychographic, geographic and/or behavioural characteristics. After selection of the target group, the current level of knowledge and awareness of its members about specific health problems and prevention possibilities should be estimated by using the knowledge scale, which has following levels: absolute unfamiliarity with the problem, recognition of the problem, basic knowledge, significant knowledge about the problem and absolute familiarity with the problem (Siegel and Lotenberg, 2007).

- Determination of communication objectives:

The objectives are usually applied as: change in behaviour, attitudes and/or beliefs, higher knowledge and information level about health problems etc. Objectives of these type of campaigns are sometimes difficult to quantify, but, for example, can be presented as a greater number of people doing preventive screening, greater number of cancer detections in the early stage etc.

- Creation of a message and determination of appropriate source:

This phase consists of following decisions: what to say (message content), how to say (creative strategy) and who should say it (message source). Generally, messages of this type can be classified into two broad categories - those that include informational or transformational appeal. Informational appeals assume that members of the target group rationally process communication messages and that their behaviour is based on logical reasoning. This type of message is used when the target group has a highly developed awareness of the disease and prevention and is prone to self-initiated behavioural change when there is a real need for that. Transformational appeal is used when attempting to provoke negative or positive emotions of the target group. Many health promoters use negative emotions such as fear, guilt and shame to motivate people to change their behaviour (for example**,** to take care of the teeth hygiene and go for regular check-ups per year), or to stop doing certain things (for example, to reject smoking or uncontrolled overeating) (Kotler et al., 2008). Selection of proper message source is significant when it comes to health prevention. Three main factors that give more significance to sources are: expertise, credibility and likeability.

- The choice of marketing communications mix:

The choice of an adequate communication instruments ensures that the message reaches the target group. Marketing communications mix is a combination of these instruments, with optimal participation of each of them, which will ensure the achievement of marketing communication objectives (Kostic – Stankovic, 2013). Campaign dedicated to health prevention requires a synergy of the instruments in a way that enables a fully successful communication process.

- Establishing a budget for communication:

The budget for the marketing campaign reflects the cost of development and its implementation, which include those associated with the promotional mix and additional costs anticipated for monitoring and evaluation. Additional funding sources may include a variety of companies, institutions, foundations, media partnerships, donations and sponsorships. Budget must be sufficient to ensure continuity of the campaign and policy of its adoption must be flexible in order to enable adaption to the current changes and situations (Kostic – Stankovic, 2011).

- Measurement and evaluation of the results

Results should be aligned with the objectives set for the campaign. Monitoring is conducted after the beginning of the campaign, but before its completion in order to determine whether adjustments are necessary to ensure that program objectives would be achieved. Evaluation refers to the final report on what was actually achieved through the campaign.

4. EMPIRICAL RESEARCH

The survey based on polling a sample of female patients of the Serbian Railways Medical Centre was conducted in October, 2013. The main purpose of the research was to examine the level of awareness of the respondents about ways to prevent breast and cervical cancer and major channels of communication that are used for informing about those topics.

The sample was structured by age into four groups: from 20 to 29 years (31% of respondents), from 30 to 39 years (21%), from 40 to 49% years (16%) and 50 years or more years (32%). Greater percentage of the respondents (69%) comes from urban areas, while the rest (31%) live in rural areas in Serbia. In terms of education, the approximate percentages of the sample have completed their secondary school education (44%) and higher education (43%), while the remaining 14% have only primary school.

4.1. Results and analysis

The research results indicate that women who belong to the age group of 20 to 29 years, in most cases (51.6 %), gynaecological examination perform annually, while 16.1% do not do such examination at all. More than half of those who regularly go for check-ups always done Papanicolau test (in further text abbreviated as Pap test), approximately 42% sometimes and 6.5% never. When it comes to the age group of 30 to 39, 47.6% of women go to gynaecological examination once a year. About 52% of them regularly do Pap test, 38.1% sometimes and 9.5% never. Approximately 19% of the members of this age group do not go to a gynaecologist´ at all. Among women aged 40 to 49, the highest percentage (56.2%) goes to annual examinations, the quarter twice a year and 12.5 % never. Pap test regularly does half of them, 37.5% sometimes and 12.5% never. A significant percentage of women who have 50 or more years (71.9%) goes to gynaecological examination once a year, 9.4% twice, and 15.6% never. Pap test always does 59.4%, while 28.1% does that test irregularly and 12.5 % never.

From the perspective of areas that respondents come from, it can be concluded that there are variations in responses. About 56% of women who live in urban areas do gynaecological examination ones a year, 18.8 % twice a year and 14.5 % do not go to such medical examinations at all. Among those who visit a gynaecologist at least once a year, 62.3 % always demand Pap test, 30.4% irregularly and 7.2% never. When it comes to respondents who come from rural areas, 61.3 % go to such examinations once a year, 9.7% twice and 19.4% never. Pap testing regularly does 35.5%, 48.4 % sometimes and 16.1% never. It can be seen that women in rural areas have less developed awareness of performing Pap test on regular basis, which is the main indicator of early cancer stages.

The results indicate the existence of some differences in frequency of performing gynaecological examinations and Pap tests observed by education level. More than half (53.5%) of higher educated women do annual gynaecological examination, 18.6% do such examination twice or more and 9.3% never. A significant percentage (67.4%) regularly does Pap test, 27.9% sometimes and 4.7% never. When it comes to women with secondary education, the survey results indicate that the greatest percentage (65.9%) does annual gynaecological examination, while 13.6% does not. Pap test is a regular item for 54.5% of them, for 34.1% occasional, while 11.4 % do not consider that it should be done. Equal percentages of women who have completed primary school do gynaecological examination ones a year and never (46.2%). Slightly more than 69% of women of this age group are not doing Pap test regularly, while only 7.7% of them do it every year and 23% never.

The results indicate that the largest percentage of respondents from all age categories are familiar with the way of performing breast self-examination: 77.4% of women aged 20 to 29, 71.4% of women aged 30 to 39, 68.8% women aged 40 to 49 and even 96.9% of women who have 50 or more years. The percentage of women who perform self-examination is slightly higher in urban (84.1%) than in rural (74.2%) areas. The awareness of the necessity of performing self-examination increases with level of education. In the group of women with only primary education, the percentage of those who are not familiar with this type of examination is higher - 61,5%. Approximately 80% of women with secondary education are familiar with the way of carrying out this examination, as well as 95.3% of those with higher education. A high percentage of women of all age groups has never performed mammography or ultrasonography: 84% of women aged 20 to

29, 76% of women aged 30 to 39, 63% of women aged 40 to 49 and 43.8% of women that have 50 or more years. The percentage of women who have done mammogram screening is higher in urban areas (37.7%) than in rural (25.8%), but it remains evident that the overwhelming percentage of the women had never performed this type of examination. In the group of women with only primary education, this type of examination has already done 23%, as well as 40% of women with secondary and 30% with higher education.

The largest number of women of all ages has been informed about the possibility of preventing breast and cervical cancer by the media - more than 60% of those who belong to the first three age groups and 43.8% of women older than 50. Such information have been received from the medical staff when it comes to 22% of women aged 20 to 29, 24% of women aged 30 to 39, a quarter of women aged 40 to 49 and 43.8% of women aged 50 years and more. Among women aged 20 to 39, there is no uninformed about these issues. Within the age group of 40 to 49, 6.2% identified themselves as uninformed, as well as 3.1% of women aged 50 years and more. For women who come from urban areas, the main source of information is medical staff (53.6%), media (34.8%) and none of them are uninformed. In rural areas, 64.5% of respondents have received the information by the media, significantly less (19.4 %) by medical staff, while 6.5 % are not informed about this topic at all.

From the perspective of the educational structure of the sample, women with primary education are mostly informed by the media (46.2%), slightly fewer (38.5%) by the staff in medical institutions and 7.7% are not informed about prevention possibilities. Women with secondary education are also generally informed about prevention by the media (56.8 %) or in health care institutions (34.1%). A small percentage (4.5%) have had an opportunity to hear lectures about prevention at work or at school, while 2% are not informed at all. Women with higher education prefer to get information by the media (60.5 %), but consider medical staff being also a significant source of information (23.3%). Approximately 14% have heard lectures on this topic at work /university. There are not uninformed within this educational category.

When it comes to information by television, 74% of respondents had the opportunity to watch TV programs dedicated to the prevention of cervical and breast cancer, while 17% only during special media campaigns dedicated to these topics. A small number of respondents (7%) are not interested in watching this type of content on television, while 2% believe that national television stations lack this type of content (Figure 1).

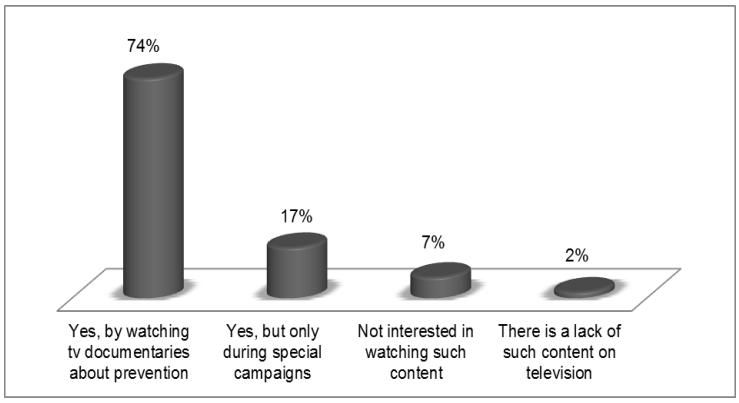

Figure 1. Informing about cancer prevention through television

Radio shows dedicated to the prevention of cervical and breast cancer has so far listened 48% of women and 20% of them only during specific campaigns. A small percentage (6%) is not interested in listening to the radio content of this type, even though they have had a chance to do it, while 26% of women believe that radio stations lack information of this type (Figure 2).

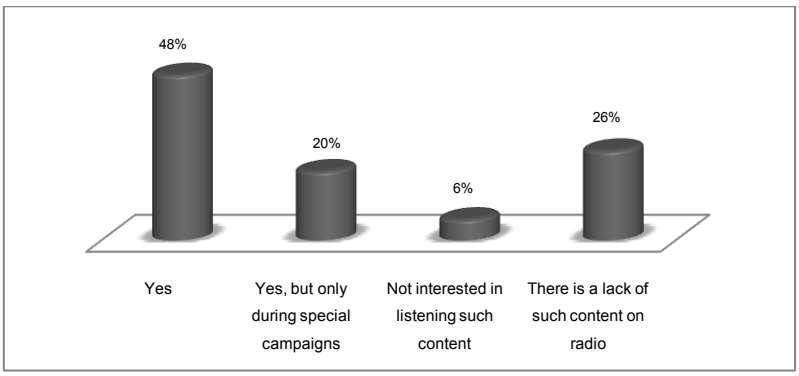

Figure 2. Informing about cancer prevention through radio

When it comes to information by printed media, 34% of respondents have had the opportunity to read the articles dedicated to prevention of breast and cervical cancer in daily newspapers and 54% in specialized magazines about health. A small number of women (8%) are not interested to read this type of articles in the press, while the lowest percentage, 4%, considers that these issues are not provided enough attention to in national newspapers and magazines (Figure 3).

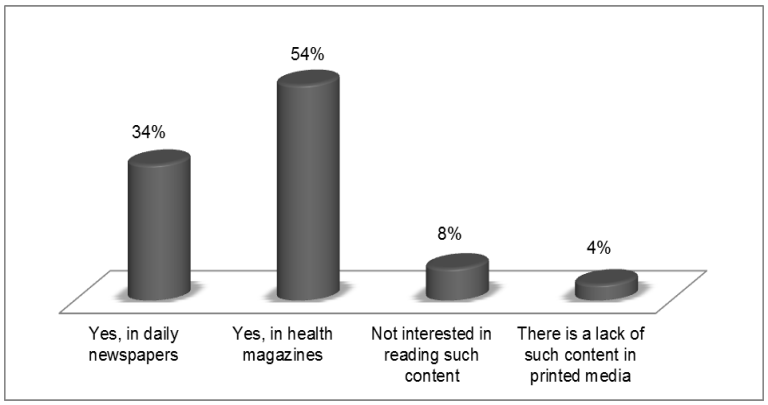

Figure 3. Informing about cancer prevention through printed media

As shown in Figure 4, 42% of women have informed themselves about preventive measures on sites dedicated to health and one fifth of them on the sites of medical institutions. Blogs or forums on health, follows 13%, mostly younger, women, while a quarter of respondents have not read about these topics on the Internet.

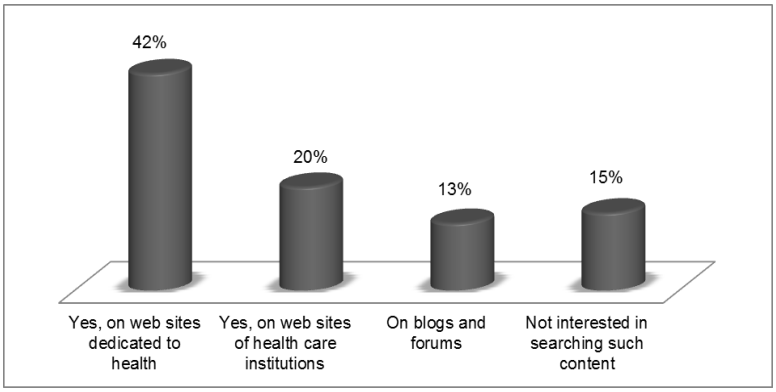

Figure 4. Informing about cancer prevention on Internet

The highest percentage of women (84%) have informed about methods of prevention through posters in health facilities or brochures that have been given to them in these institutions. Among them, 71% have read the promotional material in detail, while 13% have not been interested in reading it. Sixteen percentages of respondents had never seen or received promotional material of this type in medical institutions (Fig. 31).

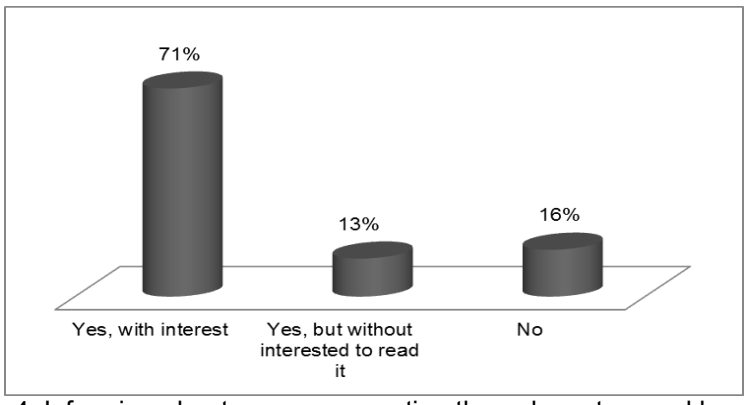

Figure 4. Informing about cancer prevention through posters and brochures

In relation to the attitude of respondents regarding the most responsible subjects for the education of women about cancer prevention, in most cases these were health institutions and the Ministry of Health. Most women who belong to the age group of 20 to 29 (38.7%) believed that the Ministry of Health played a major role, followed by the media (29.8%) and healthcare institutions (29%). Only 6.5% of younger respondents stated that every woman should educate herself on her own initiative. Women aged 30 to 39 thought that the main role belonged to health care institutions (52.4%), media (28.6%) and the Ministry of Health (19%), while the initiative is not on women themselves. Women aged 40 to 49 also stated that health care institutions played the main role in education (56.2%), then the Ministry of Health (31.2%), media and women by themselves (6.2% each). Women, who are 50 or older, as the most important, considered the role of health care institutions (43.8%), but a significant number (31.2%) highlights the importance of taking self-initiative. A quarter of women within this age category considered that the Ministry of Health had a fundamental role in encouraging the education of women in the area of cancer prevention (Figure 5).

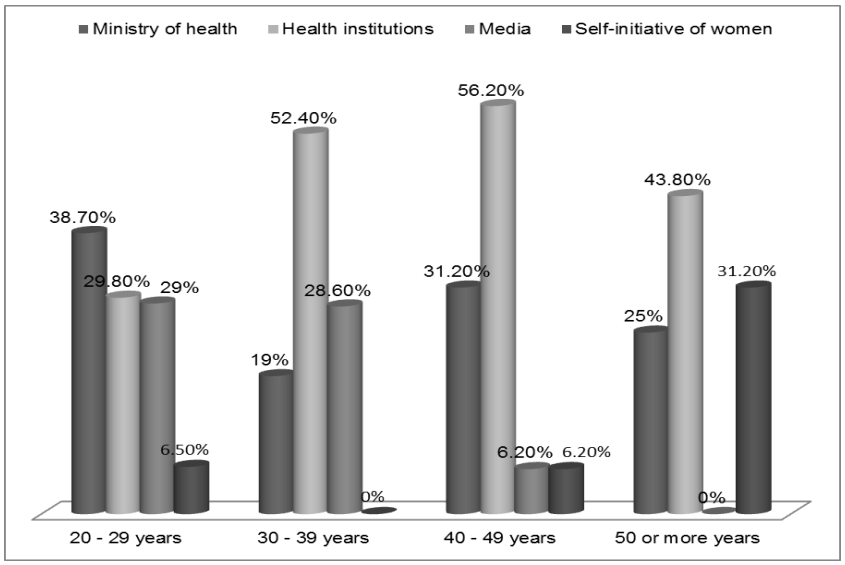

Figure 5. Role of different subjects in informing and education about cancer prevention

The largest percentage of respondents from both, urban areas (39.1%) and rural areas (51.6%) believed that health care institutions were the most responsible, followed by the Ministry of Health (30.4% in urban and 25.8% in rural areas). Respondents from urban areas also emphasized the role of the media (18.8%) and, at least, self-initiated education of women (11.6%). Women in rural areas valued more the role of women self-initiative (16.1%) than the role of the media (6.5%). From the perspective of the level of education results are as follows: women with primary education equally valued the role of the Ministry of Health and health services (38.5% each), followed by the role of the media (15.4 %) and self-initiative of women (7.7%). Women with secondary education considered that institutions played the main role (59.1%), followed by self-education of women (20.5 %). Around eleven percentages thought that the media played a major role, while 9.1% thought that the Ministry is more responsible. Higher educated women, at most, emphasized the responsibility of the Ministry of Health (46.5%), then health care institutions (27.9 %), media (18.6%), while the lowest percentage (7%) emphasized the role of self-initiative of women.

5. CONCLUSION

Changes in medical practice in recent decades have caused the introduction of marketing communication in this sector. Social and economic trends that affect the health care sector show imply an increased need to inform and create awareness of target public in order to motivate behaviour change in the way of adoption of preventive measures. Such measures could contribute the reduction of the mortality rate of certain types of cancer, including breast and cervical cancer. Results of the research indicate that television is the leading media when it comes to information on these topics. Posters in health facilities or brochures given to women in these institutions are also considered significant. When it comes to the attitude of respondents regarding the subjects that are most responsible for the education of women, health institutions and the Serbian Ministry of Health are considered as the most important.

REFERENCES

Bratt, J. H., Weaver, M., Foreit, J., De Vargas, T. & Janowitz, B. (2002). The impact of price changes on demand for family planning and reproductive health services in Ecuador. Health Policy and Planning, 17 (3), 281–7.

Cheng, H., Kotler, P., & Lee, N. (2009). Social Marketing for Public Health - Global Trends and Success Stories, Jones & Bartlett Publishers, Sudbery, USA.

Ferlay, J., Shin, H. R., Bray, F., Forman, D., Mathers, C., & Parkin, D. M. (2010). Estimates of worldwide burden of cancer, GLOBOCAN 2010 - Cancer Incidence, Mortality and Prevalence Worldwide, IARC CancerBase, Lyon, France.

Janković, S., Gledović, Z., & Marković – Denić, Lj. (2004). Malignant tumours: Epidemiology, aetiology and prevention, Medical Faculty, University of Belgrade, Beograde, Serbia, pp.133-173.

Kelly, M.P., Crombie, H., & Owen, L. (2004). The Contribution of Smoking, Diet, Screening and Treatment to Cancer Mortality in the Under 75s, Health Development Agency, London, UK. Retrieved from http://www. publichealth.nice.org.uk/documents/cancerunder75sbriefing.Pdf, 28.10.2013.

Killoran, A., & Kelly, M.P. (2004). Towards an evidence-based approach to tackling health inequalities: the English experience, Health Education Journal, 63, 7–14.

Kostic – Stankovic, M. (2013). Marketing Communications in Customer Relationship Management, Belgrade: Andrejevic Endowment.

Kostic – Stankovic, M. (2011). Integrated Business Communications, Belgrade: Faculty of Organizational Sciences..

Kotler, P., Shalowitz, J., & Stevens, R.J. (2008). Strategic marketing for health care organizations: building a customer-driven health system, 1st Ed., Jossey-Bass, San Francisco, USA.

Labonté, R., & Laverack, G. (2008). From local to global empowerment: health promotion in action Palgrave Macmillan, Basingstoke, Hampshire, UK.

Labonté, R., & Schrecker, T. (2007). Globalization and social determinants of health: The role of the global marketplace, Globalization and Health. Retrieved from: http://www.globalizationand health.com/content/3/1/6, 25.10.2013.

National Commission for Health Education Credentialing, (2007). Responsibilities & competencies. Retrieved from: http://www.nchec.org/aboutnchec/rc.htm, 28.10.2013.

Nicholson, P.J., (2001). Communicating health risks, Occupational Medicine, 49 (4), 253 – 258. Retrieved from: http://occmed.oxfordjournals.org/cgi/reprint/49/4/253.pdf, 28.10.2013.

Peréz, M. A., &Raffy, R. L., (2008). Cultural competence in health education and health promotion, Jossey-Bass, San Francisco, USA.

Plsek, P.E., & Wilson, T. (2010). Complexity, leadership and management in healthcare organisations, Quality United BMJ, 32 (7315), 746–749.

Pokhrel, S., & Sauerborn, R. (2004). Household decision-making on child health care in developing countries: The case of Nepal, Health Policy and Planning, 19 (4) 218–33.

Rifkin, S. (2003). A framework linking community empowerment and health equity: It is a matter of choice, Journal of Health and Population Nutrition, 21 (3), p.173.

Roman, K., Maas, J., & Nisenholtz, M. (2003). How to advertise (3rd Ed.), St.Martin's Press, New York, USA.

Siegel, M., Lotenberg, L. (2007). Marketing public health: Strategies to promote social change. Jones and Bartlett Sudbury, USA.

Watson, J., & Platt, S. (2002). Researching Health Promotion, Routledge, London, UK.

VOJVODINA AS A TOURISM DESTINATION: CITIZENS' PERSPECTIVE

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Abstract: *Creating a tourism destination brand is a demanding and time-consuming process. It necessarily involves local population as it plays an active role in the creation of the brand and image of the destination. This study includes an empirical research which examined the views and opinions of the citizens of Vojvodina regarding Vojvodina as a tourism destination. We have identified the main characteristics and values of the destination, which can be the basis of a successful brand positioning. Research has highlighted the main advantages that should be used to attract tourists, as well as main features that can be used for positioning this region in the minds of tourists from the perspective of local population.*

Keywords*: destination brand, brand identity, brand image, positioning, Vojvodina*

1. INTRODUCTION

The development of tourism, business and a growing number of people that allocate a part of their earnings for visiting places around the world contributed to the development of geographical locations branding. Cities, states, regions and continents are active in branding and promotional campaigns with the goal of positioning and developing desired association for the location and arousing interest to visit it. Tourism is one of the most developed service branches in almost all developed countries, as well as the industry that achieves the biggest progress in developing countries (Gabor et al., 2012). States, regions, cities, tourist organizations and agencies, affected by economic and cultural globalization, have to fight for its place in the tourist industry. One of the ways to do so is differentiation, or the creation and development of the destination brand. The importance of the state, city, or a particular region brand is not only to attract tourists, but also in creating the image and the reputation of the state (Morgan et al., 2011).

Tourists face a lot of information on various tourist destinations. In order for those destinations to become recognizable in the market and to become famous and attract tourists, one of the starting points is to build an identity, differentiate from other destinations and to build and successfully maintain their positive image. The paper by Pike (2009) presents scholars researches that emphasize the importance of the development of destination brand identities and monitoring destination brand position in time.

In Serbia, there are significant, yet still unused opportunities in tourism, which require a serious approach, knowledge, creativity and commitment to the process of building identity and image of tourism destinations. One of these options is autonomous province Vojvodina, a region of Serbia, and it is necessary to systematize the rich and diverse offer of Vojvodina and position it as a destination brand.

This paper describes the basic concepts of tourism destination brand. As literature review points out, the basis of creating and positioning a destination brand are the brand values. Therefore, the research that is presented is aimed at identifying the values and characteristics of the destination. The survey was conducted in Vojvodina, and based on the opinions and attitudes of citizens the basic features and brand values of Vojvodina as a destination have been defined, and they can be used as one of the basis for creating a branding strategy for this destination.

2. BASIS OF A TOURISM DESTINATION BRAND

In today's market environment, one of the basic conditions for successful business is building positive relationships with stakeholders. Brand creation is one of the ways to establish and maintain positive relations, because the brand is not only the name of the company/product, but the brand is a functional and emotional well-rounded story about it (Cicvarić, 2006, p. 9).

The concept of the brand was created with the idea to differentiate one manufacturer's products from the products of other manufacturers (Kotler & Keller, 2006, p. 274). Brand represents a distinctive set of elements (name, logo, symbol, design and message) that identify and differentiate: organizations, products, services, as well as people, places, and ideas, and create unique rational and emotional associations, beliefs and expectations of customers/consumers/users (Cicvarić, 2006, p. 29). The essence of the brand is to create relationships between brand and stakeholders, and it was analyzed by Chevalier and Mazzalovo (2004). Through this relationship they define the brand as a kind of contract, which is basically the relationship of trust that includes expectations of stakeholders on one hand, and promised features of the brand on the other side. Relationship and the benefits are mutual and not purely rational, but they also involve an emotional connection.

According to Kotler (1997, p. 430) product is everything that can be offered in the market to meet a certain desire or necessity, so these products can be: physical goods, services, retail stores, a person, organization, a place or an idea. In accordance with Kotler's product concept, brand concept can be linked to all categories previously mentioned.

In this context, the concept of the brand can also be applied to places or geographical locations and destinations, so the destination brand involves a name, symbol, logo, word and/or other elements that serve to identify and distinguish one destination from competing destinations. In this case, brands provide a promise of a positive traveling experience to a specific destination to potential visitors, and they are used to reinforce and strengthen the memory of a beautiful experience for those who have already been there (Kerr, 2006, p. 277).

According to Anholt (2007) branding is the process of creating, planning and communicating an identity in order to build and manage image and reputation (p. 4). Identity is the way in which the brand should be seen and understood. The basis is a visual identity, but in addition to visual representation, identity should include core values, history, culture and other specific features (Balmer, 2001). The image is public opinion about a particular brand and it is based on many factors and influences from the environment (Kapferer, 1997, p. 32). Given that image and reputation are comprised of a range of experiences, memories, expectations and other emotions that are associated with the brand, these feelings are important drivers of human behavior, so Anholt (2007) concludes that brand image is one of the key concepts relevant to the development of nations, cities and regions (p. 5).

In the process of strategic destination branding the starting point is defining the vision and mission of the destination brand. According to Chernatony (2010), the vision of a strong brand is composed of three components that are interconnected, and they are: 1. Projection of the future environment that will be realized if the brand achieves its goals; 2. The purpose of the brand, which is the reason for its existence, 3. Values that will represent the characteristics of the brand, respectively the values that will enable the brand to achieve the purpose for which it exists. The mission of the destination brand should present the reasons for starting the destination branding process, as well as the expected benefits the brand will bring to a geographical location in the future.

Park & Petrick (2006, p. 263) cited following as main reasons for destination branding: building identity and image that can attract tourists, differentiation of destination from others and positioning in order to stimulate the consumption of tourists, image management, as well as the increase of economical contribution of tourism to the destination development. Therefore, destination branding is focused on differentiating destination from the competition, especially by developing awareness and recognition among potential customers, as well as creating a positive image of the destination. By achieving this goal, it is possible to affect the attraction of tourists, attracting investors to invest in a destination, creating trade and political engagements and agreements with other destinations/countries, the organization of events on an international level and the number of other benefits that positively contribute to the development of a destination (Anholt, 2003).

The process of branding a tourist destination is quite complex and time consuming, because it is conditioned by the nature of a tourist destination, respectively its characteristics, cultural and historical heritage and natural features, a set of activities, attractions, tourist facilities and services that a destination offers. Many of these characteristics, such as the names of destinations, geographical location and natural characteristics are already defined and can not be changed in the process of branding. Therefore, the creation of a brand identity is based on them as starting elements and further includes defining other elements of identity and a campaign that will present the destination in a best possible way, bringing it closer to potential tourists and making it desirable and attractive.

Echtner and Ritchie (2003) believe that the destination image includes the perception of its characteristics (such as, for example, location, climate, accommodation facilities, hospitality of the population), as well as some of the holistic impressions (mental images or imagination) on the spot (p. 42). Therefore, it is necessary that the image is created so that it takes into account the existing resources of destinations that are specific to a given destination, while the other side must also contain personal impressions and perceptions of visitors that are a result of creating and delivering the promised brand value.

One of important conditions for success of the process of branding a tourism destination is the involvement of all relevant stakeholders in the process, in fact that all those who have an interest in the way the destination will be presented (Garcia et al., 2012). The identity of the local population should be the starting point for creating a destination brand identity. In addition to population of the location, the following groups can be identified as the stakeholders in destination branding: the representatives of local, regional and national tourism organizations, government, businesses, the arts, culture and education organizations, media and the general public.

The study of destination image is a relatively new field in the problem of positioning tourism products. So far, several studies have been made and they clearly demonstrate that destination image has an impact on consumer behavior, and in the case of a destination with a very positive and powerful appeal there is always a great chance that in the process of decision making the customer/tourist will opt for it, in comparison to competing destinations (Gallarza et al., 2002, p. 56).

3. POSITIONING A TOURISM DESTINATION

Position of the product (brand) is a complex set of perceptions, impressions and feelings that consumers have regarding a particular brand in comparison to its competitors. It includes a ratio of own brand's image to competing brands (Veljković, 2010, p. 108). Each brand is perceived differently by an individual consumer in relation to the competitor and on the basis of attributes which are important to consumers.The position of the destination on the market is the way in which the destination is seen by the potential and current visitors in terms of experience and the potential benefits it offers in comparison to competitive destinations (Reich, 1999, p. 1-2).

According to the same author, elements that assist in positioning a destination are the name, symbol and message of the tourist destination. The destinations have their own names that it is impossible or very difficult to change. It is a constant on which tourists have already developed associations. Symbol and/or logo of the tourist destination can help identify the destination and reflect its personality. Visual or graphical display which will be linked to the destination brand are considered by the author as the mandatory element of the brand. The importance and impact that a symbol/logo can have derives from the constancy of its use and recognition over time. The message of a tourist destination is an element that is often used to describe the essence of the destination brand, but is not a mandatory element for positioning.

Genov (2013) defines four principles of successful positioning of tourism destination: clarity, consistency, visibility and competitiveness (p. 165). Clarity refers to the communication with the market and emphasizing competitive advantage, where it is important to have clear and accurate communication, as well as specific, clear and precise message. Consistency as a positioning element refers to the persistence and insistence in communicating basic ideas into messages that are broadcast to consumers. Visibility is an important element of positioning because in that way the competitive advantage finds its place in the minds of consumers in the target market. Competitiveness of tourist destinations in the process of positioning must have a good and relevant basis so its competitors could not compete with it or copy it. The destination brand values that are the basic component of the brand vision represent previously mentioned basics.

The research that is presented aims at identifying the values and characteristics that the destination has which actually should be the starting point of creation and brand positioning of a destination.

4. THE CHARACTERISTICS OF VOJVODINA AS A TOURISM DESTINATION: CITIZEN PERCEPTION

In order to identify the values and characteristics of Vojvodina as a tourist destination, the authors conducted an empirical study among inhabitants of Vojvodina, on the basis of which further steps in destination branding can be determined. As it was previously identified that residents play an active role in the creation of the brand and image of the destination (Gallarza et al., 2002, p. 61), for the purposes of this study authors

examined the attitudes of people living in Vojvodina. The study was conducted in 2013, and it was based on primary data collection and employed questionnaire as a research method. On a random sample, 128 valid responses were collected, where the share of women with 75.8% was three times higher compared to the share of men at 24.2%. The age structure of the sample included respondents aged 18 to 58, where 66% of all respondents belong to the group of 21-30 years of age.

Respondents were offered responses of values and characteristics, among which it was necessary to opt for the one with the open possibility to write additional charachteristics on their own if they believe that the stated values and characteristics do not reflect their views. The answers were offered on the basis of short interviews with 32 residents of Vojvodina, made prior to the making of a questionnaire, as well as on data from a research and development project "Marketing strategy of tourism in Vojvodina", which was the basis for the design of the questionnaire.

In the opinion of interviewed citizens of Vojvodina, homesteads (typical Vojvodina farms) (32%) and the natural beauty of the Pannonian lain (27%) are the responses that have been recognized by largest number of examinees as most expressed features of Vojvodina (Figure 1). The other three answers offered are approximately equally represented: rich in tradition and culture (16%), tasty, traditional food and wine (13%) and authentic towns of Vojvodina (10%).

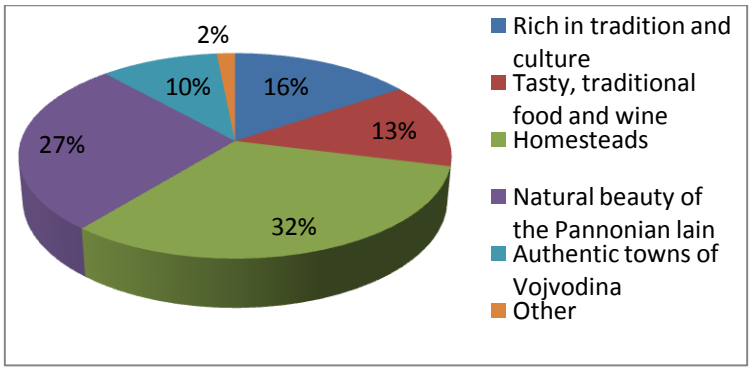

Figure 1. Most expressed features of Vojvodina

The local population was assessed by 2/3 of respondents as friendly and hospitable (Figure 2). This information is extremely important when we consider the importance that local people have in the creation of a positive brand image of the destination. When a bohemian life (13%) and preserving tradition (18%) are added to the cordiality and hospitality, it could be said that the citizens of Vojvodina are seen as a repository of friendly people.

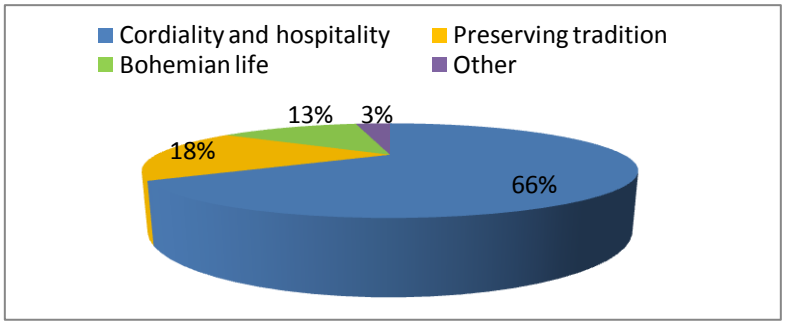

Figure 2. Features of Vojvodina inhabitants

When asked what is the main advantage of Vojvodina as a tourist area, the responses were equally represented (Figure 3). The rich cultural and historical heritage (22%), the Pannonian plain (18%), multiculturalism (19%), romantic and dreamy destinations (16%), wine and delicious traditional food (17%), and unspoiled nature with somewhat lower percentage of responses (7 %) are significant advantages in the region, while also representing a part of their resources as usable for further development, as well as to creating a destination brand.

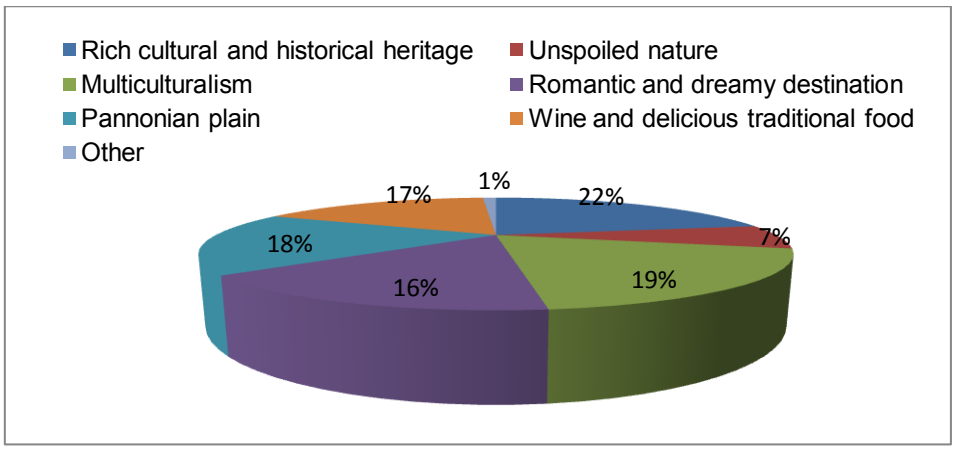

Figure 3. Main advantages of Vojvodina as a tourist region

As the result of pre-investigation, Vojvodina was described as quiet and peaceful oasis for relaxation, in the survey 88% of respondents agreed with the insignia of the region (the degree of agreement examined on a Likert five-point scale), which can be a basis for attracting tourists and creating a specific brand.

Based on the questions and answers above, the main features of Vojvodina are summarized, and they can be a starting point for building a destination brand: quiet and peaceful oasis for relaxation of mind, natural beauty of the Pannonian plain colored with fertile fields, rich culture and tradition, hospitality and kindness of Vojvodina, exceptionally delicious food and wine, homesteads and tamburitza players, as well as romantic and dreamy destinations.

Based on the survey results, by identifying core values and characteristics of the destination according to the public, Vojvodina can be positioned as a destination rich in natural beauty, as calm and quiet oasis for relaxation, with delicious food, wine and the sounds of tambourine, where with every aspect of offering there is a feeling of warmth and comfort, where the beauty and grandeur are inexhaustible.

Such positioning can include rational and emotional values, which are more expressed in this case, and it can be argued that they should lead in creating the tourism product of Vojvodina. Based on the above, Vojvodina occupies the position of a destination that promises all the benefits of rest, where every tourist can find a way and a place for enjoyment and fulfillment of expectations. In creating a destination brand strategy, it would still be necessary to explore the views and opinions of other stakeholders, and define common values on which a brand identity and further image of Vojvodina as a destination can be built.

Destination brand is a promise of an experience that potential tourists can expect from the destination. Brand positioning of Vojvodina should attract the interest and attention of potential tourists to come and visit it, stay in it and come back again.

5. CONCLUSION

Creating a successful destination brand is a complex process. Nowdays, it is no longer enough to offer basic features and attributes of a particular destination, such as geographical features, services, climate; it is necessary to create a unique and attractive offer, based on the unique characteristics and values that will attract tourists. The battle for tourists at a very competitive marketplace has become an emotional process, so the goal is to create a brand that will also affect the senses and emotions.

Destination branding is a major challenge and it requires a strategic approach in creating, positioning and maintaining brand. As one of the regions of Serbia that is rich in natural resources, culture and tradition, which respects traditional values that make its inhabitants so warm, hospitable and friendly, Vojvodina has the potential to become a preferred tourist destination. In this regard, it is necessary to precisely determine its characteristics and position it on realistic and impressive grounds, with a package of services that fully express the essence and brand promise. This paper identified the values and characteristics of Vojvodina as a tourism destination from the perspective of local population, and they can be used as one of the basis for creating a branding strategy for this destination.

REFERENCES

Anholt S. (2003), Brand new justice, the upside of global branding, Butterworth – Heinemann, Oxford, Burlington

Anholt, S. (2007), Competitive Identitiy: The New Brand Management for Nations, Cities and Regions, New York: Palgrave Macmillan

Balmer, J.M.T. (2001). Corporate identity, corporate branding and corporate marketing - Seeing through the fog. European Journal of Marketing, 35(3-4), 248-291.

Chernatony, L. (2010), From brand vision to brand evaluation: The strategic process of growing and strengthening brands, Elsevier, Butterworth Heinemann, Oxford, Burlington

Chevalier, M. & Mazzalovo G. (2004). Pro Logo – Brands as a factor of progress, Plagrave Macmillan, New York

Cicvarić, S. (2006), Brend – kreiranje, pozicioniranje i održavanje, Beograd: Zadužbina Andrejević

Echtner, C. M. & Ritchie J. R. B. (2003), The Meaning and Measurement of Destination Image, Journal of Tourism Studies, 14(1), 37-48.

Gabor, M.R., Conţiu, L:C. & Oltean, F. D. (2012), A Comparative Analysis Regarding European Tourism Competitiveness: Emerging Versus Developed Markets, Procedia Economics and Finance, 3, 361-366. doi.org/10.1016/S2212-5671(12)00165-7

Gallarza, M. G., Saura, I. G. & Garcia, H. C. (2002). Destination Image – Towards a Conceptual Framework, Annals of Tourism Research, 29(1), 56-78. doi.org/10.1016/S0160-7383(01)00031-7

Garcia, J.A., Gomez, M. & Molina, A. (2012). A destination-branding model: An empirical analysis based on stakeholders, Tourism Management, 33(3), 646-661. doi.org/10.1016/j.tourman.2011.07.006

Genov, G. (2013), Menadžment turističke destinacije, Beograd: Visoka turistička škola strukovnih studija

Kapferer, J. (1997), Strategic Brand Management, Great Britain: Kogan Page

Kerr, G. (2006), From destination brand to location brand, Journal of Brand management, 13(4/5), 276-283. doi:10.1057/palgrave.bm.2540271

Kotler, F. (1997). Upravljanje marketingom - analiza, planiranje, primjena i kontrola, MATE, Zagreb

Kotler, P. & Keller, K. L. (2006), Marketing menadžment, Beograd: Data status

Morgan, N., Pritchard, A. & Pride, R. (2011). Tourism places, brands, and reputation management, Destination Brands, 3-19. org/10.1016/B978-0-08-096930-5.10001-1

Park, S. & Petrick, J.F. (2006). Destinations' Perspectives of Branding, Annals of Tourism Research, 33(1), 262-265. doi.org/10.1016/j.annals.2005.10.007

Pike, S. (2009). Destination brand positions of a competitive set of near-home destinations, Tourism Management, 30(6), 857-866. doi.org/10.1016/j.tourman.2008.12.007

Reich, A. Z. (1999), Positioning of tourist destinations, Champaiqn: Sagamore Publishing

Republic of Serbia, Autonomous Province of Vojvodina, Provincial Secretariat for Economy (2009), Marketing Strategija Turizma Vojvodine, available at http://www.spriv.vojvodina.gov.rs/spriv_files_for_download/MSTV-revizija.pdf

Veljković, S. (2010), Brend menadžment u savremenim tržišnim uslovima, Beograd: Centar za izdavačku delatnost Ekonomskog fakulteta

THE EFFECTIVENESS OF MEDIA CAMPAIGNS IN COMMUNICATION WITH CHILDREN

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Abstract: *The main subject of this research were particularities of media campaigns that are designed to draw attention of children, as targeted audience, to services and products. The analysis refers to TV advertisements and examples of product ads in magazines on territory of the Republic of Serbia, which point out the main characteristics, types of message placement, and media vehicles and communication tools used in media campaign. In the research results discussion, the authors explain the managerial implications based on the research, and give directions enhancing the quality of planning and realization of media campaigns directed to children, having their better efficiency and effectiveness as a goal.*

Keywords*: marketing, media campaign, media, children, advertising*

1. INTRODUCTION

Nowadays, when the combination of modern ideas with creativity and consistency represent a prerequisite, a great deal of effort is necessary for companies and advertisers in general, to betake the market. According to Perić (2010, p. 8) the goals of media campaigns have to be conceived in accordance with the goals of customers, taking into consideration all relevant market opportunities, consumers' characteristics, their habits, as well as the primary media they are using.

Market opportunities are constantly changing, therefore, it is not sufficient anymore for a product to be in the center of attention, to be made out of the best ingredients, to be placed originally; making the field of the research itself, in the concept of modern marketing, shift towards building-up a relationship with targeted groups, indicated Filipović and Kostić-Stanković (2011, p. 94). Consequently, during a media campaign analysis targeted for children in this research, it has been noted that they are the result of combining, applying and placing special emotional aspects. The proposals, according to this study, have been organized in a way to present a planned combination in choice of media, key messages, design and presentation of ads and advertising spots.

From the communicational perspective, the goal of promotion is stimulating sales and growth of profit. Moreover, it could be redirected to creation of consciousness about the brand, encouragement of product testing, as well as placement of a product in consumers' consciousness. It can also be used for correcting wrong pictures about a product or service, as well as for reminding the consumer about the product or a special offer (Jobber and Fahy, 2006, p.237). Considering the importance and impact that media campaigns potentially have, it is important to choose adequate tactics and instruments for addressing children as targeted audience. It has been concluded in this research that it is necessary to adjust techniques and the language that is used, so that the message is clear and unambiguous, being in accordance with ethical and legal standards.

Two basic aspects of media communication are advertising and publicity. That implies the knowledge of media editing policy, the method of content production, as well as all relevant quantitative data on viewership, listenership, and readership. In order to organize a good and successful media campaign, it is also essential to understand the current media scene, its atmosphere, and the position of the primary targeted audience, and their affinities. Mainly, the goal of a media campaign is the creation of desirable media identity and organizational image, that becomes an integral part of corporate identity, and image; on long-term basis, it can be of major importance in creation and maintenance of a company's reputation (Vlastelica, 2007, p.9).

Due to a limited research and information in regards to specifications, manner of planning, and placement of media campaigns targeted to children, the authors have decided to investigate this topic and define managerial implications for improving the quality of planning of media campaigns directed to children, having their better efficiency as a goal.

2. CHILDREN AS CUSTOMERS

To understand better the behavior of children, and their contribution on the process of purchase, it is necessary to examine the determiners of their environment that influence them at a great extent. The family is the primary, relevant, and referential group that has the highest influence on an individual in consumption. The reason for that lies in the fact that the relationship between family members is much closer than in any other social group. It is only the household that is based on a set of people that form a life unit, and have socio-economic group features (Maričić, 2010, p. 219).

According to Filipović (2011) "Children are not the miniature versions of grownup people, as many companies would think when approaching them, they actually represent a very specific segment of customers. Nowadays, it has been established that children are different from grownups in the psychological profile, the manner of creating social ties, and overall perspective of the surroundings in which they are growing up. Most importantly, they possess significantly bigger amounts, and they are free to use that money independently".

One of the most common ways of defining a child is the United Nations definition, and it is read: "Thanks to the Convention, it became very simple to define a child, which is a human being under 18 years of age, unless the law of his or her country deems him or her to be an adult at an earlier age, which is rare" (Zakon o ratifikaciji konvencije Ujedinjenih Nacija o pravima deteta).

Research has shown that children, younger than 8 years of age, according to their cognitive and psychological characteristics are incapable of defending themselves from advertisers' influence. Thereby, that implies that they are not able to recognize that the goal of somebody's addressing is sales, and they accept the information that is placed through advertising to be accurate without any further pragmatic analysis. Western European countries such as Sweden and Norway forbid all advertising directed to children younger than 12 years, Greece has forbid toy advertising after 10.00 p.m., and Denmark and Belgium have made some general restrictions and bans in advertising for children (American Academy of Pediatrics, 2006).

Parents and extended family members are training children to become consumers, communicating their own experience and knowledge on products, services, shopping facilities, concept and importance of company or brand image, pointing out the price- quality relation. Social interaction in which children are familiarized with the information about a product is done through the Internet, as well as at public places (Maričič, 2010, p. 308).

Children learn how to become consumers throughout the next five following phases (Maričić, 2010, p. 309):

- observing
- demand placing
- choosing
- doing smaller (ancillary) shopping
- and independent shopping.

Beside the consumer characteristics, in this research, it has also been taken into consideration how much time children spend in consumption of media, including all ethical and legal standards that need to be consulted and respected during a production of a media campaign for children.

Act on advertising contains a range of regulations that are protecting the rights of minors during advertising (Unicef, 2011). The Act provides certain norms that do not directly apply to children, but contain norms that are of great importance in protecting minors, such as: norms on freedom of advertising, norms on verity, completeness, and singularity of a message, norms on advertising messages, norms against discrimination, and hurting moral values etc. The message must not contain elements that openly support violence or unjustified fear or addressing minors, economically and

generally dependent persons, in a dominant way. When talking about bans on influencing minor persons, according to Article 48, Act on Advertising, the use of personal property of public persons, musicians, actors, TV speakers, and others) must not be exploited in product advertising for minors. (Unicef, 2011).

Along these Acts, the following Acts are also represented that contain regulations that contribute children, as targeted group, and they are listed as Act on radio and television broadcasting, Electronic Communications Privacy Act, The Public Information Act, Law on Free Access to Information of Public Importance, Data Secrecy Law, and Personal Data Protection Act.

3. RESEARCH METHODOLOGY

The methodology that was used to identify and analyze the particularities in certain advertising campaigns was the cross case study analysis. It represents an analysis and presentation of relative cause, which is based on deduction and combination of sets of data in order to get the same conclusions (Eisenhardt, 1989). For the purpose of this research, seven TV commercial were reviewed. All spots are taken from the video-sharing website YouTube. Advertising spots are from the food product domain, and are related to products that are aimed to children in shape and manner of promotion. The products are the following: "Juhu" chocolate bars, "Barni" biscuit, Grated Plazma biscuit, "Cipiripi" cream, "Smoki smokić" flips snack , "Cokić na eksić" beverage. The October editions from 2013 of "Bravo", "Hey", and "Mali zabavnik" were the subject of analysis. The analysis covered 20 newspaper-advertising pages and 8 advertorials. According to Vlastelica (Vlastelica, 2007, p. 89), advertorial is a paid text in a magazine or daily paper in a form of a newspaper article or some other editorial.

During the analysis of TV advertisements, four criteria were taken into consideration and based on them their behavior and use of certain instrument in a product presentation was monitored. Those are the following criteria: The usage of animated characters, the usage of music, the usage of family patterns, and the usage as part of social environment. Every abovementioned criteria can be seen in the Table 1, including their presence in TV advertisements.

Table 1: The criteria for analyzing television ads

	"Chipita Fineti"-sticks and dips	"Cokić na eksić"-beverage	"Mlevena Plazma"-ground biscuit	"Barni"-biscuit	"Cipiripi"-cream	"Juhu"-chocolate bar	"Smoki smokić"-flips snack
Usage of animated characters	No	Yes	No	Yes	Yes	Yes	Yes
Usage of music	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Usage of family patterns	Yes	No	Yes	yes	Yes	Yes	No
Usage of children as part of social environment	Yes	No	No	Yes	No	No	Yes

In the following graph, we can see the relation between advertorials and magazine advertising pages. Apart from that, it was also observed if the magazine contained a certain extra supplement, what is the size of the advertisement, as well as what were the advertised products and brands.

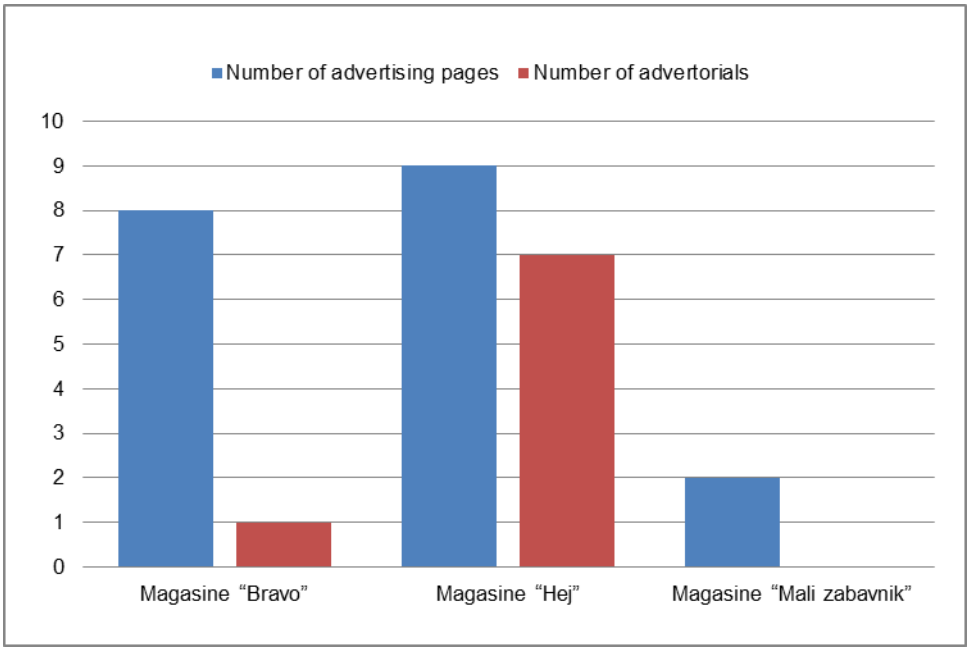

Figure 1: Relationship between number of advertising pages and advertorials

4. RESEARCH RESULTS

Using analysis and research, we can conclude that all advertisement spots last for 30 seconds in average. Looking the manner and details in choice of presentation and formulation of TV ads, and ads in children's magazines, it could be noted that the preparation was detailed and in accordance with targeted audience addressed by the advertiser or company. The ad space in the magazines was designed to make the ads notable, with adequate choice of design. The ads were usually printed on an A4 advertising space in order to present the information clearly. The ads printed on one-half of the pages were mostly brief, with too much text presenting the wrong picture of a product or service that was advertised. Every media campaign in Serbian language that went under this research had a good musical background, tune, and an adequate choice of words addressing the audience. It has been noted that if the TV advertisement is in a foreign language, the words are not pronounced properly, and the text itself is difficult to be understood

Animated characters are used in almost every TV advertisement covered in this research. If the companies decided to implement this way of advertising, they usually used an animated animal character that had some good characteristics that are related to the product that was advertised. It has also been concluded in this research that a great deal of visualized effects were used describing the ingredients of the advertised products. In addition to that, the printed editions contained photographs of a mascot in its promotional surroundings that overlaps with the promotional message that needs to be presented to targeted audience. Within the ad space in printed media, photographs of mascots and celebrity endorsers were used. These photographs remind the audience of colors of the brand, animated character, the distinctive appearance of the product. Using analysis, it has been concluded that the children are told which product they should use during their everyday activities, and if the product is to be their choice, unreal benefits of the product are represented. In advertising spots, the process of fantasizing about some certain abilities and physical manifestations after the use of a product or service is not separated clearly from the part where the product is being presented. It can also be seen that in printed media the ad spaces advertise certain services that suggest an unreal image after their use.

The use of advertorials is present in large amount in researched magazines and ads. Advertorials, in certain editions, became a basic component of magazines, such as redacted columns. Products in form of Gifts are popular, and they are pointed out in advertisements.

It has been concluded in the research that the advertisers usually use the traditional forms of the Internet activity and social media. It is shown in the next Table which of the advertisers has a

corporate website, product website, Facebook page for their product, and Twitter or Instagram account.

Table 2: Online activities of advertisers

	"Chipita Fineti"- sticks and dips	"Cokić na eksić"- beverage	"Mleveni plazma"- ground biscuit	"Barni"- biscuit	"Cipiripi"- cream	"Juhu"- chocolate bar	"Smoki smokić"- flips snack
Corporate web site	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product web page	No	No	Yes	No	No	No	Yes
Facebook page	No	No	Yes	Yes	Yes	Yes	No
Twitter	No	No	No	No	No	No	No
Instagram	No	No	No	No	No	No	No

5. DISCUSSION

Considering the fact that the advertiser and the company address a specific targeted audience, an adequate approach has to be made. In that way, all advertising spots last in average up to 30 seconds, which is short enough to keep the viewers focused, and to be efficient since it is enriched with varied contents. On the other hand, it is long enough to present the necessary segments and advantages of a product.

Certainly, an adequate research of media characteristics has to be made in order to have the realization of a campaign within the right media that will have an adequate influence on the targeted audience. Therefore, the planned budget and costs for a certain media campaign will be covered having realistic results. The size of an advertisement in printed media is also one of the factors that need to be taken into consideration. Big, simple ads, with clear photographs are clearly transmitting the advertiser's intended message.

TV advertisement that had a good musical background, tune, and an adequate choice of words, represented the product in a more explicit and proper way. Though some information indicated that, some tunes where described as irritating among the consumers, at the same time they were the trademark of a certain product. The amount of presented characteristics of a product is less notable if presenting a simple dialogue between the actors within TV advertisements, including simple music in the background. When the children are suggested a product within a tune, that has some stylistic components such as rhymes and jokes, they will acquire the message more easily, and be informed in a way that is familiar to them. In the process of placement and organization of an advertising spot, it is recommended that the music follow the characteristics of the product and its purpose. By using a control test group, it could be determined if the tune is catchy, pleasant, and if the text is notable. The tune is of essential importance, but the text has to be adjusted. Since the children at that age are still not completely familiar with other languages, a Serbian language form of a text is suggested. Apart from that, the voice in the advertisement should be adjusted with the character pronouncing it; the language should be simple and clear.

All the media campaigns that fell under the research had a celebrity endorser or a mascot for every product. The latest products, or products that are to be placed on the market, should connect main attributes and key messages to a certain designed mascot or character if there is not an animated character or a real presentation of a mascot, the visualization of the product character is harder, including its association with a certain company. Product branding and its placement on the market are certainly eased if there is an adequate character designed for the product. The option of combining photographs, sound, and movements on the TV gives the anticipated results with an occasional appearance of the product character. It has been noted that he photograph of a mascot within printed media, evokes same associations with the same product as in TV commercials. Hence, a photograph of a character is suggested, which would enable its connection to the product, as well as to the advertiser.

Visualization and conjuring the taste throughout real pictures of ingredients are a better choice than animation of main ingredients. The analysis of spots advertising sweets, which are pointing out the appearance of ingredients of products to targeted audience, gives a better insight of a product itself. Based on the research results, a presence of a photograph within a TV advertisement is suggested along with the ad space in printed media. The analyzed media campaigns for children have not shown a notable list of ingredients, or certain components, which raise questions on everyday basis (i.e. suggested daily sugar intake). Children as targeted audience will not understand the importance of the abovementioned characteristics, but the financially solvent family members will, even within a smallest research or having the smallest interest in the product, more easily decided to buy that product.

Apart from previously provided parts of the research of advertisement campaigns, it has also been noted that special attention was paid to some special gifts that are granted with the original product. It has been noted that the ad campaign for chocolate bar "Juhu" designed a package that has free scrapbook pictures. The child sees it as a way of amusement and granting beside the basic product, enabling an extra activity for him or her. Emphasizing the importance of the present within a product in media campaign, a positive reaction is evoked. That data can be clearly presented in all types of media advertisements, and upon presenting the extras and presents, it is necessary to introduce their diversity and ways of getting a hold of them. It is also important to put the appearance and the purpose of presents into a media campaign, making the targeted audience better understand why the product is targeted to them. Innovations that could be presented at the market are the new kind of products that is offered within the packing Therefore, apart from the usual scrapbook pictures and rubbers, those products could also be designed for males or females, in forms of hair bands, simple makeup, or key ring flashlights. In addition to that, a groundbreaking move would be making of an exclusive partnership with some of the grand chains of toy stores, or with popular heroes from certain companies where small figurines are distributed with the product. That would enable a possibility to make a new TV advertisement which could be posted as an advertisement in the newspapers, representing a new partnership.

While doing the analysis, it was noted that apart from the animated characters, the context of the ad is very often put in a realistic time, situations and children's activities. That is why the children become far more happy and capable after the use of the product. The use of certain products and services that contribute physical and psychological advance is often suggested in TV and newspaper ads. This trend of showing realistic situations should be continued in future media campaigns, but overemphasizing and delusion making in what are the effects after using a product should be avoided.

In the retrospect of the use of advertorials in printed media, that were the subject of this analysis, it can be noted that the texts are related to the use of some cosmetic products and consumption of food products. This mode of disguised advertising, that suggest the use of products, is not in accordance with ethical standards, and could jeopardize the company image, once recognized by the consumer.

In addition, an essential part of good media campaign is an active and adequate communication with the targeted audience on social media and on the Internet in general. The shortage of an official web page, as well as a well-organized corporate review of information regarding the product, creates the impression of inadequate care of the company for consumers, and a bad image that is being built. In addition, use of new social media is necessary to keep communication with target groups in pace with modern times. Certain products, that were a subject of this research, were largely criticized on blogs and forums. Given the fact that the Company feedback was missed out, the criticism continued spreading towards social networks. By following announcements and being present in online community, the Producer gained bad publicity. The advantage in following some relevant blogs is multiple, since we can get information on companies, services and products, and in that way, we can be prepared on time for potential crisis. It has also been determined that if a product possesses its own website, its information is more complete, the product seems to be more serious, and it is more accentuated on the market. Interactive websites and Facebook pages where the children are offered special activities, such as games and different creative contests are proven to be very dominant. Based on the research, if the information on a product is strictly within a domain of the corporate website, it is desirable to have a specially determined and technically presented part within the website, so that the user does not spend too much time on finding the right information.

6. CONCLUSION

Children as consumers are being noticed at a greater extent by marketing experts and media planers. Nowadays, it is not questioned if children have influence on the process of buying, but how big that influence is, and how it changes during the time. Along with the process of socialization, they also notice a great amount of products, which have been surrounding them in the everyday communication. Family, as a primary social group, builds certain consumer habits toward the youngest family members. Children under the age of eight are not aware of the nature of certain advertising messages, and are not able to protect themselves from their influence. They notice that there are products, which are placed through various media, on every-day basis.

The aim of this paper was to give an insight into media advertising towards children in Serbia, which covered a certain number of television spots and advertisements, by researching specific media campaigns for children in general. Research was done using seven television spots, and three editions of children's' magazines where 20 pages of advertisement and 8 advertorials were observed and processed. Research included activities on social media, on the Internet in general. Television spots were observed using four types of criteria and those were Usage of animated characters, usage of family motives, usage of motives of children in social environment and usage of music as a factor.

The study concluded that media campaigns aimed at children generally use certain mascot or trademark personality of the product. In addition, music and tone of voice are important factors that affect the level of understanding and interest in the promotional message. TV spots last for thirty seconds, and the most common format of advertising in printed media is one full page. It was concluded that spots mainly present ingredients that are consisted in the advertised product. The analysis shows that the use of the product is associated with real situation and activities of the children, and it often suggests unrealistic benefits of consuming the product. The use of advertorials is very pronounced in certain editions of the magazine. The study also concluded that advertisers generally use traditional forms of the Internet activities and social media. In order to increase efficiency and effectiveness, in the implementation of activities targeted at the youngest audience, it is necessary to further research the topic and area of advertising and specificity of media campaigns for children.

REFERENCES

American Academy of Pediatrics. (2006). Children, Adolescents, and Advertising. Pediatrics, 118(6), 2563 -2569. doi: 10.1542/peds.2006-2698.

Maričić, B. (2010). Ponašanje potrošača. Beograd: Ekonomski fakultet

Filipović, V., & Kostić–Stanković, M. (2012). Marketing menadžment. Beograd: FON

Filipović, J. (2011). Deca potrošači. Retrieved from http://edukacija.ekof.bg.ac.rs/tema-meseca.php?temaId=9

Jobber, D., & Fahy, J. (2006). Osnovi marketinga. Beograd: Datastatus

Eisenhardt, K. M. (1989). Building theories from case study research. Academy of Management Review, 14(4), 532-550. doi: 10.5465/AMR.1989.4308385.

Perić, N. (2008). Planiranje medija i medijskih kampanja. Beograd: Čigoja štampa

Vlastelica, T. (2007). Medijska kampanja - Publicitet i oglašavanje. Beograd: Zadužbina Andrejević

Unicef. (2011). Analiza zakonodavstva Republike Srbije s aspekta prava deteta. Retrieved from Unicef: http://www.unicef.org/serbia/Analiza_zakonodavstva_RS_9.2.11%281%29.pdf

Zakon o ratifikaciji konvencije ujedinjenih nacija o pravima deteta. (n.d.). Retrieved from: http://www.paragraf.rs/propisi/zakon_o_ratifikaciji_konvencije_ujedinjenih_nacija_o_pravima_deteta.html

CHALLENGES AND OPPORTUNITIES OF INTERNET MARKETING IN SERBIA AND THE WORLD

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Abstract: *Contemporary information and communication technologies and the Internet have, to a great extent, altered the conventional manners of business and market appearance. A prerequisite for a successful business in a situation characterized by extremely strong competition and the need to, along with existing and potential consumers, build long term partnerships, implies finding new manners of appearance and communication with the consumers. Combining marketing knowledge and contemporary technologies is a recipe for achieving competitive advantages, creating an image and conquering consumers. Therefore, companies pay more and more attention to the introduction of internet marketing strategy that enables interactive communication with their consumers, 24 hours a day, 7 days a week. This paper shall attempt to highlight the significance of internet marketing to the companies that want to outperform their competition, expand their business beyond national borders and to establish continuous and interactive contact with the consumers. The aim of this paper is to point out the most important factors that contribute to the increasing use of internet marketing, challenges it still faces, as well as the situation in Serbia and the world when speaking of the use of this type of marketing.*

Keywords: *internet marketing, challenges, opportunities, Serbia*

1. INTRODUCTION

"If your business is not on the internet, then your business will be out of business." Bill Gates

Modern trends in almost all business segments, extremely rapid changes in the market and consumer preferences are getting more and more difficult to track. The development of technology and increasing use of the Internet have led to the need for quicker and more flexible appearance in the market, continuous monitoring of business and effects achieved, as well as fast response to potential problems. For this reason, marketing appearance in the Internet field has taken a special place in the business of a vast number of companies, as an effective means of achieving competitive advantage, interaction with consumers and building long term relationships with them.

An increasing number of individuals and households have access to the Internet, and the number of those who get informed about products and services via this medium or exchange opinions with other consumers via social networks, forums etc. grows daily. Today, companies have two choices, not to be present in the global network and be unaware of what consumers think of them and their products, or to take advantage of all the benefits offered by the Internet as a medium, and to always be informed regarding the attitudes and opinions of consumers, changes in their preferences, activities undertaken by competition etc.

Therefore, the majority of marketing communication in contemporary business environment consists of a bidirectional communication between the company and consumers. That said, internet marketing has opened up space for practical interactive marketing action, aimed at consumers not as a group of similar individuals, but a consumer as an individual. In addition, the intrinsic characteristics of marketing concept or key principles of marketing remain the same in this case: to create value for consumers, achieve competitive or special advantage and direct and focus aims, resources and efforts of the company to achieve the highest possible degree of customer satisfaction and their loyalty. Specificity or a new qualitative factor that has primarily been introduced to the marketing context by internet marketing is interactivity – direct or immediate with consumers and potential consumers.

Modern trends point out a remarkable growth and expansion of activities based on the use of possibilities and potentials of Internet marketing throughout the world. Today, this type of marketing is highly ranked as means of communication of companies with various profiles that have on that basis already built or wish to set up their future business orientation.

2. INTERNET MARKETING – CHALLENGES AND OPPORTUNITIES

In the last 15 years, Internet has become one of the most significant media of communication of companies with consumers. Moreover, the Internet has become a business tool, instrument of socialization, excellent place for entertainment, limitless encyclopedia and database… At the same time, Internet marketing is one of the most important phenomena in marketing theory and practice, thanks to which companies have access to consumers throughout the world and appear in the global market. David Siegel says: Internet marketing is not about building a web site, but building a web business... harmonising the power of customers (Chaffey and Smith, 2013).

Within its actions, Internet marketing uses Internet space to expand traditional marketing. That said, Internet marketing has many similarities with classic (traditional) marketing. Its aims, as well as aims of traditional marketing are to build relationships with consumers, so that the companies, through offering superior products and services, as well as through continuous communication with consumers, could gain maximum yield. In accordance to the said, it must be creative, interesting and constantly subject to change. What guarantees the success of Internet marketing is, on the one hand, a good product and attractive website, and on the other hand the attention of selected target consumers. The following four pillars of Internet marketing provide the aforementioned to the companies (McAllister, 2013):

- ***Relationships*** - Companies want their customers to buy from you, but customers want to know that they are buying the right thing from the right companie and that after they've bought it they'll continue receiving the right support. Companies can not simply tell them that they're doing the right thing (although this actual statement does help). Companies have to convince them that they interested in THEM, not just their money, and that they interested for the LONG term. The fact is, it is easier to get a group of customers with whom they developed relationships with to purchase from companie again than it is to find and develop new customers. So companies must treat their customers right, as a friends, and help them to find the real answers to the problems they bring the companie, and it will help their business soar.
- ***Tips of the Trade*** – Companies must develop their skills at advertising and internet marketing. They need to invest in a high-quality program that is developed by the true gurus - the people who: 1) know how to succeed in the internet marketing business, 2) know how to teach others how to succeed in the internet marketing business, and 3) are going to be there supporting you as you take the steps necessary succeed in internet marketing.
- ***Value Marketing*** - Many internet marketers make the mistake of pushing their products to the point of forgetting Pillar 1 of Internet Marketing. People want to have a relationship with companies. They want to purchase their product, but they want to know that company have their best interests at heart. And they dont want to be sold to. So, instead of pushing something at them, even if it is the best product ever created, create an attraction for them by building company's credibility. The company must show them that she is a leader in the industry by providing them with value.
- ***Have a HIGH Quality Product*** - In this technological day, customers are being bombarded with sales offers, and it is often difficult to decide which item is the best one. People are willing to spend money, and they are willing to pay the price for something they find valuable, but it is got to be worth the price (even if the price is giving their attention). And since the companies are attempting to develop relationships with customers, and experiences with these customers that will cause them to provide company with good word of mouth, they should make sure that their product's quality towers above its cost.

The implementation of Internet marketing campaigns increases the efficiency of the entire marketing communication, which is achieved by creating a communication strategy aimed at creating relationships and mutual values among the company and its consumers. Internet marketing can help create a business where the customer participates – through a constant dialogue, expressing interests, requesting products and services, suggesting improvements, giving feedback and where ultimately, the customers drives the business.

2.1 Opportunities and incentives of internet marketing

Growth and development of global economy, i.e. the elimination of importance of geographical borders thanks to the development of information technology, including electronic commerce, have provided incentives for the increasing use of Internet marketing by companies around the world. New information technology that involves the use of Internet as a medium has an extremely strong impact on the development of this type of marketing. First, the Internet as a communication medium contributes to the expansion of the marketing communication field, in terms of the number of people involved. Second, the Internet allows the increase of diversity of marketing communication by combining text, video and audio components. Also, the availability of a large number of contents, outreach to a wide range of consumers and the ability of interactive control of experience make the Web one of the richest media today. Third, the

Internet has significantly expanded the intensity of information regarding the market by supplying the marketers (and consumers) with detailed, real-time information about consumers and their transactions in the market (Laudon and Traver, 2009).

The Internet and Web have revolutionized the conventional business models and greatly contributed to the appearance of new ones. The use of Internet is expanding in all sectors of the economy, which allows companies to provide a personalized experience to the consumers through adapting websites to individual preferences and allowing bypassing those contents that are irrelevant to them. This is achieved by monitoring consumer movement on the Internet and combining such information with those obtained from the consumers themselves, including, among other things, payment information, interests, hobbies and the like. Personalization greatly simplifies and makes Internet surfing and finding desired contents more comfortable.

Although today a large portion of promotional campaigns still takes place through traditional marketing media such as television, newspapers, magazines etc., the Internet is playing an increasingly important role in the positioning and continuous strengthening of brands. Personalization technology may help companies to understand the needs of their consumers and direct their marketing campaigns towards precisely defined market segments, thus achieving high response rates. The Internet, as a new medium, enables the broadcasting and publishing messages in the form of bidirectional communication, where direct communication between individuals and organizations occurs thanks to interactivity, independently of space and time. Thanks to the Web, the network is practically unlimited, so there is a possibility of constant presence and establishing contacts with potential customers throughout the world. Thus, the World Wide Web has provided marketing with new tools and benefits that may increase the success of marketing efforts, so it is rightfully considered one of the most important stimulating factors of Internet marketing.

In the mid nineties of the twentieth century, in developed countries, the concept of electronic commerce based on EDI technology started its establishment. Large and costly experiments lead to a combination of electronics and communication with traditional commercial activity. E-business greatly improves Internet marketing and represents an important factor of strengthening companies' competitiveness. Thanks to e-business, the performance of business operations through electronic technology based on interactivity has been enabled. Through horizontal and vertical integration, Web sellers will develop direct e-mail marketing while ensuring consumer protection in the processes of sending and receiving e-mail.The following table shows the impact of e-business technology on internet marketing.

Table 1: Influence of e-business technology on Internet marketing (Laudon & Traver, 2009)

E – COMMERCE TEHNOLOGY DIMENSION	SIGNIFICANCE FOR INTERNET MARKETING
UBIQUITY	Expanding the impact of marketing communications at home, work, etc.; losing significance of geographical boundaries for marketing. Classic market is replaced by virtual, and temporal and geographic boundaries are removed. Consumer benefits are improved and purchase costs are reduced.
GLOBAL REACH	Providing services and marketing communications with consumers around the world. Promotional messages can reach out to a vast number of consumers, regardless of geographical location.
UNIVERSAL STANDARDS	Costs of sending messages through internet marketing, as well as receiving feedback from consumers are greatly reduced due to common, global standards on the Internet.
INTERACTIVITY	Consumers may be involved in dialogue, establishment of communication contents and structure of information, as well as customizing products and services to their own needs and requirements. In this way the provision of individual offers for each consumer is made possible.
INFORMATION DENSITY	Possibility to collect and analyze individual, very detailed information about individual customers. Data mining Internet technology allows everyday analysis of large amounts of data about consumers in order to design adequate marketing campaigns.
PERSONALIZATION/ CUSTOMIZATION	Ability to adapt products, services, and promotional and other messages to individual consumers. In this way long-term relationships with customers are established, as well as ensuring their loyalty and strengthening the ability of marketers to create a brand.

Pursuant to the data from the table, it can be concluded that intensive and continuous changes in information technology open the door to internet marketing and represent an opportunity for its affirmation and increasing use by companies. At the same time, they lead to improvement and increase in the efficiency of internet marketing, as well as to certain alterations and transformations within organizations. This primarily refers to acceptance of new technologies with new products, services and processes by the organizations, or the formation of a virtual organization that in the future shall be one of the most significant organizational forms of business.

In addition to the Web and e-commerce as new technologies, one of the important opportunities for the increase in share of internet marketing are the changes taking place among consumers. Namely, the specificity of contemporary consumers is sophistication that is manifested in the possession of more initiative in making a choice what and how to buy. Prior to the decision on purchase, consumers seek for a large number of information provided by the Internet, i.e. the World Wide Web. Consumers search through offers and information that are available to them, evaluate the offers, consult and exchange experiences with other consumers and users, and make their decision in such a way that they themselves design (create) "their own" product. In such way, companies are trying to adapt to individual customers by providing them with personalized content. Personalization and mass customization can be used in order to deliver individualized content to individuals or groups through websites or e-mails, and to remind the consumers of a product or service offered by the companies.

Personalization can be used in order to offer innovative services to the customers. Online bookseller BOL (www.bol.com) allows consumers to choose their favorite parts from different types of tourist guides, for example, historical facts from one (Rough Guides), maps from another (Lonely Planet), but also include information about nightclubs and restaurants. Such personalized book can be printed at consumer request. Also, personalized services are provided by portals such as iGoogle, Yahoo and Excite (Chaffey, 2011). They provide an opportunity to the consumers to create their own home pages in order to deliver information they are interested in, such as weather data, interesting facts in fashion, film, technology areas etc.

Thus, under the influence of new technology there is a change in relations with customers that operates on an interactive basis, in order to create a more flexible, responsive and long term relationship with target market segments. Personalization and mass customization allow manufacturers to, taking into account every customer, create products in accordance with their needs. In order for the companies to carry out mass customization in the best way possible, today they use integrated Internet, internet and extranet in order to implement various marketing activities.

2.2 Challenges and limitations of internet marketing

Although the development of new technologies, manners of communication and changes in the needs and desires of consumers opens up numerous opportunities for advancement and growing presence of internet marketing in the strategy of company market appearance, there are also many difficulties and challenges that lead to limitations in its wider use.

The most significant of these challenges is related to the use of Internet as a medium in establishing contact with consumers. Internet access is one of the limiting factors, but there are also certain consumption related barriers that may occur with consumers that have access. In fact, a large percentage of current non-users of the Internet (51%) said that they will never connect to this network (Chaffey, 2011). Most people accept innovations with a certain amount of distrust and disinterest. Identical situation is with contemporary information technology and use of the Internet as a medium in marketing communication. Internet as a brand new form of communication was initially accepted by only a narrow circle of people – innovators, primarily scientists, military personnel and university professors. Over time, more and more people started using the Internet and the benefits it provides (Stankić & Krsmanović, 2007). However, it will take many years for the Internet and Internet business to be accepted and implemented in all parts of the world.

Technical challenges of Internet marketing encompass a large number of factors, whose influence shall, due to the continuous development of new technology and finding solutions to current problems, be largely reduced and the impact of some shall be eliminated completely. This type of limitation includes the following categories (Turban, King, Lee, Liang & Turban, 2010):

- lack of security, reliability, standards and some communication protocols;
- narrowness of the field of communication;
- software development tools are still evolving and changing radically;
- it is difficult to integrate the Internet and e-commerce software with certain existing applications and databases;

- customers have a need for special Web servers, network servers and other infrastructure;
- some e-commerce software does not necessarily have to be in accordance with some hardware or may be incompatible with some operating systems and other components.

As for non-technical challenges that Internet marketing has been facing, they cover a range of factors, from legal and ethical issues related to internet marketing, through high costs and other limiting factors. The most significant non-technical challenges are:[1]

- **Effects and impacts of Internet marketing are not yet fully studied and documented.**
  The Internet marketing environment is a rapidly changing field and up to now only speculations concerning its success have been made. There have been successful examples but it is only now that we are entering the maturity stage and realizing its implications. A lot of organisations are waiting for the situation to stabilize before engaging in Internet matketing activities.
- **Several unresolved legal and regulatory issues exist.**
  International and national laws are slowly adjusting to the changes caused by the appearance of this new kind of online activities. Issues like taxation, ownership and ethics on the net need to be addressed.
- **Privacy issues have arisen.**
  Many people are willing to offer some of their personal data in order to have more personalized services. Still, with all the modern technologies and software applications on the one side, and the lack of technical expertise and awareness on the other side, the thin line of privacy may be crossed.
- **People resist to change and are not used to faceless / paperless / non-physical transactions.**
  Most consumers are used to conducting "look and feel" transactions. They are used to touching and examining the product they want to buy. Also the face-to-face contact is very important in business deals and transactions since it is related to trust. But in the new environment of faceless transactions, the concept of trust has to be reconsidered.
- **People feel that there is a lot of exaggeration and are cautious.**
  People feel that there is a lot of enthusiasm but there is undocumented evidence and lack of real and concrete results.
- **People are concerned about possible breakdown in human relationships.**
  People feel that transactions are de-humanized and that personal, social contacts will be reduced.
- **Many business face cultural obstacles and linguistic challenges**
- **Limitatons of support services**
  This limitation implies financial costs and sourcing tech support in foreign languages.
- **Costs and justification**
  Development costs can be extremely high, and errors due to inexperience can result in delays. In addition, it is important that system confirmation is performed with some intangible benefits that are difficult to quantify.
- **Lack of online touch and feeling**
  Potential customers are unable to see and feel the product before the purchasing act, and many of them want to know exactly what they are buying.

An important limiting factor of internet marketing is the possibility of causing negative impact on the company image, especially at a time when consumers are exposed to its impact on a daily basis. Many internet marketing activities are considered intrusive and irritating and consumers perceive them as an invasion of privacy. Unwanted electronic mail (junk mail), a growing number of promotional messages, poor targeting and the like lead to negative consumer reactions and represent a limiting factor in the success of internet marketing. On the other hand, internet marketing can be quite expensive for communicators, since the costs of acquiring consumers are high.

Certainly, plenty of time shall pass until the solutions to the challenges faced by internet marketing are found, but as the understanding of new technology and experience in its use improve, there shall be an increase in the number of internet marketing users and a higher degree of its acceptance in communication with consumers. Until then, numerous legal and ethical issues, such as the issues of privacy, intellectual property protection, freedom of speech on the Internet, as well as protection of customers and sellers from fraud and deception, shall be relevant and encourage finding modern solutions.

[1] Some of the points in the above list are adapted from: Paradkar S. (2014)., eCommerce in the Customer Empowerment Era; Schneider G. (2012)., Electronic Commerce, Turban E., King D., Lee J., Liang T.P., Turban D.C. (2010). Electronic Commerce 2010, A Managerial Perspective and http://saravanesh.files.wordpress.com/2009/06/lecture-02.pdf (May 2014)

3. INTERNET MARKETING IN SERBIA AND THE WORLD

In order to show how rapid is the growth of Internet economy, Boston Consulting Group (BCG) published in 2012 the results of a research according to which Internet business is playing an increasingly significant role in economic growth and that it shall in 2016, as anticipated, participate with 4,2 billion dollars in the gross domestic product (GDP) of the members of the Group of 20 most developed countries of the world (G-20) (http://wd.rs/novosti/internet-zarada-jaca-od-nemacke-ekonomije.html). It also showed that the Internet economy shall grow at a rate of eight percent per year in developed countries, and twice as more in the developing markets. The fastest growing sector is e-commerce, and it is estimated that online market shall double its value by 2018, given that consumers are increasingly demanding access to products and services 24 hours a day, 7 days a week, and the easiest way to do so is to perform operations online.

BCG researches state that the total Internet economy in the UK shall continue to increase over the next four years at a rate of 11 percent per year, reaching a total value of 221 billion pounds by 2016. This is compared to the expected growth rate of 5,4 percent in the USA and 6,9 percent in China. Such trend forecasts are particularly good news for small and medium companies, since the research has shown that in many countries, including France, Germany and China, small and medium companies that actively operate their business in the Internet, have obtained significantly higher sales growth, in comparison to companies that are not present enough on the Internet, and that in the past three years, their revenues increased by 12,5 percent each year. All of the above indicates that Internet marketing plays a very important role in achieving success in the contemporary, highly competitive market.

This is corroborated by the fact that the global network has become the second most important medium for advertisers for the first time, and digital promotion today covers 25,6% of the advertising market in Europe. Advertising on the internet rose last year by 11,5% in Europe and 17,29% in Serbia, as stated in the results of recently published research of the Interactive Advertising Bureau (IAB). Internet advertising revenues in the United States totaled $42.8 billion for the full year of 2013, with Q4 2013 accounting for approximately $12.1 billion and Q3 2013 accounting for approximately $10.6 billion. Revenues for the full year of 2013 increased 17% over 2012 (www.iab.net). The following figure shows the trend of growth in revenues from Internet advertising in the period between 1996 and 2013.

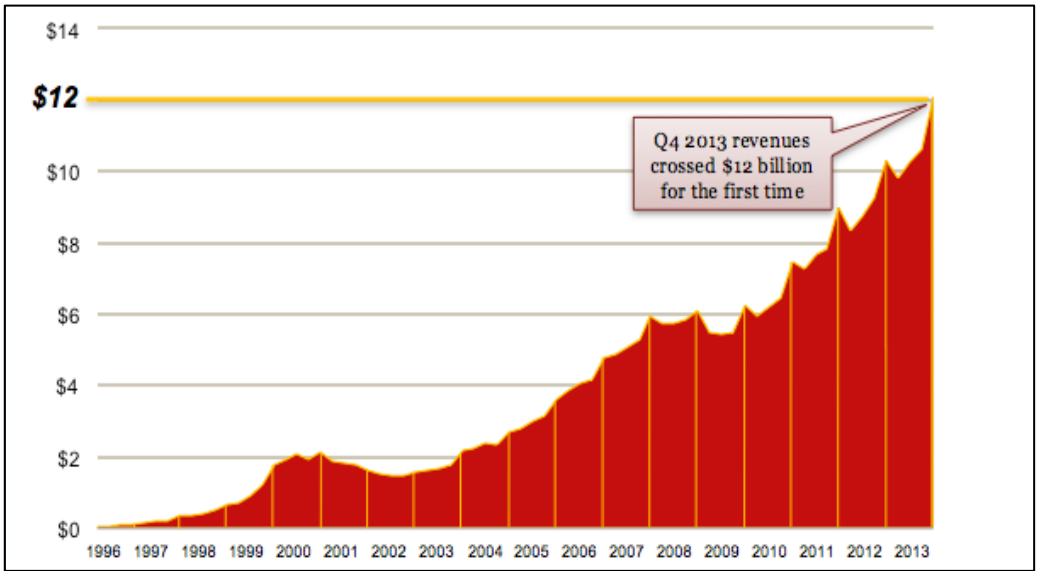

Figure 1: Revenue growth trends 1996 – 2013 ($ billions) (www.iab.net)

This growth is attributed to the increasing number of Internet users who order products and find information on various brands in the global network. This refers to advertising on websites, social networks (Facebook etc.), and search engines (Google, Yahoo) and include promotional messages on computers and mobile phones. Only in Europe there are 426,9 million users of the global network. In America, another enormous digital market, there are more and more members of the auditorium who watch films, series and TV shows on websites. Apart from the above, advertisers have noticed that an increasing number of readers read their papers in electronic format. Analysts have estimated that Internet marketing shall, from its current share of 18 percent in marketing industry, reach a share of 23,4 percent in 2015. According to recent estimates of the European Commission, this year's rise in revenues from advertisements in online and mobile sector shall be 1,9 percent in the UK and 1,2 percent in Germany. Eastern European countries have recorded even larger growth since this market has started to develop later in these countries.

What indicates the growing importance of Internet marketing is the research how the world's top 100 companies use the Internet for marketing purposes, and the results show the following (Miljković, Alčaković & Alčaković, 2011):

- 100% of companies has a website,
- 33% have a corporate blog,
- 54% have Facebook fan pages,
- 65% have Twitter accounts.

Companies that operate in Serbia also increasingly recognize the importance of Internet marketing and the advantages it brings in reaching out to existing and potential consumers. Online advertising market is increasing along with growing habits of domestic customers to order goods and pay bills on the global network, but also to "consult" websites and forums prior to purchasing. The value of the digital advertising market in Serbia last year amounted to 14,32 million Euros, with most advertisements relating to consumer goods (18%), mobile phones (16%) and IT industry (11%) (rs.ejo-online.eu). The following table shows what techniques of appearance on the Internet and Internet marketing tools are used by companies operating in the domestic market.

Table 3: Internet marketing of top 10 companies in Serbia in 2012

Rang	Kompanije	Web site	Blog	Facebook	Twitter
1.	NIS	√	x	√	√
2.	EPS	√	x	√	x
3.	Telekom Srbija	√	x	√	√
4.	Delhaize Srbija	√	x	√	√
5.	Srbijagas	√	x	x	x
6.	Tarkett	√	x	√	√
7.	Merkator - S	√	x	√	x
8.	Delta Holding	√	x	√	√
9.	Victoria Group	√	x	√	x
10.	Koncern Farmakom M.B.	√	x	x	x

√ - exists; x – does not exist

Regardless of the presence of the majority of domestic companies in the market, their management still does not observe seriously enough their appearance on the Internet. Although 95% of the companies have their own website, they sometimes are not updated and improved for a longer period of time, or they do not follow current trends. Also, in case of holding companies, a very common situation is that every subcompany does not have its own individual website, but that the main information of all subcompanies is on the main website of the holding company. On the other hand, none of the companies have a corporate blog. Some companies have a news category where they post information which fall into the category of PR announcements rather than a blog. Given the importance of blogs in the world of Internet, it is essential for companies to change this attitude (Miljković, Alčaković & Alčaković, 2011).

The fact is that Internet marketing in our country is becoming increasingly popular, whereas budgets dedicated for online promotion from one year to another have been growing, so that in the future we may expect a large number of creative solutions in this type of marketing. Also, most analysts predict further growth of online marketing industry, since millions of people around the globe conduct business via the Internet or spend their free time on it. Therefore, the use of Internet marketing is something that companies of all sizes need to recognize as an opportunity to conquer and to better understand their consumers, as well as to construct a distinctive competitive position in the market.

4. CONCLUSION

Internet marketing is an activity that is in growth phase and gains significance daily, especially due to its great impact on the creation and maintenance of partnerships between companies and consumers. Every company that wants to be successful and recognized in the market must have a high quality Internet presentation and well-designed Internet marketing campaign. Internet marketing brings benefits to both

consumers and companies. On the one hand, consumers benefit from the availability of a large number of data and information, interactivity and immediate, continuous communication with companies 24 hours a day. On the other hand, companies have gained a powerful tool that enables flexibility in appearance in the global market, as well as the development of long term relationships with customers. Therefore, it is still unacceptable that a successful company does not have its own website, as it borders with the fact that it is almost non-existent.

Due to the growing number of Internet users in the world, online marketing is experiencing long term growth trend. Millions of people have access to the Internet from personal computers, laptops or mobile phones, which provides access to various consumers and gives a strong boost to the internet marketing industry. For those wondering what the future of internet marketing will be, it is very important to point out that the answers are diverse and numerous. Some experts say that web design will greatly affect future online success of the companies because it is a great way to attract attention and interest of the consumers. Great design is also a great way to build trust with target audience. Besides that, content marketing will be bigger than ever, considering the fact that the sole purpose of this type of marketing is presenting clear and valuable content to the consumers through variety of channels. Judging by the latest trends, the next step in advertising will be directing resources towards mobile devices which are the future. In fact, predictions say that the 87% of connected devices sales by 2017 will be tablets and smartphones. Therefore the companies must provide positive experience for the consumers that are browsing via a mobile phone through creating the alternative mobile versions of the website or by using the appropriate web design. Otherwise, it's easy to lose customers to competitors who have adapted to this trend. So called "Native Advertising", which is mentioned more and more often should provide greater efficiency of net advertising regardless of the type of format. This way of advertising implies thematic sync of the advertisement with the content consumed by the customer, i.e. even more precise targeting of the target group as well as more efficient placement of the ads. Social network advertising is becoming more and more popular due to the fact that these types of websites are appearing on a daily basis. In addition, the advertising on those types of websites is much cheaper than, e.g. banners on the most visited native websites, and at the same enables various payment models as well as much more precise selection of the target audience.

Internet marketing in our country is experiencing increasing popularity, and budgets allocated to this form of promotion grow yearly. However, despite the trend of growth of digital advertising, many domestic companies still do not realize that Internet appearance requires constant innovation and improvement, since otherwise they shall not be competitive in the future. What businesses need to take into account is to adhere to a code of conduct on the Internet, follow the examples of successful global companies and create a distinctive strategy for Internet marketing.

REFERENCES

Chaffey D. (2011). E – Business and E – Commerce Management: Strategy, Implementation and Practice (5th ed.), Pearson: Financial Times Prentice Hall

Chaffey D., Smith P. R. (2013). eMarketing eXcellence, Planning and Optimizing your digital marketing (4th ed.), Routledge

Laudon , K. C., Traver C. G. (2009). E – commerce: Business, Tehnology, Society (6th ed.). Prentice Hall

McAllister M. (2013). Discover the 4 Pillars of Internet Marketing. Retrived from www.empowernetwork.com/michellemckat/blog/discoverthe-4-pillars-of-internet-marketing

Miljković M., Alčaković S., Alčaković S. (2011). Značaj Internet marketinga za poslovanje dvadeset vodećih srpskih kompanija, Singidunum revija 8 (2), 137 – 144

Paradkar S. (2014)., eCommerce in the Customer Empowerment Era. Retrived from http://www.bptrends.com/ecommerce-in-the-customer-empowerment-era/

Schneider G. (2012). Electronic Commerce (10th ed.), United States of America: Cengage Learning

Stankić R., Krsmanović B. (2007). Elektronsko poslovanje, Bijeljina: Fakultet spoljne trgovine Bijeljina

Turban E., King D., Lee J., Liang T.P., Turban D.C. (2010). Electronic Commerce 2010, A Managerial Perspective, Pearson Education

IAB internet advertising revenue report – 2013 full year report (April 2014). Retrieved from http://www.iab.net/research/industry_data_and_landscape/adrevenuereport

European Journalism Observatory (April 2014). Retrived from http://rs.ejo-online.eu/category/oglasavanje-i-marketing

http://wd.rs/novosti/internet-zarada-jaca-od-nemacke-ekonomije.html (April 2014)

http://saravanesh.files.wordpress.com/2009/06/lecture-02.pdf (May 2014)

THE EFFECTIVENESS OF ATL AND BTL ADVERTISING TECHNIQUES

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Abstract: *The aim of this paper is to compare ATL and BTL advertising tools and to examine consumers attitudes towards these channels of communication. By analyzing several examples of global companies, we came to the conclusion that companies are increasingly turning to BTL activities and reducing their ATL budgets, allocating it for BTL campaigns. The survey we conducted showed that consumers themselves consider that BTL techniques are more efficient and effective than traditional forms of ATL communications. However, companies should not disregard the ATL activities, but they need to be creative and innovative when making campaigns.*

Keywords*: Above the line, Below the line, Through the line, Advertising, Marketing*

1. INTRODUCTION

Considering the changing requirements of today's business, many companies wonder how to best represent their products or services to customers, and therefore to encourage sales. The solution is certainly in the quality of communication with end consumers. Defining the advertising as a creative communication process, we distinguish ATL, BTL and TTL advertising techniques. Lots of companies spend large ammounts of money on marketing campaigns, combining these three techniques of advertising. The aim of this paper is to examine consumer attitudes on effectiveness of these types of advertising, as well as to indicate on what kind of communication should companies be oriented.

"Marketing is the science and art of exploring, creating, and delivering value to satisfy the needs of a target market at a profit. Marketing identifies unfulfilled needs and desires" (Kotler, 2012). Marketing points out to the process of preparing the product for the marketplace. "Advertising is any paid form of non-personal presentation and promotion of ideas, goods and services through mass media such as newspapers, magazines, television or radio by an identified sponsor" (Kotler & Armstrong, 2001). Advertising is just part of the whole marketing process and it refers to making your product and service known to the marketplace. Advertising is a way of communication with customers in order to familiarize them with the product or service and therefore encourage sales.

In the context of advertising, more and more often we hear the terms "Above the line" (ATL), "Below the line" (BTL) and "Through the line" (TTL). ATL, BTL and TTL are advertising techniques. ATL is a term that indicates the promotional activities of the companies done through the mass media channels of communication. BTL is a type of advertising that encourages immediate or delayed purchase, and TTL points out to the activities that try to integrate both ATL and BTL.

2. ATL, BTL AND TTL

These terms were first used in 1954 when Procter & Gamble began paying advertising firms separately from other suppliers who dealt with more direct promotional efforts (Manral, August 22, 2011). The term originated spontaneously while composing a budget of Procter & Gamble. Only traditional advertisement costs were listed in the draft budget (television, radio, printed media, outdoor and movie theatre ads). Employees in company then considered free sampling, discount programs, sweepstakes, sponsorships, etc. which made them draw a line below initial costs, in order to include these previously uncharted costs of promotion (In the Beginning, There Was ATL, n.d.). Advertising agencies made commission from booking different types of media – TV, cinema, radio, press, magazines and out-of-home. Since BTL activities had no involvement of media, no commission was made for these agencies. The accountants marked different types of media as ATL an BTL depending on where it would sit in the balance sheet and profit and loss accounts (ATL stands for profit oriented activities, and BTL stands for non profit activities). During the time, this advertising budget structure became popular and became practiced around the world. Now, "above the line" stands for capital expenditures and "below the line" for current expenditures (Advertising, n.d.).

“Above the line” is an advertising strategy based on all types of communication, which involves the use of mass media channels such as television, cinema, radio, print, and out-of home, in order to promote brands or present special offer (Pritchard, 2011). The objectives of ATL activities are to strengthen brand awareness, to build a brand identity and to improve the brand image about company’s product or service. This type of communication is conventional and impersonal to customers, and much more effective when the target group is very large and difficult to define. One of the major drawbacks in the ATL campaigns is the inability to evaluate the commission based on the campaign. It is impossible to calculate how much the sale increased due to campaign. For this reason, companies spend large ammounts of money on ATL campaignes, without being able to measure their effectiveness. It happens that these campaigns do not give results, and companies do not have a way to deal with it. Looking at a longer time period, it is certainly necessary to communicate with consumers using ATL tools, in order to acquire the habit of consumption of the specific product. However, ATL is necessary, but uncertain.

“Below the line” uses less conventional methods than ATL, focusing on direct communication, like promotions, sampling (tastings), sweepstakes and contests, loyalty programs, “guerilla marketing”, direct mail and event marketing. BTL refers to non-media communication which is short-term incentive and mainly oriented at consumers (Pritchard, 2011). Main advantages of BTL are better targeting, direct and often personalized communication, with measurable performance (ROI can be calculated) and more tightly attached to sale than ATL. Advantage of BTL is also in communication flexibility. BTL campaigns take place at the point of sale, where consumers can make the final decision on the purchase. There is a direct interaction with customers or potential customers, indicating the opportunity for personalization of communication. Once you achieve effective personal approach, sales should increase. BTL is a common technique used for “touch and feel” products, where the customer will rather rely on immediate information about product, than previously researched items. This technique ensures recall of the brand while at the same time highlights the characteristics of the product.

ATL is facing creation awareness of the product while BTL is facing creation of a desire for purchasing the product. Above the line is much more effective tool of advertising when the target group is very large and difficult to define, while below the line is more advisable when the target group is limited and specific.

“Through the line” is related to an advertising strategy which involves both above and below the line forms, where one form of advertising indicates the target market to another form of advertising, thereby crossing the “line.” In recent years, agencies and clients have switched to integrated communication (Pritchard, 2011). Mix of ATL and BTL is used to optimize returns from these separate investments and to integrate marketer’s efforts. The main idea is to optimize the return on marketing budget spent on BTL battles than on ATL wars with well-funded competition. (PR Newswire, January 23, 2006).

3. ATL VS. BTL TRENDS AND EXPENDITURES

In the case of Canon India, this company has taken various activities (photography workshops, activities in retail touch points, consumer engagement activation, exclusive lounges, experience corners in retail shops) to engage more consumers with its products. This company’s annual marketing budget was 9,592,000.00 EUR in 2008. In 2008, the company’s marketing spend came down by 2,398,000.00 EUR, leaving it with 7,194,000.00 EUR to spend in the economic downturn, with consumers increasingly deffering their buying decisions. Technology is such a category of products where the obsolescence rate is high, so as the level of brand loyalty. Consumers decisions depend mainly on practical experience and experience of others. Company management decided to increase the BTL spend by 20 per cent, in order to provide consumers with more than “hands on product“ experience. Canon India's BTL share now stands at 70 per cent. Canon India has decided to create a better relationship with customers by sharing with them the technical knowledge on how to use the product better. The company has developed BTL strategy which included all parts of its marketing chain: consumers, traders and promoters (Tyagi, January 30, 2009).

Large corporations and well-known brands know that experience and engagement of consumers can be achieved only through BTL, so more and more marketing money is spent to connect with consumers (Balasubramanian, August 01, 2013). Estimation is that the BTL industry is growing at 25-30 per cent and will continue to grow exponentially over the next few years (Ernst & Young Report, 2012). Goal of the BTL activations is that the consumers elicit an emotional response so that they remain inspired and touched. In this way, consumers are not only introduced with the core benefits of a product, but they are honored to try or test the product, give their contribution in the form of feedback, and participate actively in the process of brand building. Thus, consumers feel special and treated with care, and the information you get in return are very valuable. Brands can’t just talk down to customers, they need to be part of a two-way communication.

Companies like Voltas, LG and Whirlpool indicate that their in-store activation budgets have been upped by as much as 20 per cent compared to last year. In many cases, BTL spendings give better return on investment than ATL. LG's inclination towards BTL has come at a rise of 15 per cent as compared to last year. Despite the high brand recall, LG feels that the process cannot be completed unless there is direct customer engagement, in-shop demonstration. Whirlpool is expecting its BTL spends to go up by 15-20 per cent than the previous year, which includes adding more hands-on in stores (Pal, May 28, 2013).

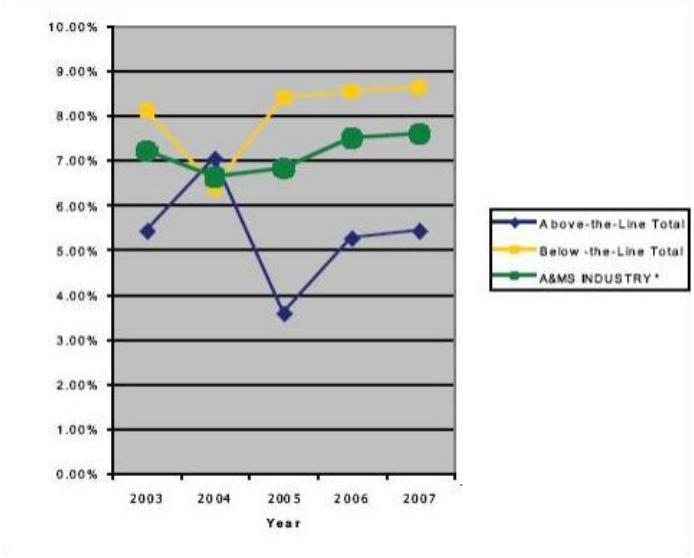

Figure 1: Growth in expenditure of BTL and ATL activities
(V12 Group & Winterberry Group LLC Report, 2006)

As we can see on the Figure 1, ATL expenditures compared to BTL expenditures have decreasing trend over the years. On this figure, we can see where the efforts are, but we can not see why. It is interesting that after so many successful years with ATL methods, companies are increasingly turning to BTL approach. Also, consumers are more willing and open to BTL communication rather than ATL. There are seven trends exploring the internal and external factors that are contributing to this emerging marketing emphasis. These trends are directly impacting the allocation of marketing budgets for both ATL and BTL campaigns. Trends are given in the table below.

Table 1: Seven trends impacting the allocation of marketing budgetes for ATL and BTL campaigns
(Atl and Btl Activities Research Paper, 2008).

1. Changing consumer demographics decrease the influence of traditional mass media marketing messages.
2. Growing consumer sophistication heightens the demand for channel-agnostic communications.
3. Widespread marketing "clutter" diminishes the impact of commercial messages that don't address specific and individually relevant consumer needs.
4. Enhanced information availability empowers both marketers and consumers with insight that allows for precise customer targeting and intelligent purchase decisions.
5. Heightened client pressure to deliver quantifiable value by evaluation of ROI of the marketing initiatives , forces marketing service providers – especially agencies – to re-evaluate services platforms.
6. Growing effectiveness of "multichannel" campaigns (those that cross multiple media) reinforces demand for tactics that establish one-to-one relationships between marketers and consumers.
7. Rapid technological advances allow for consumer/marketer interactions that are more frequent, easier and more relevant than previously possible.

4. SURVEY: CONSUMER'S POINT OF VIEW

In order to examine the consumer's point of view regarding the efficiency of ATL and BTL campaigns in Serbia, we conducted an online survey, with 200 participants, where 45 % respondents are male and 55 % are female. Survey participants are Serbia citizens, where 67 % of them are currently students, 20 % are

employed and 11 % are unemployed. 26 % of respondents make buying decisions on their own, while in 61 % of respondents households, that decision is made together with other family members. In Table 2, you can see an overview of the respondents age.

Table 2: Respondents age overview

Age	Response	%
Less than 20	4	2 %
20 – 25	176	88 %
26 – 30	16	8 %
31 – 35	0	0 %
36 – 40	2	1 %
41 – 45	0	0 %
46 – 50	0	0 %
More than 50	2	1 %

Our aim was to examine the attitudes of consumers and their reactions to various types of ATL and BTL advertising techniques. The survey is designed to first examine the attitudes related to ATL, then BTL, and then to compare these techniques.

As a response to question how do the respondents react when they see a commercial break while watching televison programs, 45 % said they immediately change the channel, 6 % watch commercials, while the rest devote to other activities. Many respondents do not have clear attitude about what does the TV commercials try to say and more than 50 % of them think that those commercials do not affect their opinion on products/services. Also, most of them are sure that TV ads do not encourage the purchase of goods. High percentage of the respondents consider that quality TV commercial must be short, funny, true and of course, original. Commercial that will evoke emotions, connect us with a brand and thus encourage the purchase.

Taking into consideration other ATL channels of communication, the results are given in the table below.

Table 3: Attitudes towards ATL channels of communication

	Question	Disagree	Mostly disagree	Neither agree nor disagree	Mostly agree	Agree
1	Radio commercials attract attention.	36,45 %	18,69 %	20,56 %	21,50 %	2,80 %
2	Billboard advertisements affect my opinion about product/service.	17,76 %	31,78 %	35,51 %	14,95 %	0
3	Advertising in print media inform me about product/service.	19,63 %	22,43 %	38,32 %	16,82 %	2,80 %
4	I always read the leaflet I get.	23,36 %	24,30 %	18,69 %	24,30 %	9,35 %

When ranking the advertising type that most influences consumers opinion on product/service of all ATL communication channels, first of all are TV commercials. Billboard advertisements take second place, while radio and print media took an equal number of votes for third place.

When we look at the consumer's point of view of ATL campaigns, generally it seems that they are not too enthusiastic and thrilled, on contrary, they are tired and they feel this kind of marketing does not affect their awareness about product or service. Therefore, companies need to be more innovative and creative in their ATL campaigns, which is very difficult to do in a saturated market.

Talking about BTL campaigns, 42 % survey participants like to be informed about promotions in sales objects where they usually do shopping, but more than 50 % participants are not willing to inquire about the promotion by themselves. They are not ready to make first step and approach to the promo stand. Companies therefore have promo teams who have to be very communicative and pleasant, but not intrusive, who will provide necessary information at the right place, at the right time. Around 68 % of participants like to get free samples of some products at the point of sale. It is important for consumers to be able to feel, touch and taste a product which is being offered. On the other hand, less than 50 % of respondents do not like to

taste free food at the point of sale. Depending on the purpose of a product, companies need to consider whether to do free sampling or to allow testing the product at the scene.

Beside the promotion, some other BTL activities like sweepstakes and direct mails are interesting for consideration. The same percentage of respondents is interested, disinterested and neutral towards taking part in the sweepstakes at the point of sale. One of the consumers favourite BTL activation is receiving gifts when buying a certain product. Most of them declared that branded shelves in sales objects attract their attention, but great majority of them ignore informational e-mail about new products or services.

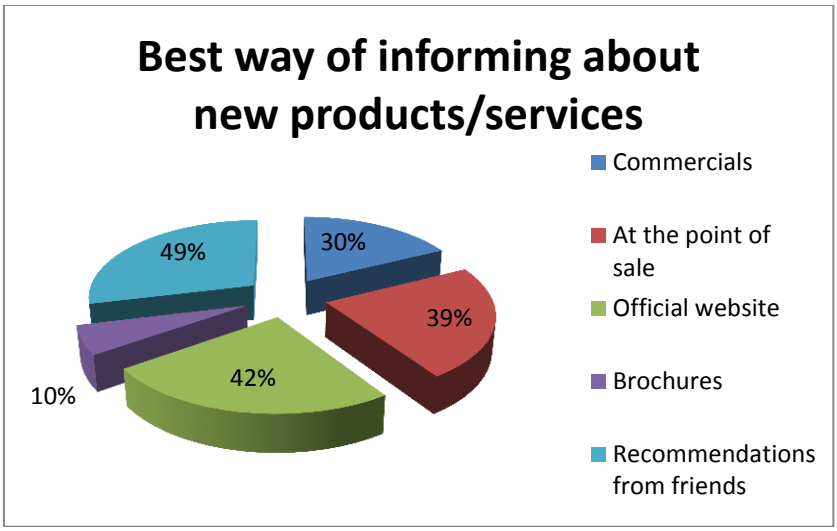

Figure 2: Best way of informing about new products/services

As we can see in the Figure 2, most of the survey participants trust a friend's reccomendation when informing about new products or services. Brochures and commercials are becoming more and more the past, while websites and points of sale are becoming the future. Companies need to spend less on print materials, and to invest more in quality staff who will be qualified and capable of explaining to potential buyer everything he wants to know about certain product/service.

As a result of the survey, we found that consumers in Serbia prefer BTL communication. They are much more ready and willing to engage in BTL mechanisms than to be left to television and other ATL media. Personal, 1-1 communication makes them feel special, which contributes to the effectiveness of BTL campaigns. In this way, consumers feel like someone cares about their needs and they are creating desire for buying that product they will be thrilled about.

5. CONCLUSION

Analysing the practice of few global companies, so as results of conducted survey, we have concluded that BTL campaigns are gaining more and more importance. Marketing activities which are left to the consumer's free will, meaning that he has a choice to see them or not, are doomed to failure. Customers have less time for shopping, their taste is more refined, their money is requiring maximum quality and their wishes are more and more specific. Because of that, companies need to maximize efficiency of communicating with target customers. The effectiveness of BTL activities is rising, that is why companies are ready to invest more in BTL than ATL mechanisms. They should invest more in BTL activations and on 1-1 communication. ATL should not be disregarded, but people are getting bored with classical way of advertising. Less budget should be spent on ATL, but ATL sector must increase innovation and creativity when inventing a campaign.

REFERENCES

Advertising. (n.d.). Retrieved from http://www.creativeimages.co.za/cindy/services/advertising/

Atl and Btl Activities Research Paper, (2008). Retrieved from http://www.slideshare.net/sonam2008/atl-and-btl-activities-research-paper

Balasubramanian, D. (August 01, 2013). *BTL spend is a critical, non-negotiable part of marketing budgets*. Retrieved from http://www.exchange4media.mobi/story.aspx?news_id=52171#sthash.NFG7xCNc.dpuf

Ernst & Young Report (2012). *The business of experiences: The Indian events and activation industry,* India: EEMA

In the Beginning, There Was ATL. (n.d.). Retrieved from http://www.marketmedia.lv/eng/instoretv/atlbtl/

Kotler, P. (2012). *FAQS Marketing: Answers and Advice by the Guru of Marketing*, Singapore: Marshall Cavendish Business

Kotler, P., & Armstrong, G. (2001). *Principles of Marketing,* Prentice Hall (9th ed.)

Manral, K. (August 22, 2011). *Difference between 'above the line' and 'below the line' advertising,* retrieved from: http://theadvertisingclub.net/index.php?option=com_content&view=article&id=3256:difference-between-above-the-line-and-below-the-line-advertising&Itemid=175

Pal, N. (May 28, 2013). *Consumer durables up their BTL budget to 20%.* Retrieved from http://pitchonnet.com/blog/2013/05/28/consumer-durables-up-their-btl-budget-to-20/

PR Newswire. (January 23, 2006). *Winterberry Group Report Quantifies Fundamental Marketing Shift as Spending Moves 'Below-the-Line'. Retrieved from: http://www.ulitzer.com/node/173752*

Pritchard B. (2011). *Kick-Ass Business & Marketing Secrets: How to Blitz Your Competition,* Hoboken, New Jersey: John Wiley & Sons, Inc.

Tyagi, Ch. (January 30, 2009). *Canon India spends 70 per cent of marketing budget on BTL.* Retrieved from http://www.afaqs.com/news/story/24363_Canon-India-spends-70-per-cent-of-marketing-budget-on-BTL

V12 Group & Winterberry Group LLC Report, (2006). *Tracking the Trends: A Comparison of Above-the-Line & Below-the-Line Expenditure Trends.* New York: Winterberry Group

OPERATIONAL RESEARCH AND QUANTITATIVE METHODS IN MANAGEMENT

APPLICATION OF SOME LOCATIONAL MODELS IN NATURAL RESOURCES INDUSTRY - AGRICULTURE CASE

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Abstract: *Nowadays large scale, uncertainty and multiple objectives appear increasingly in decision processes. One of the very important strategic decision for starting a business is where to locate facility. Application of operations research methods and models has had a great success throughout the years, including modeling and solving various location problems. Natural resources industry, especially agriculture sector, is a significant factor of growth and prosperity most commonly for developing countries. Operations research/management science (OR/MS) contributions in each one of applied areas of natural resource industry – agriculture, fisheries, forestry and mining are very significant. In this paper we present application of Capacitated Facility Location Problem (CFLP) in agriculture sector and we are encouraging researchers to use quantitative techniques in order to manage the use of different natural resources.*

Keywords*: Natural resources industry, Agriculture sector, Location analysis, Capacitated FLP*

1. INTRODUCTION

By using natural resources according to their needs, a man survived and evolved as a cultural, social and spiritual being. The development of various technologies shaped the life of modern man, but led to the rapid exploitation of its environment, and the rapid depletion of resources. People have changed the face of the earth more than any other species in the history of the planet - and the speed of these changes is increasing. People today spend between one-third and one-half of what the global ecosystem created.

The natural resources of a country determine its wealth and status in the world economic system, its power and political influence. According to this, it is obvious that operations research, as a discipline that deals with the application of advanced analytical methods to help make better decisions has a significant impact on decisions in this area. Application of operational research methods and models to modelling of complex realities and development of algorithms for problems increasingly difficult to solve has had a great success throughout the years (Weintraub, 2007).

Operations research has played an important role in the analysis and decision making of natural resources, specifically, in agriculture, fisheries, forestry and mining, in the last 40 years (Weintraub, 2007). There are natural differences related to the form of managing the production in each application. For example, the time horizons of growth and extraction vary from months to a year for fisheries and agriculture, to almost a century for some tree species. Mining is non-renewable, and, as such, is associated with a different type of natural resource (Bjørndal et al., 2012). Mine lives can run for a few years to centuries. In agriculture, farmers are primarily concerned with how to plant crops and raise animals more efficiently.

Decisions in forestry are centered around the strategic, tactical and operational levels of managing plantations and public lands to meet demands while adhering to supply restrictions, which are coupled with events such as forest fires and policies, e.g., environmental regulations and concerns (Bjørndal, 2012).

Operations research, e.g. location analysis has been applied to handle various problems in agriculture and forestry area, elaborating on mathematical techniques and successful applications. In this paper we present one more application of OR/MS in agriculture sector and we are encouraging researchers to use quantitative techniques in order to manage the use of different natural resources efficiently from an economic as well as an environmental point of view.

2. NATURAL RESOURCES INDUSTRY AND OR/MS

According to the significance of natural resources especially today, it would be expected that operations research (OR) could have made a significant contribution to decision making in this area. But achievements in practice have been disappointingly small. The industry comprises of a large number of small individual businesses which do not permit specialisation in management functions. Consequently, technical advice and

much R and D is provided from public funds. OR applications for agriculture have mainly been developed by Universities, Colleges, State Advisory Services and Quangos. Quango is a quasi-autonomous non-governmental organisation is an organisation to which a government has devolved power. In the United Kingdom this term covers different "arm's-length" government bodies, including "non-departmental public bodies", non-ministerial departments, and executive agencies. The Forestry Commission, which is a non-ministerial government department responsible for forestry in England and Scotland, is an example of a quango (Wikipedia, http://en.wikipedia.org/wiki/Quango).

Some techniques are frequently used in agriculture like linear programming, dynamic programming and simulation. Other techniques have had limited uptake and application. Reasons for the pretty low impact of OR are outlined as a set of problems specific to farmers and their systems and problems specific to computer use. One of the obvious problems in efficient application of OR/MS methods and techniques are in recruiting and training OR specialists for these specific fields of application. Generally, how important OR models are in decision making depends on several factors (Weintraub & Romero 2006):
—The quality of data,
—The competitiveness of markets,
—Ownership and
—The culture of the application area and peoples' understanding of OR's advantages.

There exists several ways for increasing OR impact in these areas: one is in training today's farmers (and, probably more important, future farmers) in an understanding of what computers can do and what models are available. There is a general lack of good flexible formulation of problems to be dealt with by OR techniques. A third problem is the need for much more efficient two-way communication and feedback between the developers of OR tools for agriculture and practical farmers. At present OR has connotations of being of little use to practical farmers, but of great value to academic enthusiasts who are unable and/or unwilling to transfer ideas into practicality.

3. APPLICATION OF LOCATION MODELS IN AGRICULTURE SECTOR

Location theory has found its use in agriculture since the early days of the field. The theory of spatial equilibrium and optimal location and the foundations of agricultural location theory are traced back to the classical work of von Thunen in 1826. He investigated the impact of the distance from the market on the use of agricultural land.

In agriculture, use of OR models is increasing with advances in hardware and software. The most commonly used OR techniques are LP models, simulation, risk programming, and multiple-criteria programming. People use models at two levels and for two purposes. They use them to improve decisions at the farm level, and they use them to help policy makers predict the impact of policy changes on farmers' behaviour (Weintraub & Romero 2006). Lucas and Chhajed (2004) give an overview of application of location analysis in field of agriculture and some selected applications of location analysis in agriculture are presented in table 1.

Table 1: Selected applications of location analysis in agriculture (adapted from Lucas and Chhajed (2004))

Authors	Problem description	Features
Grain storage in South Brazil (Borstein and de Casto Villela, 1990)	Optimal location of warehouses for grain storage, then location of service stations for technical assistance	Economies of scale Political, economic, and social aspects Partially funded by State Agency
Soybean-processing industry (D. Souza, 1988)	Optimal number, size, and location of soybean processing plants	Large size, with 57 regions US Economies of scale Multi-commodity (soybeans, then meal and oil) Consideration of two base periods 1977-1981 and predictions for 1999 and 2000
Cattle-slaughtering industry in Queensland, Australia (Brown and Drynan, 1986)	Selection of plant sites, sizes, throughputs and product flow	Economies of scale Marked seasonal and year-to-year variations Comparison of results form static and dynamic models

Authors	Problem description	Features
Post-harvest handling-chain operations in Northern Tahiland (Chu, 1989)	Optimal number and location of cooling facilities and assignment of production sites to those facilities	Large-size problem with 30 villages and 50 kinds of vegetable products, Problem decomposition, based on access road network and on locations of various extension stations Seasonality of production volumes and access road conditions Project supported by Government
Dairy industry in Ontario, Canada (Polley, 1994)	Changes in existing network (closing of several plants and warehouses) at Aults Foods – Canada's largest diary processor	Analyse the benefits of specializing each plants production mix and using multiple sources for shipping depots Sensitivity analysis with sales projection for 3, 5 and 10 year 30 plant production strategies
Brewing industry in Turkey (Koksalan, 1995)	Optimal locations of new breweries, and optimal distribution plans for malt and beer	Large-scale problem with 15 alternative cites and 300 customer zones High seasonality of beer demand, capacity constraints

Mladenović (2004) states common classification of location problems into (a) continual, (b) discrete, and (c) network models. Location problems in agriculture exhibit several features, such as their large scope and size, or the consideration of multiple and often conflicting objectives and, thus, demonstrate increased levels of complexity and realism. Common in agriculture are location– allocation problems, in which the number of facilities, their locations, and these interactions all become decision variables. Moreover, these location–allocation problems themselves are often complicated by routing decisions, leading to location–allocation-routing models.

Lucas and Chhajed (2004) presents six groups of location analysis application in agriculture: a cotton-ginning problem, the location of grain sub-terminals, the collection and processing of rubber, the fresh citrus packing industry, the cattle-slaughtering industry and The Bangladesh grain model. These applications of location analysis in agriculture do not consider solving of airfield location problems. Description and solution of one of the first problems regarding location models in agriculture aviation in Serbia can be found in Andrić Gušavac et al. 2013.

3.1 Simple and capacitated plant location problems

The simple plant-location problem (SPLP), also known as the uncapacitated facility-location problem, is one of the fundamental and most studied models in facility-location theory. The objective is to choose, from a set of potential facility-locations on a network, which ones to open to minimize the sum of opening (or fixed) costs and service (or variable) costs to satisfy the known demands from a set of customers. Although the origins of the plant-location problem go back to the pioneering work of Weber (1909), the actual of SPLP may be attributed to Stollsteimer (1963), Kuehn and Hamburger (1963), and Balinski (1965). In view of the size of facility-location problems that being tackled in practice today, ability to solve very large SPLPs is becoming more important. Mladenovic et al. (2006) develop a new methodology for solving the SPLP using variable neighbourhood search (VNS) to obtain a near-optimal solution, and they show that VNS with decomposition is a very powerful technique for large-scale problems, up to 15,000 facilities × 15000 users. Hansen et al. (2007) emphasized the fact that the SPLP is finding other applications in such areas as cluster analysis, computer and telecommunications network design, information retrieval, and data mining.

A basic CFLP model was formulated by Balinski (1961) and Manne (1964) for the simple plant location problem. This problem consists of locating plants and warehouses among a set of given locations in order to satisfy a given demand at minimum cost.

The assumption that all potential sites equally costly used like in maximal covering location problem, *p*-center, *p*-median problems, and location set covering problem is dropped in the simple plant location problem and its variant, the capacitated plant location problem (CPLP). Its objective is to locate an unspecified number of facilities and to meet all demand while minimizing the sum of site-related and transportation costs. The model makes a number of assumptions, the most important of which are as follows (Eiselt & Sandbloom, 2004):

- The facility can be supplied with unlimited resources whose prices do not vary by source;
- The transportation costs from factories to markets are linear, i.e., there are no economies of scale;
- The production costs at a facility are linear in a quantity produces once an initial fixed cost has been incurred;
- Demand in known and does not vary with changes in the delivered price;
- There is no capacity limitation on the quantity produced at a factory (for the SPLP);
- There is a fixed cost for purchasing and developing a site of selected for a facility.

Given the above assumptions we can define the following parameters. Denote by the fixed costs for opening facility , is the distribution cost for satisfying demand of user from facility . Then we need to define two sets of variables: is a binary variable equal to 1 if facility is in use and 0 otherwise; variable is the percentage of a satisfied demand of a user from facility . Now we can formulate the simple plant location problem as follows.

$$\min_{x,y} z_p = \sum_{i=1}^{m} f_i y_i + \sum_{i=1}^{m}\sum_{j=1}^{n} c_{ij} x_{ij} \qquad (1)$$

s.t.

$$\sum_{i=1}^{m} x_{ij} = 1, \quad \forall j \in I \qquad (2)$$

$$x_{ij} - y_i \le 0, \quad \forall i \in I, \forall j \in J \qquad (3)$$

$$y_i \in \{0,1\}, \quad \forall i \in I \qquad (4)$$

$$x_{ij} \ge 0, \quad \forall i \in I, \ \forall j \in J \qquad (5)$$

The placement of upper limits (that is, capacities) on supplies transforms an uncapacitated problem into a capacitated one. The CFLP is defined by introducing another type of constraints (6), which refers to the capacity of airfields. Denote by surface of fields in hectares and capacity of each airfield. Capacity of airfields is defined as total amount of fields in hectares which can be cultivated from every airfield.

$$\sum_{j=1}^{m} d_j x_{ij} \le Q_i y_i, \quad \forall i \in I \qquad (6)$$

CFLP has wide application for analysis of single-commodity location problems where capacity is an important consideration--that is, where management wishes to place a cap on the maximum output for any one facility.

4. CASE STUDY: AGRICULTURE

Simple plant location model is applied on large agriculture filed of company X which is situated near Belgrade (Andrić Gušavac et al. 2013). Company X is one of the leading companies in food production and production of this corporation is main base for meat and milk industry, industrial and other vegetables used in food industry. This company is considered as the premier supporter of the stable supply of high quality forage, fresh produce and dairy products to the local and regional markets. They own nine large agriculture fields with different crops: wheat, barley, corn seed, corn mercantile, soy etc. They use land mechanization and agriculture aviation for nutrition and protection of agricultural crops. This spring they processed 15000 ha of arable land with land mechanization and two aircrafts. Underground water represents great problem and limiting factor for successful fulfilment of agro technical deadlines. These deadlines are especially important in corn production, since corn is cultivated on 62.72% sawn area. Use of aircrafts in the technology of growing these crops would give better results in terms of yield and quality and also it will be necessary to use aircrafts due to underground water. (Jakovljević, 2006)

Subject of location models application is one of nine agriculture fields with approximately 9000 ha which is divided into 245 small fields and one part of land is unusable. Map of this part of land is presented in Figure 1. This part of land has nine airfields. Company had a problem to determine which of the airfields to activate, and how to allocate 245 fields to specific airfields. Each airfield is represented by a green node.

Figure 1. Map of arable land divided into fields (Andrić Gušavac et al. 2013)

Two groups of costs are summed up in the objective function (1). The first group represents the sum of costs f_i for opening airfield i, security and maintenance of that airfield. The second group of costs includes distribution costs c_{ij} for satisfying the demand of field j from airfield i, and these costs are proportional to distance between center of fields and airfields. In order to equalize units of two groups of variables in objective functions, model requires the conversion of the distances to distribution costs with unitary distribution cost of 1 EUR/km.

Distances between center of these fields (which have been earlier calculated) and airfields were calculated using Euclidean metric, where one distance unit represents 0,5 kilometers. Euclidean metric was used due to rectilinear aircraft movement.

The Euclidean distance between points p and q (7) is the length of the line segment connecting them ( ). If $p = (p_1, p_2,..., p_n)$ and $q = (q_1, q_2,..., q_n)$ are two points in Euclidean n-space, then the distance from p to q, or from q to p is given by:

$$d(p,q) = d(q,p) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \cdots + (q_n - p_n)^2} \quad (7)$$

Capacity of airfields is defined as total amount of fields in hectares which can be cultivated from every airfield. Capacity for each airfield is presented in table 1.

Table 2: Capacity of airfields

Airfield	1	2	3	4	5	6	7	8	9
Capacity [ha*100]	10	10	10	10	10	25	25	10	10

There is a slight difference between capacities of airfields. Airfields 6 and 7 were built as the first airfields in this area. These airfields were supposed to cultivate all of the arable land, and accordingly to this, the capacity of the chemical and gasoline storage were quite large. In the following period, it was obvious that these two airfields could not fulfil all of the needs of the arable fields. This resulted in setting up new lesser capacity airfields. Airfield area is calculated with the Heron's formula.

Table 3: Fixed costs for each airfield

Airfield	1	2	3	4	5	6	7	8	9
Fixed cost	70	70	70	70	70	100	100	70	70

Fixed costs are the same for each airfield – this is the case because all the airfields approximately are of the same size and capacity with same costs for opening – therefore the costs are the equal. Differences between these costs occur only for airfields 6 and 7 as a result of larger capacity.
Distribution costs between center of one example field (field 1) and every airfield are presented in table 2. Demand of each field refers to its surface in hectares (for example surface of the first airfield is 0,21ha^2).

Table 4: Distribution cost between center of field 1 and airfields

Airfield	1	2	3	4	5	6	7	8	9
Field 1	3,07472	4,34427	7,69806	9,86206	7,93396	6,27875	12,11549	13,63764	10,57403

The model was solved using GLPK software package. This package (GNU Linear Programming Kit) is intended for solving large-scale linear programming (LP), mixed integer programming (MIP), and other related problems. The GLPK package consists of several main components, including stand-alone LP/MIP solver - glpsol. The model was solved in order to suggest which airfields should be activated and used for cultivation. The solution also gives allocation of every field to specific airfield. Solution file from the solver has comprehensive insight in all the elements of the model solution:
1 objective: Total costs (=1093.17096)
2459 constraints:
Coverage
Allocation
Capacity
2214 integer variables
5 active airfields (1, 4, 6, 7, 8)

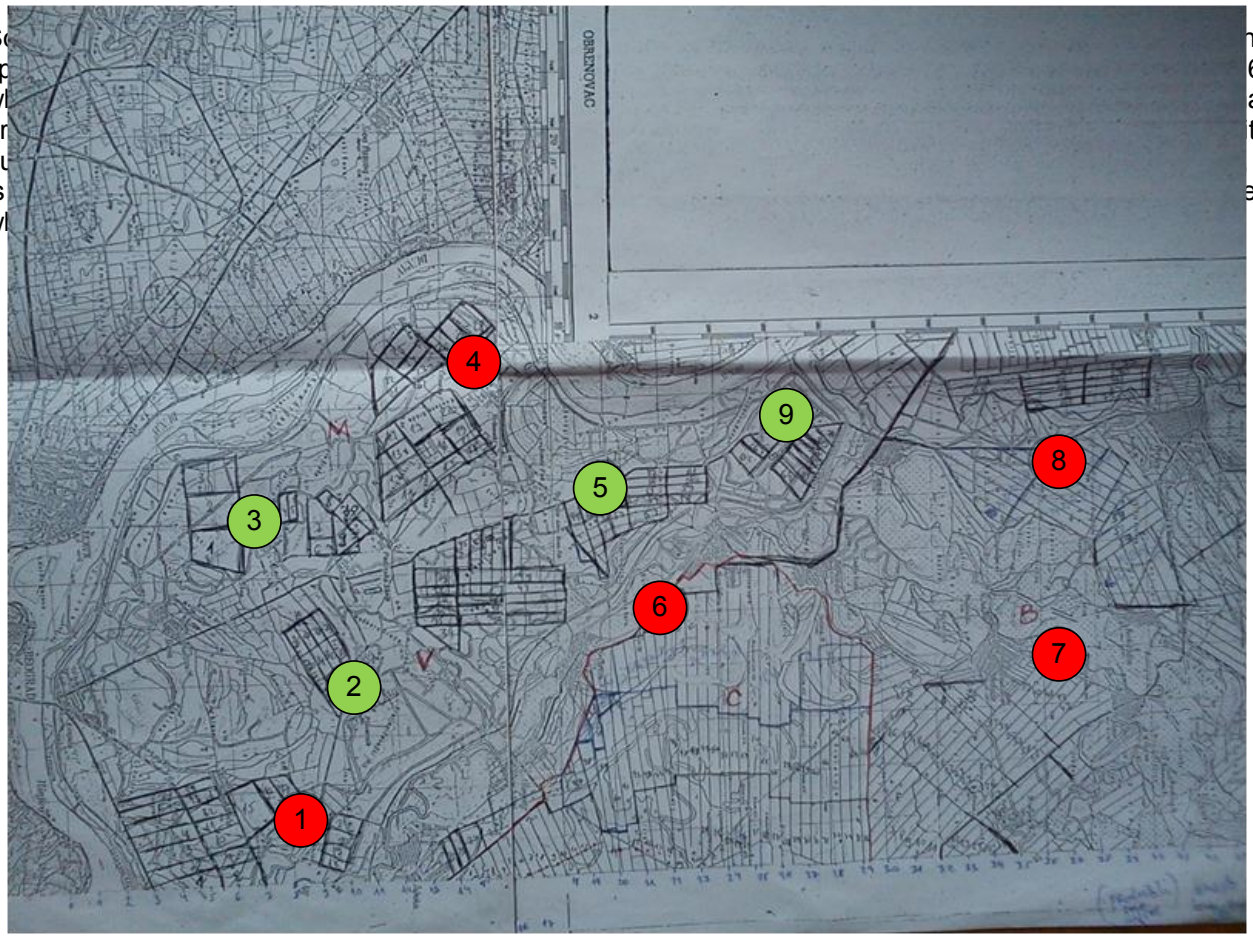

Figure 2. Map with chosen airfields

The number of fields allocated to the specific airfield is presented in the figure 3. Red nodes represent the activated airfields. This problem was firstly solved as a simple plant location problem, but there exist several factors which were not taken into consideration. One of these factors is a capacity of each airfield – defined as a total amount of hectares which can be cultivated from each airfield in a given period of time. This requires calculation of surface of each field in order to include this factor into model. Two solutions of the analyzed problem are presented in figure 3. Solution of the problem when simple plant location model is applied and the solution when a capacitated facility location problem is applied are presented in figure 3.

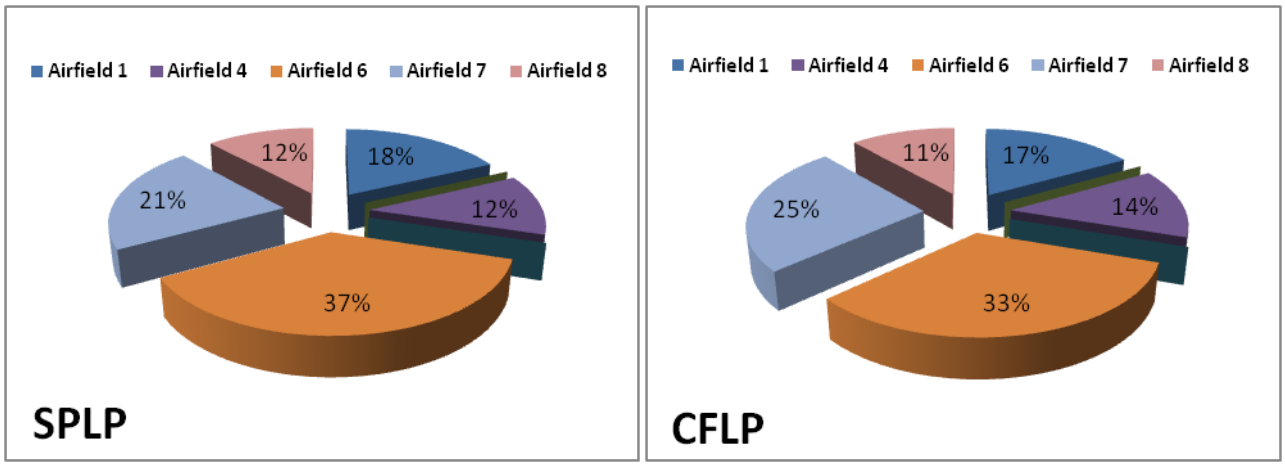

Figure 3. Solution of the problem - application of SPLP and CFLP

Figure 3 presents procentige of all fields which are cultivated from each activated airfield. There is a slight difference between result of SPLP and CFLP application which occurs as a result of a limited capacity of the airfields, but in the both cases the same airfields should be activated.

Table 5: Capacity utilization of airfields

Airfield	Maximum capacity of airfields [ha*100]	Capacity utilization [ha*100]
1	10	9.81110
4	10	9.39511
6	25	24.90626
7	25	19.96847
8	10	9.98313

Previous table shows a remarkable capacity utilization of airfield 1 (98%), airfield 4 (94%), airfield 6 (99%), airfield 7 (80%) and airfield 8 (99%).
Application of this solution enables the company to maximize use of capacities of the airfields. The remaining airfields can be closed and that area can be turned into arable land.

5. FUTURE RESEARCH

Application of a location model helps the management to orient their decision for airfields location rapidly and easily. Authors are convinced that a simple tool helps decision making and that the management should include the modeling results in business analysis including their possible preferences, so as to bridge the gap between measurability optimality and unpredictable and immeasurable compromises. Several more criteria should be taken into consideration for choosing airfield location, for example, proximity to the central airfield (main) or proximity to the important roads, etc. The results of this research could serve as an initial base for future optimization in agriculture aviation, where solutions could increase productivity and decrease energy supplying.

REFERENCES

Andrić Gušavac B., Stojanović D., Jakovljević S. (2013). Simple plant location model in agriculture aviation in Serbia, XI Balkan Conference on Operational Research Balcor 2013, pp. 321-326

Balinski, M. L., (1961) Fixed-cost transportation problems. Naval Research Logistics Quarterly, 8, 41-54.

Balinski, M. (1965). Integer programming: methods, uses, computation. Management Sci, 12, 253–313.

Bjørndal, T., Herrero, I., Newman, A., Romero, C., & Weintraub, A. (2012). Operations research in the natural resource industry. International Transactions in Operational Research, 19(1-2), 39-62.

Eiselt, H. A., & Sandblom, C. L. (2004). Decision analysis, location models, and scheduling problems. Springer.

Hansen, P., Brimberg, J., Uroševic, D., Mladenovic, N. (2007). Primal-Dual Variable Neighborhood Search for the Simple Plant-Location Problem, INFORMS Journal on Computing Articles in Advance, 1–13.

Jakovljevic S., (2006): Optimization of technically - technological systems in agriculture aviation of Serbia. (Doctoral disertation). University of Belgrade. (In Serbian)

Kuehn, A. A., Hamburger, M. J. (1963). A heuristic program for locat-ing warehouses, Management Sci, 9, 643–666.

Lucas, M.T., Chhajed, D. (2004). Applications of location analysis in agriculture: a survey. Journal of the Operational Research Society 55, 561–578.

Manne, A., (1964) Plant location under economies-of-scale: decentralization and computation. Management Science, 11, 213-235.

Mladenović, N. (2004). Continual location problems. Matematički institut SANU.(in Serbian)

Mladenovic, N., Brimberg, J., Hansen, P. (2006). A note on duality gap in the simple plant-location problem, Eur. J. Oper. Res., 174, 11–22.

Stollsteimer, J. F. (1963). A working model for plant numbers and locations, J. Farm. Econom, 45, 631–645.

von Thunen, J.H. (1875) Der Isolierte Staat in Beziechung auf Landwirtschaft und Nationalokonomie". (3rd ed.). Berlin: Schumacher-Zarchlin.

Weber, A. 1909.Ueber den Standort der Industrien. Tübingen (EnglishTranslation: C. I. Friedrich, translator. 1929. Theory of the Location of Industries. University of Chicago Press, Chicago, IL).

Weintraub, A. (Ed.). (2007). Handbook of operations research in natural resources [electronic resource] (Vol. 99). Springer.

Weintraub, A., & Romero, C. (2006). Operations research models and the management of agricultural and forestry resources: a review and comparison.Interfaces, 36(5), 446-457.

Weintraub, A., & Romero, C. (2006). Operations research models and the management of agricultural and forestry resources: a review and comparison. Interfaces, 36(5), 446-457.

MULTIPLE CRITERIA APPROACH TO SELECTING SITES FOR PORTS OF NAUTICAL TOURISM

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***Abstract**: In this scientific paper the authors explore the issue of selecting a site for a nautical tourism port using the methodology of multi-criteria analysis (MCA). Given the huge importance of tourism, in particular, nautical tourism in most maritime countries, including the Republic of Croatia and its coastal counties, any help in resolving that issue would be of immense significance. In Croatia, the existing distribution of nautical tourism ports (NTPs), their capacities and the quality of their services are not fully suited to the spatial features. Often these ports fail to blend with their environment and provide no effective protection to natural assets. The distribution of capacities does not match actual spatial potential, while the quality and level of facilities and services varies greatly and is generally inadequate. Hence, the aim of this paper is to identify criteria for the location and development of NTPs in coastal areas. The paper applies the multi-criteria approach to selecting a site for NTPs in Split-Dalmatia County (SDC). Potential micro locations (35) in that region have been studied and criteria and sub-criteria for selecting sites for NTPs, identified.*

***Keywords**: criteria, multiple criteria analysis, site analysis, nautical tourism port, Croatia.*

1. INTRODUCTION

Site selection is a strategic problem addressed in many studies and by many authors whose scientific work have provided a better understanding of the importance of using the right methodology. Different issues are often united in a methodological approach involving the use of multiple criteria analysis (MCA). The reason for this is the fact that using MCA at the scientific level helps to expand the number of NTP sites and sites for accommodating vessels on land, thus resolving the problem of lack of space and the growing demand for berths by boaters.
This paper focuses on identifying the current state of nautical tourism in Croatia, specifically in Split-Dalmatia County (SDC), comparing it with Mediterranean trends, and analysing its spatial and environmental factors. Upon analysing existing and proposed NTP sites in SDC, the advantages and carrying capacities of marine areas are evaluated and criteria for selecting sites on the mainland and on islands are established.
Through research and analyses, the authors seek to accomplish the purpose of this paper which is to define spatial possibilities and constraints, and to propose criteria to ensure the selection of a location for NTPs. With regard to the research problem, the general and special goals set call for the application of MCA in selecting the criteria critical to determining the location for NTPs.

2. THEORETICAL DETERMINANTS AND NAUTICAL TOURISM DEVELOPMENT IN CROATIA

One of the most promising forms of tourism in Croatia, nautical tourism is a complex tourism and maritime concept and its pervasive connection with the sea and navigation makes it all the more difficult to define (Luck, 2007). Namely, the maritime component does not define nautical tourism in its entirety, although superficial analysis may make this seem so (Luković, 2007). Given the fact that both *tourism* and *nautical tourism* are derived concepts representing a set of activities adherent to them but which can change and be added to over time, the authors conclude that nautical tourism is a multidisciplinary phenomenon.

The Tourism Activities Act (Official Gazette 8/96, 19/96, 76/98) defines nautical tourism as "*the navigation and sojourn of tourists/boaters in vessels and in NTPs, for the purpose of recreation and entertainment*".
In the Croatian Adriatic, nautical tourism received powerful incentives and a strong identity in the mid-1980s through the construction of the ACI Marina system, which quickly became the leading nautical organization in the Mediterranean. However, due to various reasons, this role as a leader was lost during the two decades following Croatia's independence. During that period, France, Greece, Turkey, Italy, and other Mediterranean countries invested heavily in marina construction. Today the nautical tourism capacities of Italy are five-fold greater than those of Croatia. An analysis of the current state of nautical tourism in Croatia indicates that the assets of Croatia's Adriatic coast and islands have still not been valorised to any sufficient extent (Bošković et al, 2006). An analysis of statistical and other available data and the Development Strategy of Nautical Tourism in Croatia (2008) suggest that less than half of all vessels and yachts sailing the Croatian Adriatic in the summer season use berths in commercial marinas, while the majority of vessels and yachts are freely anchored in natural coves or moored in transient local harbours. The main reason for this is the shortage of marina capacities in the summer period, in particular, on the islands. Less than half of nautical tourism traffic (excluding small vessels that do not use marinas) in Croatia is encompassed in the organized accommodation of vessels, an activity which has an environmental protection function as well as an economic function. SDC is no exception; it accounts for a mere 13% of all available berths in Croatia. Considering that the existing offering of berths at sea and on land is lacking, many authors are of the opinion that it is necessary to plan sites for the organized accommodation of vessels.

Table 1: NTPs in Croatia and SDC, 2006 - 2012

Year	NTPs, total		Share of SDC in %	Indices	
	Croatia	SDC		Croatia	SDC
2006	95	11	11.6%	-	-
2007	94	11	11.7%	99	100
2008	97	11	11.3%	103.2	100
2009	98	13	13.3%	101	118.2
2010	98	13	13.3%	100	100
2011	98	13	13.3%	100	100
2012	98	13	13.3%	100	100

Source: the authors after CBS

Table 1 shows the number of NTPs in Croatia and SDC. The table demonstrates a continued growth in the number of NTPs in Croatia over the years, the greatest increase being in 2008. SDC also displays an upward trend, with the greatest boost being in 2009.

Table 2: Number of berths in Croatia and SDC, 2006-2012

Year	NTPs, total		Share of SDC in %	Indices	
	Croatia	SDC		Croatia	SDC
2006	15 973	1 591	9.9%	-	-
2007	15 834	1 581	9.9%	99.1	98.4
2008	16 403	1 576	9.6%	103.6	103.6
2009	16 848	1 789	10.6%	102.7	101.1
2010	16 913	1 792	10.6%	100.4	101.1
2011	17 059	1 913	11.2%	100.9	106.8
2012	17 454	2 238	12.8%	102.3	117

Source: the authors after CBS

Table 2 shows the number of berths in NTPs in Croatia and in SDC per year. Both Croatia and SDC display an obvious upward trend, with SDC accounting for about one-tenth of all berths in Croatia.

An analysis of the current state of NTPs in Croatia compared with the Mediterranean countries (Kovačić et al, 2012), together with an analysis of the existing state of infrastructure for accommodation of vessels in SDC, reveals there are:

- Sites which are established in existing plans
- Sites already being used for the purpose of nautical tourism although there is no organized accommodation of vessels at such sites and
- Sites which need to be included in new spatial plans.

Previous practice indicates that without the approval of the local community, the business policies of investors and the location of new NTPs come up against resistance as early as the initial phase of site preparation.
SDC spatial plans have identified sites for the construction of new NTPs, spurred by the growing demand for berths, the distinctiveness of the destination and the vicinity of outbound tourism regions. NTP capacities foreseen in plans are in accordance with the county's spatial potential and the interest of boaters. A large number of NTPs in SDC are used only during the summer season. The existing ports and harbour that do not have NTP status are exploited extensively and their marine areas are mostly occupied by small vessels, with no economic effect for the local community.
A survey conducted in SDC local government units points to poor communication (interaction) between towns/municipalities and NTPs, primarily as a result of imposed coexistence in a constrained area of two separate entities whose interests and goals apparently seem to differ:

- A port of nautical tourism – a marina, in particular – is a business entity focused on business efficiency, productivity, market competitiveness and development.
- A town/place/municipality, as a community of residents, is focused on promoting the well-being and quality of life of its citizens, and accordingly aspires to the environmental and visual assets and the expectations of people (residents).

From these diverging visions, conflicts may emerge bringing the physical and functional use of space into question (Kovačić et al, 2013). Hence, it is essential to involve the local government in the preparation phase of spatial planning, not only to gather opinions but also to communicate the socio-economic effects that the organized accommodation of vessels could bring (Favro et al, 2005).
The Development Strategy of Nautical Tourism (2008) is a fundamental document of the future development of nautical tourism in Croatia. It foresees the construction of NTPs as follows:

- Marinas in the vicinity of airports
- Marinas and moorings within urban centres
- The organization of transit berths at tourist moorings in traditional island ports
- The organization of a system of anchorages
- The construction of marinas for mega yachts.

3. BASIC FEATURES AND METHODOLOGY OF MCA

If conducted correctly (Nikolić and Borović, 2006), MCA requires the cooperation of all interested parties and the practical involvement in the decision process of all stakeholders to whom a problem applies, which, on the other hand, facilitates the realization of obtained priorities and eliminates any doubts concerning subjective decision making (Favro and Kovačić, 2010). The importance of building NTPs and using natural resources in contemporary conditions is particularly emphasized, as well as the number of parties interested in reaching a suitable solution (Jugović et al, 2011). The transparency of available data used in making analyses is highly important because it makes it possible to check whether parameters have been correctly evaluated. From a methodological perspective, MCA represents a systems approach, and in terms of methodology, it is the most effective and functional approach to problem resolution (Kovačić, 2010).
A systems approach to the problem of selecting sites for NTPs in SDC points to an unstructured problem which at strategic and tactical levels of decision making required a complex analysis of the goals set in this research. Problem structuredness or refinedness is the most important characteristic with regard to the decision-support methods and procedures available for a concrete problem (Brans and Vincke, 1985).
Before MCA methodology can be applied, it is necessary to establish whether the problem is characterized by alternative solutions. This was established for the problem of selecting sites for NTPs in SDC. It is also essential to ascertain whether all relevant criteria have been taken into consideration and have been properly evaluated, in particular parameters which are the product of expert judgements. Previous experience in evaluating the use value of space has justified the convenience of

using MCA because it makes it possible to understand and then evaluate all aspects of a problem across a variety of criteria.
A number of methods can be applied in resolving a problem, such as linear programming (Barković, 2002), AHP (Saaty, 1990), ELECTREE (Čupić et al, 1991), PROMETHEE (Brans et al, 1986, 2005), GAIA (Mareschal, 1988) and other methods. The experiences of authors in this field differ (Brans et al, 1984, 1986, Martić, 1992, Nikolić et al, 1996). In accordance with this paper's research problem, the PROMETHEE and GAIA methods have been applied.
PROMETHEE is an MCA method that makes it possible to express differences in the soundness of a particular site or part of the coastal zone. A mathematical procedure helps to objectivize the suitability of the selection of an NTP site.
The use of the GAIA software provides numerical results and charts that help decision-makers to understand the problem more clearly and gain better insight into the relations between criteria and activities.

4. METHODOLOGY FOR ASSESSING THE IMPORTANCE OF CRITERIA

Based on the research conducted and the results obtained from analysing the facts, the authors have identified the crucial criteria and ranked them in accordance to their importance. The weighting coefficient has been calculated for each criterion, and its preference level.
Any multiple criteria problem contains a number of different and, usually, conflicting criteria that can be of differing importance to decision makers. Most methods of multiple criteria decision-making (MCDM), require information on the relative importance of each criterion (Roubens, 1990). A number of methods can be applied in assessing the level of importance of criteria, each of which relies completely upon human judgement. The techniques in this category may pertain to individuals or to groups of people. Measuring opinions consists of a series of methods used to obtain information from an individual or to gather information from a certain number of people, mostly experts in a field relating to the given problem. The advantage of group opinion over individual opinion is that it provides a broader spectrum of information and brings expertise and experience to the analysis. However, there are certain problems related to the use of expert groups. An important aspect of assessing criteria importance is the fact that the involvement of a number of people will generally result in a varied ranking based on an individual judgement. So, methods are required that serve to synthesize these differing assessments. Relative criteria importance can be expressed in terms of priority or weight. Priority relates to cases in which criteria are listed in order of importance. In this, until a higher level (more important) criterion is taken under consideration, the next (less important) criterion may not be considered. On the other hand, weighting is used to numerically express (usually in percentages) the importance of a criterion or to distinguish between the relative importances of several criteria within the same priority. For the purpose of this research, group weighting methods have been used. These are: (Nikolić et al., 1996).
• **Ranking** – It is assumed that n criteria Aj (j = 1, 2, ..., n) need to be assessed and that l experts Ek (k = 1, 2, ..., l) are involved in this task. Each referee (expert) is required to rank all criteria according to their importance, by assigning the number $n-1$ to the most important criterion, the number $n-2$ to the second most important criterion and so on, down to the least important criterion that is assigned the number 0. This is a fairly simple method and requires little time to obtain the judgements of experts. Because only a set of whole numbers is obtained from each referee, there is no need for weighting the assessments of each individual referee. Instead, only the rankings of all experts are weighted.
• **Rating** – Each referee is presented with the criteria and asked to give a numerical rating to each criterion. Ratings are usually made on a given scale of, for example, 0 – 10 or 0 – 100. Each criterion is weighted separately as the sum of elements in a given line in the table. If these weights need to be normalised, this is done by dividing each criteria with the sum of all weights, which is equal to the number of referees.

5. APPLYING MCA IN SELECTING NTP SITES IN SDC

This chapter analyses SDC spatial and environmental factors and presents criteria and sub-criteria for selecting NTP sites.

5.1. ANALYSIS OF SDC SPATIAL AND ENVIRONMENTAL FACTORS

According to data of the Croatian Bureau of Statistics (2013), SDC is the largest Croatian county in terms of space. SDC has a total area of 14,045 km^2 of which, land accounts for 4,572 km^2 and 67.5% is sea (9,473 km²), (RiĐanović, 2002). The county is located in the central part of southern Croatia in the historical district of Dalmatia. It stretches from Vrlika in the north to the islands Vis and Palagruţa in the south, and from Marina in the west to Vrgorac and Gradac in the east. Its population numbers 455,242 people, of which 67% live in the coastal area; 7%, on the islands; and 26%, in the hinterland. SDC comprises 368 settlements organized in 16 towns and 39 municipalities.
Being the most populated and developed part of Dalmatia, the coastal zone of SDC has always played an important role in terms of traffic in this part of the Adriatic. This is where the traffic corridors running parallel to the coastline intersect with traffic corridors running vertical to the coast from the hinterland (neighbouring Bosnia and Herzegovina), and continue in the direction of the islands and across the Adriatic.
The island area comprises 74 islands and 57 rocks and reefs. The islands are poorly populated. Although economically more developed than the hinterland, the islands have experienced steady emigration due to a variety of circumstances. Four islands stand out in terms of size and population density: Šolta, Brač, Hvar and Vis. Six more islands are also populated: Veli Drvenik, Mali Drvenik, Sv. Klement, Šćedro, Biševo and Sv. Andrija. The islands have a pronounced Mediterranean climate and gentle relief.

Table 3: Spatial features of large SDC islands

Island	Area km^2	Length of coast (km)	Indentedness coefficient
Šolta	58.98	73.1	2.69
Brač	394.57	175.1	2.49
Hvar	299.66	254.2	4.14
Vis	90.26	76.6	2.88

Source: by the authors according to CBS data for 2012

SDC is within the zone of the Adriatic type of Mediterranean climate, the primary features of which are dry, hot summers and mild, humid winters (Filipčić, 1996). Mean annual temperatures drop from the islands towards the coastal zone and hinterland, while the amount of annual precipitation increases. The island area has a warm climate with abundant sunshine, temperatures that rarely drop below zero and little precipitation, unlike the climate of the hinterland where temperatures during the autumn and winter often fall below zero and there is much more precipitation.

5.2. ANALYSIS OF MCA INPUT PARAMETERS – CRITERIA AND SUB - CRITERIA

In resolving the problem of selecting NTP sites in SDC, factors relevant to site selection were previously analysed. The analysed factors were grouped according to their importance and parameters were identified that can be recognized as criteria for site selection. The importance of each criterion based on rating is defined by its weight or priority. Priority represents the importance of an individual criterion in a group of factors. These criteria, together with others identified during analysis, make up the information basis that enables decision makers to choose one solution from a number of proposed solutions. This is important with regard to management structure and the management level of the decision-makers.
Considering that an array of factors impacts the quality and suitability of a coastal area for NTP development, target analysis was used to separate those factors (criteria and sub-criteria) that have the greatest influence on the quality of specific sites and parts of the coastal zone. Elimination criteria were also needed to exclude those areas whose natural features would be substantially threatened by NTP construction.

Table 4: Criteria and sub-criteria for selecting an NTP site in SDC (with assigned weights and established min/max)

Criterion/sub-criteria		***weight***	***min/max***
Institutional and political	**A**	**10**	
Spatial plans of micro locations	**A1**	**8**	**max**
Regional tax and surtax system	**A2**	**2**	**max**

Natural and accommodation	**B**	**25**	
Geo-morphological features (relief of the coastal area, etc.)	**B1**	**5**	**max**
Hydrographic features of the site	**B2**	**7**	**max**
Oceanographic features of the micro location	**B3**	**6**	**max**
Micro climate features	**B4**	**7**	**max**
Environmental	**C**	**25**	
Ecological value and vulnerability of micro location to human activity	**C1**	**8**	**min**
Environmental impact assessment	**C2**	**8**	**min**
Amount of investment in environmental protection (5%-30%)	**C3**	**9**	**max**
Technical and technological	**D**	**15**	
Carrying capacity of micro location – size of vessels (yachts); assumed installed fleet	**D1**	**4**	**max**
Level of development of transport and other infrastructure, distance from airport, distance from Port of Split	**D2**	**3**	**max**
Distance from town cores	**D3**	**3**	**min**
Safety and sailing conditions at the micro location	**D4**	**5**	**max**
Economic	**E**	**15**	
Nautical services offering in the region (potential scope of market activity)	**E1**	**2**	**min**
Offering of providers in surrounding area	**E2**	**3**	**max**
Concession fee	**E3**	**3**	**min**
Investment amount	**E4**	**5**	**max**
Available personnel (professional ability)	**E5**	**2**	**max**
Socio-cultural	**F**	**10**	
Direct and indirect benefits	**F1**	**4**	**max**
Level of urban development and distinctiveness of micro location	**F2**	**3**	**max**
Improvement in quality of life of local community	**F3**	**3**	**max**

Source: the authors

For some (or all) criteria, corresponding qualitative ratings may be given which are translated into quantitative values using a linear scale of 0 – 10 and the ratings *poor*, *average* and *good*. Criteria have two characteristics:

- They can be of the maximization or minimization type.
- Most often they do not have the same importance and it is customary to assign weight coefficients. The sum of sub-criteria weights equals the global (total) weight of a criterion.

In the rating procedure, criteria weights were normalized by the total possible sum (100), which greatly facilitated further analysis.

The greatest weights were given to the Natural and Accommodation criterion and sub-criteria, and the Environmental criterion and sub-criteria. The importance of the Institutional and Political criterion and Socio-cultural criterion is relatively small. The Technical and Technological criterion and Economic criterion are of slightly less importance, which is understandable considering that the economic criterion is not necessarily crucial in selecting suitable sites and is dependent upon technological solutions. Distance from the town core, road and other infrastructure is not a crucial factor considering that research is focused on sites on islands which already have to deal with the problem of distance

and accessibility. When sub-criteria are analysed, it is evident that some sub-criteria have greater weights than others. For example, all three sub-criteria of the Environmental criterion have distinctly greater weights. Interestingly, sub-criteria A1- Spatial plan of micro location – has greater importance than most of the sub-criteria of the Technical and Technological criterion and the Economic criterion. This is because sub-criterion A1 could be a constraining factor in cases where a spatial plan has not been adopted or does not foresee a possible NTP site in a given micro location. Such cases require preliminary research to be carried out and the presentation at the local level of all benefits and advantages that an NTP built at a specific micro location could bring. Special attention should be called to the importance of safety and sailing conditions in selecting a site, as experts have rated this sub-criterion as important in ensuring the safety of boaters and their vessels. Considering the widespread trend in the Mediterranean and worldwide towards vessels exceeding ten metres in length, sea depth plays an important role in selecting sites for NTPs.

6. RESULTS ANALYSIS AND PROPOSED MEASURES FOR FURTHER RESEARCH

The ratings are the results of research based on available data and cartographic presentation of the Croatian Hydrographic Institute of Split for each individual location. Taking into consideration the collected data and the importance of factors for selecting sites for NTPs, the ratings for each group of criteria can be explained.

The Natural and Accommodation criterion is especially important and its sub-criteria were analysed for each individual location, where, for example, the depth of the marina area was established and assigned a certain value. All three sub-criteria were maximized. Criterion C – environmental factors – was rated on a 1-10 scale using five sub-criteria. While the importance and influence of some of these sub-criteria was maximized, in others (C1 and C2) it was minimized. Criterion D – technical and technological factors – consists of four basic sub-criteria rated on a 1-10 scale. Because of their importance, the value of these sub-criteria was mostly maximized. Sub-criteria D2 and D3 referring to the distance of an NTP to the Port of Split and the airport, and to the distance from the town core, respectively, were expressed in separate ratings based on the geographical position of each site. The distances from each site were calculated and a value in points assigned. Criterion E – economic factors – was broken down into five sub-criteria rated on a 1-10 scale, with the exception of sub-criterion E4 which was expressed in actual monetary value. It should be noted that an estimation of the costs of building NTPs in the selected sites is not possible without a comprehensive cost analysis of individual sites. Such an analysis involves the meteorological and hydrographic features of areas. The need to build a breakwater or set up a floating pontoon or sea-wall is determined based on the specific features of each site, considerably impacting construction cost. The availability of infrastructure and the condition of the shore (stone waterfront or a rocky shore full of shoal) also have a great impact on the NTP construction costs. The estimation involved the cost of building NTPs (with 50, 100, 150 or 200 berths). A preliminary cost estimation, which assumes the basic preconditions to building NTPs, was done for the sites included in MCA. This estimation represents the minimal investment required for constructing an NTP and while it may give a site a certain advantage in this phase of research, it is still not the deciding criterion or sub-criterion. The value of the overall investment increases depending on the facilities and services planned and the technological capacity of the nautical port. Criterion F – socio-cultural factors – consists of three sub-criteria, the importance of which has been maximized. The distinctiveness of a micro location contributes towards its selection and may bring direct and indirect benefits to residents. The rated criteria and sub-criteria and their maximization or minimization enable the presentation of the MCA procedure carried out.

The objective of research was to identify the criteria and sub-criteria required for selecting sites for NTPs in the SDC region. Research results point to six groups of criteria and 21 sub-criteria. Obtained by using the MCA method, these results may be used in the decision process to select sites for NTPs in SCD, which will be the subject of further research by the authors.

7. CONCLUSION

Great progress has been made in the Croatian Adriatic in the past 15 years through the development and construction of accommodation facilities for vessels, justifying the market orientation towards nautical tourism. The nautical tourism market is experiencing an upward trend in the Mediterranean and worldwide.

The paper examines the opportunities of developing NTPs in SDC from the viewpoint of proper spatial use and protection. The research conducted has accomplished the goals set out. Stress is placed on the correct selection of methodologies using the group weighting method and MCA, which can be applied in the decision process of selecting the optimum location and facilities for NTPs. The research results point groups of criteria and sub-criteria. In accordance with research problem, authors recomended the PROMETHEE and GAIA MCA methods and Visual PROMETHEE as very usefull software. Based on these insights, further progress can be made in research pertaining to the valuation and management of the marine domain and NTPs.
The criteria have been correctly chosen and are appropriate for the selection of NTP sites in SDC. Research results provide decision-makers with a scientific foundation on which to base further NTP development and site planning.

REFERENCES

Barković, D. (2002). Operacijska istraţivanja, Sveučilište J. Jurja Srossmayera u Osijeku, Ekonomski fakultet Osijek.

Bošković, D., Favro S., Kovačić, M. (2006). Evaluating the Significance of Nautical Tourism for Tourism and Economy, 25th International Conference on Organizational Science Development, Portoroţ, ISBN 961-232-185-X, 957-967.

Brans, J.P., Mareschal, B. and Vincke, P. (1984). Promethee – A New Family of Outranking Methods in Multicriterial Analysis, Operational Research, North Hollan, Amsterdam.

Brans, J.P., and Vincke, P. (1985). A Preference Ranking Organisation Method: The Promethee method for Method for Multiple Criteria Decision - making MCDM, Management Science, 31, 6., p. 647-656.

Brans, J.P., Mareschal, B. and Vincke, P. (1986). How to Select and How to Rank Projects: The Promethee Method, European Journal of operational Research, vol. 24, p. 228-238.

Čupić, M.E., Tummala Rao, V.M. (1991). Savremeno odlučivanje, Naučna knjiga, Beograd, 1991.

Favro, S., Kovačić, M. (2005.). Physical Plans in Managing Sea and Coastal Area, 25th International Conference on Organizational science development: „Change management“, Portoroţ, p. 1049-1058.

Filipčić, A. (1996.): Klimatologija za geografe, Školska knjiga, Zagreb.

HHI and Ministry of Sea, Traffic and Infrastructure, Ministry of Tourism. (2008). Development strategy of nautical tourism in the Republic of Croatia 2009-2019.

Jugović, A., Kovačić, M., Hadţić, A. (2011). Sustainable Development Model for Nautical Tourism Ports, Tourism and Hospitality Management – An International Journal of Multidisciplinary Research, Vol. 17, No. 2, Opatija, Wien, Thessaloniki, str. 175-186.

Kovačić, M. (2010). Selecting the Location of a Nautical Tourism Port by Applying Promethee and Gaia Methods, Case Study – Croatian Northen Adriatic, Promet, Traffic&Transportation, Pardubice, Portoroţ, Sarajevo, Trieste, Zagreb, Ţilina; Vol. 22, No. 5. p. 341-351.

Kovačić, M., Favro, S., Saftić, D. (2012). Comparative Analysis of Croatian and Mediterranean Nautical Tourism Ports, 2nd Advances in Hospitality and Tourism Marketing&Management Conference Proceedings, 31 May - 3 June, Corfu, Greece.

Kovačić, M., Violić, A., Schiozzi, D. (2013). Organized Anchorage and their Impact on Business of Marinas, 32nd International Conference on Organizational Science Development. „Smart Organization. High Potential. Lean Organization. Internet of Things.“ Portoroţ, p. 442-452.

Luck M., (2007). Nautical Tourism: Concepts and Issues, Cognizant Communication Corporation, New York, USA.

Luković, T., (2007): Nautical Tourism- Definition and Classification, Acta Turistica Nova, Vol. 1, No. 2.

Mareschal, B. (1988). Geometrical Representations for MCDA, The GAIA procedure, EJOR, 34, pp. 69-77.

Martić, LJ. (1992). Matematičke metode za ekonomske analize I, IX izdanje, Narodne novine, Zagreb.

Nikolić, I., Borović, S. (1996.). Višekriterijumska optimizacija: metode, primena u logistici, softver, Centar vojnih škola VJ., Beograd.

Roubens, M. (1990). Preference relations on actions and criteria in multi-criteria decision making, European Journal of Operational Research, 10, 1982. p. 51-55.

Saaty, T.L.(1990.). How to make a decision: The Analytic Hierarchy Process, European Journal of Operational Research 48, pp. 9-26, North-Holland.

RiĐanović, J. (2002.). Geografija mora, hrvatski zemljopis. dr. Feletar, Zagreb.

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TRAVEL BEHAVIOUR OF TEENAGERS: KEY ATTRIBUTES IN CHOOSING TOURIST OFFER

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Abstract: *The aim of this paper is to investigate and quantify the preferences of teenagers' travel behaviour. For this purpose research conjoint analysis was used. The survey was conducted in Serbia in 2012 and refers to 163 teenage participants. The findings provided insights into how teenagers evaluate attributes of tourist offer. It has been shown that the price of tourist offer is the most important attribute on the aggregate level. Slightly less important were the following attributes: time of permanency, political stability and leisure offer, while the culture is the least important one. Preference-based segmentation was performed on the conjoint data to isolate homogeneous segments that possess similar preferences for tourist offer. Two segments of teenagers were isolated: Peace Ambassadors and Savers. The results of the study could further serves as a guideline for policy-makers to help them more effectively provide an appropriate tourist offer.*

Keywords*: Teenagers, preferences, conjoint analysis, preference-based segmentation.*

1. INTRODUCTION

Duty to synchronize both customers‟ desires and needs on the one hand and organization goals on the other, with a full social responsibility, create an obligation to approach teenagers as consumers with greater importance. The interest of companies is justified with greater purchasing power of this market although many of them are hoping to attract older consumers through this category.

Over half-billion global teens between the ages of 13 and 18 represent a dynamic opportunity for marketers who wish to grow their businesses and build consumer loyalty. Teens represent a primary market that purchases goods, an influential market that directs parental expenditures, and a future market for all retail products and services. Numerous businesses are targeting the attractive teen consumer market; however, few understand that new strategies are required to address teens‟ unique interests, choices and variety of experiences (Crutsinger et al. 2010).

Accurately defining adolescence is difficult because, like all life stages, it is a complex construct formed from socio-cultural, psychological, anatomical, legal and chronological components that may be spatially and temporally specific (Gullotta et al. 2000). This means the boundaries between adolescence and the stages that precede and follow it are fuzzy rather than distinct. As a result, there is no universally agreed definition of „adolescence‟. This research paper, however, will focus on teenagers from 15 to 19 years old although Coleman and Hendry (1999) define teenager as someone who is 12 to 17 years old.

In 2010 young travelers generated 165 billion US$ towards global tourism receipts, affirming their financial value to the global tourism industry and local economies. The last WYSE Travel Confederation New Horizons survey indicated that young travelers spent a total of US$2,600 on their main trip, compared with an average of US$950 per trip for international tourists as a whole. Since young people often take much longer trips than most other tourists, they end up spending more (UNWTO – WYSE, 2011). The importance of this market segment lies not only in the fact that their number is increasing, but also that they represent the market of the future. Compared to their older counterparts, young travelers are much more likely to revisit a tourist destination. Young travelers are very often pioneers; they like to discover new destinations. They also like their travelling to include some cultural content and they do not give up the destinations which are politically unstable or subject to natural catastrophes.

Spero and Stone (2004) suggest that teens need to be understood beyond traditional age classifications. Using a sophisticated segmentation strategy considering lifestyle variations and individual differences, marketers can reveal a more precise depiction of teens. Therefore, the purpose of this study is twofold: Firstly, to determine the preferences of teenagers while choosing a tourist offer, in order to understand tourist market better and to develop marketing strategies which suit this target segment. Secondly, to evaluate the usefulness of preference based segmentation in understanding travel-related behaviour among teenager consumers in Serbia. Specifically, the objectives of the study were to determine, first, whether teenagers could be grouped together based on similarities and differences in preferences for travelling; secondly, whether statistically significant differences existed between the resulting segments. In this regard, this study will profile the diversity of the market for a teen traveler, based on their distinctive preferences.

To elicit preferences of teenagers, in this paper we used conjoint analysis. Conjoint analysis is a consumer research technique developed to provide a method for determining the relative contributions of multiple factors to customer satisfaction. By using conjoint analysis it is possible to determine which attributes are important to certain customers, or market segments, in the selection of a travel destination.

2. KEY DRIVERS FOR TEENAGERS TRAVELING

Consuming is a complex social phenomenon especially with respect to adolescents (Benn, 2004) and teenagers can send messages through their consumption styles to illustrate commitment to different groups (peers), different lifestyles, and possibly even political or ecological affiliation (Miles, 1998). Children were first treated as consumers in the 1960s. The history of children"s consumer development dates back to the 1950s with the publication of a few isolated studies. After that, a considerable amount of literature has been published on children"s understanding of marketing and retail functions (John, 1999). Consumer socialization is a developmental process that proceeds through a series of stages as children mature into adult life. These changes take place through these series of stages helping the process of consumer socialization of children. Those wanting to do business with the teen market are motivated by three very practical reasons: (1) the estimated $175 billion (Hempel and Lehman, 2005; Wells, 2004) a year spent by this age group on product and services; (2) the amount of purchases and consumption experiences (e.g., movies, vacations, etc.) they influence among their families and friends; and (3) the possibility that, if done correctly, both brand name recognition and brand preferences can be influenced now to affect future purchases. Children of all ages influence an estimated $500 billion in family purchases (Moore, 2004). The teen market is both financially important to marketing professionals and a great source of product and market knowledge. The beginning of financial independence (access to part-time jobs, spending money, and debit/credit cards) is rooted in adolescence (Mangleburg and Brown, 1995) and may be related to adolescent consumption autonomy.

Furthermore, within the context of tourism, adolescents represent one of the largest markets for tour operators and other vacation service providers (Kang et al. 2003). This is why it is very important to understand what the key factors which motivate them to travel really are. Traveler"s motives represent a critical point in deciding on the purchase of a tourist product. Traditionally, tourism researchers argue that people go on vacation (1) in order to get away from everyday experience and (2) in search of new experiences.

Based on Maslow"s (Maslow, 1970) need hierarchy theory on motivation, Pearce"s Travel Career Ladder (TCL) „describes tourist motivation as consisting of five different levels: relaxation needs, safety/security needs, relationship needs, self-esteem and development needs, and self-actualization/ fulfilment needs" (Pearce, 2005). One of the best known typologies of tourist motives was proposed by Crompton (1979), who classifies motives into those which „push“ tourists to travel and motives which „pull“ tourists towards a tourist destination. In other words, people travel because they are "pushed" by their inner motives or because they are "pulled" by external factors of a tourist destination (Lam and Hsu, 2006).

Carr (2006) researched adolescent motivation in tourism. He made a list of 18 most important motives and listed them according to their significance: to relax; to be with friends/relatives; to get away from responsibilities; to see new things/places; to visit friends/relatives; to make new friends; to shop; to

party and dance; to engage in sport or exercise; to experience different cultures; to get a suntan; to visit heritage and historical sites; to enrich your education; in search of romance; to drink alcohol; in search of sex; to experiment with/use drugs. This list is very similar to Horner and Swarbrooke‟s (2004) stereotypical image of a North European teenager as someone who „loves beaches, sunbathing, and the idea of partying‟ in the holiday.

3. METHOD

3.1. Conjoint Analysis: Conceptual Framework

The conjoint measurement has psychometric origins as a theory, to decompose an ordinal scale of holistic judgment into interval scales for each component attribute. Originally developed by psychologist Luce and statistician Tukey (Luce and Tukey, 1964), conjoint analysis has attracted considerable attention in the field of mathematical psychology since the mid 70‟s, especially in marketing research, as a method that portrays consumers‟ decisions.

The conjoint analysis, sometimes called the „trade-off analysis‟, reveals how people make complex judgments. The technique is based on the assumption that complex decisions are made not based on a single factor or criterion, but on several factors CONsidered JOINTly, hence the term conjoint. Conjoint analysis enables the investigator to better understand the interrelationship of multiple factors as they contribute to preferences.

This approach has been broadly defined as “any decomposition method that estimates the structure of a consumer‟s preferences given his or her overall evaluations of a set of alternatives that are pre-specified in terms of levels of different attributes” (Green and Srinivasan, 1990). The basic assumption that underlies the decomposition approach is that customers evaluate the total utility of a product or service by combining the separate utilities to assess the attribute levels of that product/service.

3.2. Survey Procedure

There are several stages in the design and analysis of conjoint analysis studies (Ryan et al., 1998; Kuzmanovic, 2006): (1) Generating a list of key attributes and attributes levels; (2) Construction of the experimental design; (3) Survey implementation; (4) Data analysis; (5) Market simulations.

Generating a list of key attributes and attributes levels. The initial step is to identify the attributes of importance to the study question. We identified six key attributes based on literature review (Vukic et al. 2013; Lopes al. 2009), the previous work, and the pilot survey. In stage two, attribute levels have to be defined. The identified attributes and levels assigned to them are shown in Table 1.

Table 1: List of key attributes and their levels

Attributes	Description	Levels
Destination	Kind of tourist offer	Beach Mountain City
Time	Duration of stay at destination	2-3 days (Weekend) 4-7 days 8-12 days
Culture	Historical and cultural heritage	Rich Poor
Leisure	Level of tourist Leisure activities and Night fun	Rich Poor
Price	Price of tourist offer	Up to150€ 150-250€ 250-450€ > 450€
Stability	Political stability and safety of tourists	Stable Unstable

Construction of the experimental design. The next stage in the conjoint analysis study is to decide which scenarios to present to individuals, i.e. to generate an experimental design (Kuzmanovic,

2008). The attribute and levels in Table 1 gave rise to 288 possible scenarios ($4^1 \times 3^2 \times 2^3$). Since respondents could not realistically be expected to consider such a large number of different scenarios, a component of the statistical package SPSS (Orthoplan) was used to reduce the possible number of profiles to a manageable level, while still allowing the preferences to be inferred for all of the combinations of levels and attributes. The use of Orthoplan results in an orthogonal main effects design, thus ensuring the absence of multicollinearity between attributes. Through the use of this design, the 288 possible profiles were reduced to 16.

Survey implementation. Having established the experimental design, the next stage is to elicit preferences for the scenarios. In this study the rating approach was used. Respondents were presented with each of the 18 profile scenarios, 16 from the experimental design and 2 holdout tasks. Individuals were asked to state their level of preference for each scenario on a Likert's scale of 1 to 7, where 1 indicated "I certainly do not choose ", and 7 indicated "I certainly choose". Holdout cases are judged by the respondents but are not used to estimate utilities. They are used as a check on the validity of the estimated utilities.

Data were collected online through a web-based questionnaire. For that purpose we used social networks (Facebook, Twitter) and electronic mail. This method of data collection was chosen for several reasons: (1) Online surveys are less expensive than the traditional “paper and pencil”; (2) An online survey can be filled out simultaneously by a greater number of people; (3) The questionnaire is available to a greater number of people.

Conjoint model specification. Having collected the information on individual preference, the responses need to be analyzed. The simplest and most commonly used model is the linear additive model. This model assumes that the overall utility derived from any combination of attributes of a given good or service is obtained from the sum of the separate part-worths of the attributes. Thus, respondent *i*'s predicted conjoint utility for profile *j* can be specified as follows:

$$U_{ij} = \sum_{k=1}^{K} \sum_{l=1}^{L_k} \beta_{ikl} x_{jkl} + \varepsilon_{ij}, \qquad i = 1,...,I, \;\; j = 1,...,J, \tag{1}$$

where *K* is the number of attributes; L_k is the number of levels of attribute *k*. β_{ikl} is respondent *i*'s utility with respect to level *l* of attribute *k* (part-worths). x_{jkl} is such a (0,1) variable that it equals 1 if profile *j* has attribute *k* at level *l*, otherwise it equals 0. ε_{ij} is an error term.

The relative importance of each attribute is further calculated as the utility-range (difference between the highest and the lowest utility for that attribute) divided by the sum of utility ranges of all attributes:

$$FI_{ik} = \frac{\max_l\{\beta_{ikl}\} - \min_l\{\beta_{ikl}\}}{\sum_{k=1}^{K}\left(\max_l\{\beta_{ikl}\} - \min_l\{\beta_{ikl}\}\right)}, \; i = 1,...,I, k = 1,...,K, l = 1,...,L_k \tag{2}$$

The calculations are done separately for each respondent, and the results are then averaged to include all of the respondents.

Given that part-worth utilities are calculated at the individual level, the researcher can find preference heterogeneity if it is present. Therefore, part-worths can be used for preference-based segmentation. Respondents who place a similar value on various attribute levels will be grouped together into a segment, and the segmentation of conjoint part-worths produces true “benefit segments”. Part-worth utilities can be also used to obtain overall utility values for all possible combination of attribute levels, i.e. for all possible profiles (by inserting the appropriate part-worths into equation 1.) in order to conduct what-if analysis.

To estimate the part-worths as well as relative importance of attributes, the statistical package SPSS 16.0 (Conjoint procedure) was used. The parameters were estimated for each respondent in the sample individually, as well as for the total sample.

4. RESULTS AND DISCUSSIONS

In total 163 respondents, teenagers (from 14 to 19 years) completed questionnaires. The ratio between male and female examinees was roughly 1:3, actually, the number of male examinees was 40 (24.5 %), and female 123 (75.5 %). There were 30 respondents with income up to 100€ per household member, 55 from 100€ to 299€, 50 of them has income from 300€ to 499€, 19 people are between 500€ and 999€, and finally only 9 respondents have income higher than 1000€.

4.1. Aggregated Preferences and what-if analysis

The averaged results are shown in Table 2. The results suggest that the Price is the most important attribute (27.308%), then comes Time of permanency with importance of 20.171%. Slightly less importance on aggregate level has Political stability (19.926%). Relatively slightly important are attributes Kind of destination (13.212%) and Leisure offer and Night fun (10.121%), while Cultural offer is the least important attribute (9.263%).

The statistics for the estimated models are also presented in Table 2. A high value of the Pearson coefficient, 0.988, confirms the high level of significance of the obtained results. Similarly, a high value of the Kendall correlation coefficient, 0.900, indicates a high level of correlation between the input and the estimated preferences. The Kendall coefficient for two holdout profiles has a value of 1.000, which is an additional indicator of the high quality of the obtained data. The signs of the part-worths were all as expected, including the negative coefficient for the lowest levels of attributes. This is especially obvious for attributes with two levels, such as Political stability, Leisure offer and Night fun, Cultural offer (see Table 2).

Table 2: Aggregate level analysis (averaged results).

Attributes/levels	**Attributes' importance (%)**	**Part-worth utilities**	**Std. Error**
Destination	13.212		
Beach		0.034	0.123
Mountain		-0.046	0.145
City		0.012	0.145
Time	20.171		
2-3 days (Weekend)		-0.773	0.123
4-7 days		0.137	0.145
8-12 days		0.636	0.145
Culture	9.263		
High		0.263	0.092
Low		-0.263	0.092
Leisure	10.121		
High		0.321	0.092
Low		-0.321	0.092
Price	27.308		
Up to 150€		0.677	0.160
150-250€		0.558	0.160
250-450€		-0.191	0.160
> 450€		-1.044	0.160
Stability	19.926		
Stable		0.819	0.092
Unstable		-0.819	0.092
Constant=3.928			
Correlations between observed and estimated preferences			
	Value	**Sig.**	
Pearson's R	0.988	0.000	
Kendall's tau	0.900	0.000	
Kendall's tau for Holdouts	1.000		

As for the attribute Price, the first two levels: “up to 150€“ (0.677) and the level “from 150€ to 250€“ (0.558) increase the consumers‟ total preferences. As opposed to these, two next levels “from 250€ to 450€“ (-0.191) and “> 450€“ (-1.044) have negative values of part-worth so that they decrease consumers‟ total preferences. Considering the highly rated attribute Time of permanency, the respondents prefer the offer from 8 to 12 days. Although somewhat lower, positive preferences were

also given to the second level, that is, 4-7 days. Compared to these two levels, the 2-3 days offer decreases the total preferences (-0.773). The attribute Kind of destination, has a positive part-worth for the levels Beach (0.034) and City (0.012) and these two levels increase consumers‟ total preferences, whereas the last level Mountain with a part-worth of -0.046 decreases the total preferences (due to its negative value).

Considering the respondents‟ preferences at the aggregate level, the optimal tourist offer could be described as: 8-12 days on the beach, with rich cultural offer and night life, stable political region and the price as low as possible, up to 150 Euros. The total utility of such a scenario is 6.678.

If we offered participants mountains in exchange for the sea, and leave all other attributes on their highest levels, the total usefulness would be 6.598 (only 1.2% lower). It is such a small decrease because this attribute is not so important. On the other hand, if we looked at the most important attribute “Price” by raising the offer on the next level (from less to 150€ to price level from 150€ to 250€) the total usefulness would drop by 7%, while raising it even higher (on next price level from 250€ to 450€) we would have even higher decline of 15%. If travel deals offer a destination which is not politically stable on top of that, we would have a total usefulness drop of 35%.

Such an analysis is possible to be conducted for all the potential attribute combinations depending of requisitions that can emerge so we could have higher flexibility of tourism enterprises and anticipation of changes in customers' preferences. Such data can be further used in actual marketing scenarios as import parameters for positioning (prediction) of potential market share.

4.2. Preference Based Segmentation

A more detailed analysis of part-worths at the individual level revealed wide heterogeneity in consumer preferences. Therefore, a cluster analysis was performed to classify respondents into more homogeneous preference groups. These part-worths are then used as input for cluster analysis. This approach has been conducted by various researchers across industries, in order to determine customer segments based on distinct preference profiles (Lopez 2009; Kuzmanović et al. 2013).

The k-means cluster procedure in SPSS 16.0 was used to perform the segmentation. Based on the sample size, the solutions were searched in two and three clusters. A 2-cluster solution was chosen due to the size of the segments and statistical significance. An analysis of variance revealed that the segments in the 2-cluster solution differed significantly from each other, with respect to their part-worths (Table 3). Cluster level part-worths and attributes importance are also presented in Table 3.

Table 3. Cluster analysis results

Attributes and levels		**Attribute importance**		**Part-worths**		
		Cluster 1 (n=94)	**Cluster 2 (n=69)**	**Cluster 1**	**Cluster 2**	**Sig.**
Destination	Beach	1.54%	3.21%	-0.04	0.13	0.024
	Mountain			-0.01	-0.09	0.390
	City			0.05	-0.04	0.312
Time	2-3 days	20.52%	25.72%	-0.62	-0.99	0.000
	4-7 days			0.08	0.22	0.052
	8-12 days			0.54	0.77	0.003
Culture	High	13.39%	3.21%	0.38	0.11	0.000
	Low			-0.38	-0.11	0.000
Leisure	High	12.54%	8.19%	0.35	0.28	0.281
	Low			-0.35	-0.28	0.281
Price	up to 150€	17.01%	42.23%	0.26	1.24	0.000
	150-250€			0.35	0.84	0.000
	250-450€			-0.01	-0.44	0.000
	> 450€			-0.60	-1.64	0.000
Stability	Stable	35.00%	17.46%	0.98	0.60	0.000
	Unstable			-0.98	-0.60	0.000

The first segment, “Peace Ambassadors”, characteristics. The first segment includes 94 respondents, that is, 57.67% of the total sample. This group of tourists attaches the main importance to the attribute Political Stability (35.00%). The second level attribute by importance in tourist offer is “Time of Permanency” (20.52%), where the preferred duration of stay is from 8 to 12 days. Other

attributes have proved to be less important. The type of destination that they would most likely choose would be a metropolis, although that attribute had the smallest importance (importance only = 1.54%). The price level that they are willing to pay includes the first two levels of this attribute (up to 150€ and a price level from 150€ to 250€). The other two levels lower the total preferences.

The second segment, "Savers", characteristics. The second segment consists of 69 respondents, that is, 42.33% and is made up of the respondents to whom the price is by far the most important attribute in the choice of the tourist offer (42.23%) whereat they are willing to pay the price up to 150€, but they also consider acceptable the price level from 150€ to 250€ in which they are very similar to the first cluster group. A relatively higher importance has duration of stay (25.72%), which shows that this type of teenagers would most likely choose an offer for a vacation from 8 to 12 days. Next to last is "Leisure" attribute (8.19%). The least important attributes in this survey came out to be "Culture" and "Destination" with importance scores of just 3.21%. Although "Destination" is the least significant attribute (3.21%), we can see that this type of participants prefers the sea, while a mountain and a metropolis lower the total preferences.

Having in mind the segment size and customers‟ preferences toward tourist offer, it is possible to suggest adequate marketing strategies for tourist companies, in which we could underline attributes of higher importance and thereby gain a competitive advantage on the market. Tourist companies, in particular, would benefit from improving tourist products that could satisfy the needs and preferences of this segment by creating and delivering values that could lead to building long term relations with customers. By creating a tourist offer that can even satisfy the latent needs of teenagers as tourists, it opens up possibilities for building a future loyalty and it can even encourage consumers to pay a higher price for their dream vacation.

5. DISCUSSION AND CONCLUSIONS

Today teenagers are more and more sofisticated consumers who are more difficult to entertain than their parents. First of all, it is because teenagers are richer than ever thanks to getting higher and higher pocket money, and a bit older ones also earn money from part time jobs or sometimes household work.

Insted of common focusing on teenager-product relationship, this survey deals with their preferencies in tourism. More accurately, we used the conjoint analysis to determine the desirable features of tourist offers targeting this group in order to examine how teenagers in Serbia decide when choosing between travel deals. To our knowledge, this is the first study to use conjoint analysis to reveal teenagers‟ preferences towards tourist offer both in Serbia and abroad.

Results indicate that price was the most important atribute, as expected, considering the limited income of teenagers, which is also consistent with the results presented by Lopes (2009). Leisure offer and Night fun and Cultural offer came out as the least significant, which came as a suprise considering that we targeted teenagers, but we have to consider averaging of results. These findings differs from Swarbrooke‟s (2004) stereotypical image of a teenager as someone who who „loves beaches, sunbathing, and the idea of partying‟ in the holiday environment. For checking heterogenity of these teenage preferencies, we conducted a post hoc segmentation based on the conjoint data, which gave noticeable differencies. We segregated two clusters here: one that considered the price as the most important attribute - „Savers“ and one that most values political stability – „Peace Ambassadors“. We also concluded with this analysis that some attributes, such as Leisure offer and Night fun have a higher importancy than we concluded based on the average results, while the attribute Kind of destination which is very well ranked in average attribute importance evaluation, came out as almost insignificant.

What-if analysys can offer a good simulation of the change in preferencies if we change an attribute level. For example, the change of political stability of a destination would most likely affect travel deals with a drop of 35%. The posibility of anticipation of this kind of changes allows tourist enterprises more flexibility but also a chance to lower the percentage of 35% offering early booking or better terms of payment, like we had in the case of Serbian tourists traveling to Egypt and Tunisia in a situation when political stability in these countries was not on a high level.

Knowing these results as well as teenager desires and preferences that affect travel deals can help marketing a lot to target the market segment, to create values, to come out with new ways of

advertising, but also in promotional campaigns so that teenagers can be more convinced that there is a clear and an important difference between different tourist companies.

REFERENCES

Barua, P., & Islam, S. (2011). Young consumers‟ purchase intentions of buying green products. A study based on the Theory of planned behavior, Master thesis. Umea School of Business.

Benn, J. (2004). Consumer education between consumership and citizenship: experiences from studies of young people, International Journal of Consumer Studies, 28, 108-116.

Carr, N. (2006). A comparison of adolescents‟ and parents‟ holiday motivations and desires, Tourism and Hospitality Research, 6(2), 129-142.

Coleman, J., & Hendry, L. (1999). The nature of adolescence (3rd ed.). London: Routledge.

Crompton, J.L. (1979). Motivations for pleasure vacations. Annals of tourism research 6(1), 418-424.

Crutsinger, C., Knight, D., & Kim, H. J. (2010). Teens‟ consumer interaction styles: The impact of assertive and aggressive behaviour on attitudes towards marketing practices, International Journal of Consumer Studies, 34 (2), 196-203.

Green, P.E., Srinivasan, V. (1990). Conjoint analysis in marketing research: New developments and directions. *Journal of* Marketing*,* 54, 3-19.

Gullotta, T.P., Adams, G.R., & Markstrom, C.A. (2000). The adolescent experience (4th ed.). San Diego, CA: Academic Press.

Hempel, J. & Lehman, P. (2005), The MySpace generation”, Business Week, December 12.

Horner, S. & Swarbrooke, J. (2004). International cases in tourism management‟, Elsevier, Amsterdam.

John, D.R. (1999). Consumer socialization of children: A retrospective look at twenty-five years of research. Journal of consumer research, 26(3), 183-213.

Kang, S., Hsu, C. & Wolfe, K. (2003). Family traveler segmentation by vacation decision-making patterns‟, Journal of Hospitality and Tourism Research, 27(4), 448-469.

Kuzmanovic, M. (2006). Quantitative methods in marketing management: Application of conjoint analysis. Serbian Operations Research Society, Belgrade. (In Serbian).

Kuzmanovic, M. (2008). The nonstandard algorithm for constructing efficient conjoint experimental designs. Yugoslav Journal of Operations Research, 18(1), 63-74.

Kuzmanovic, M., Radosavljević, M., Vujošević, M. (2013). Understanding student preferences for postpaid mobile services using conjoint analysis. Acta Polytechnica Hungarica, 10(1), 159-176.

Lam, T., & Hsu, C.H.C. (2006). Predicting behavioral intention of choosing a travel destination. Tourism Management, 27(4), 589-599.

Lopes, S.D.F., Boubeta, A.R., & Mallou, J.V. (2009). Post hoc tourist segmentation with conjoint and cluster analysis. PASOS. Revista de Turismo y Patrimonio Cultural, 7(3), 491-501.

Luce, R.D., & Tukey J.W. (1964). Simultaneous conjoint measurement: A new type of fundamental measurement. Journal of Mathematical Psychology, 1, 1-27.

Mangleburg, T.F., & Brown, J.J. (1995). Teens' sources of income: jobs and allowances. Journal of Marketing Theory and Practice, 3(1), 33-47

Maslow, A. (1970). Motivation and personality. New York: Harper & Row.

Miles, S. (1998). Consumerism as a way of life. Sage: London.

Moore, E.S. (2004). Children and the changing world of advertising. Journal of Business Ethics, 52(2), 161-167.

Pearce, P. (2005). Tourist behaviour: Themes and conceptual schemes. Clevedon Buffalo: Channel View Publications.

Quart, A. (2003). The buying and selling of teenagers. Cambridge, Maine: Perseus Publishing

Raley, S.B. (2006). Children‟s time use: too busy or not busy enough. In: Bianchi, S.M., Robinson, J.P., Milkie, M.A. (Eds.), Changing rhythms of American family life. Russell Sage Foundation, New York.

Roshan, D., Ahuja, Tara Anne Michels, Mary Mazzei Walker & Weissbuch, M. (2007). Teen perceptions of disclosure in buzz marketing. Journal of consumer marketing, 24(3), 151-159.

Ryan, M., Mcintosh, E., & Shackley, P. (1998). Methodological issues in the application of conjoint analysis in health care. Health economics, 7(4), 373–80.

Spero, I., & Stone, M. (2004). Agents of change: how young consumers are changing the world of marketing, Qualitative market research: An International Journal, 7(2), 1853-1859.

UNWTO–WYSE. 2011. The Power of Youth Travel. AM Reports Volume 2. Retrieved from http://www2.unwto.org/ (accessed March 2014).

Vukic, M., Kuzmanovic, M., & Kostic Stankovic M. (2013). Evaluating tourist offer attributes using conjoint analysis, Proceedings of XI Balkan Conference of Operational Research, Belgrade-Zlatibor, September, 2013, 409-418.

Wells, M. (2004). Kid nabbing, Forbes, 173(2), 84-88.

PREFERENCES TOWARDS ORGANIC VS. NON-ORGANIC FOOD: AN EMPIRICAL STUDY OF CONSUMERS IN SERBIA

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Abstract: *Organic agriculture has become not only a significant public issue but also an important topic in academic research in the world. Because of importance and prospects of the organic agriculture, it is essential to elicit both the consumer preferences toward organic versus non-organic produced food and attitudes towards purchasing organic food. Therefore, the main objective of this paper is to analyze empirical determinants of organic food consumption by consumers from Serbia. For that purpose, we used conjoint analysis. The survey was conducted in Serbia, in January 2013. Results indicate that the price is the most important attribute for the entire population, and also that consumers have heterogeneous preferences when it comes to food origin and method of producing. It is shown that socioeconomic and demographic factors have important influence on customer behaviour in the process of buying. Based on the results of the study, it is possible to determine the optimal strategy for producers of organic products in Serbia.*
Keywords*: Organic food, consumers preferences, socioeconomic and demographic variables, conjoint analysis, segmentation*

1. INTRODUCTION

The main objective of organic agriculture production is to provide high quality food and sustainable agriculture development with the preservation of the ecosystem and maintaining and increasing soil fertility. It is obvious that maximum use of renewable energy sources is necessary, as well as maintaining genetic diversity of ecosystem and the environment. This will reduce all forms of pollution that may be the result of agricultural production in order to create the proper conditions for organic food production.

Since the organic food production in Serbia is a new trend, it is important to care about every single consumer. Although the most of the consumers have positive opinion about organic products, they don't behave consistently when purchasing them. Consumers trust in the product integrity is of crucial importance, in particular if the key attribute entails a price premium, as is the case with organic food. The organic food industry must better understand the variety of motives, perceptions, and attitudes consumers hold regarding organic food and their consumption in their own long-term interests.

In order to define effective strategic plans, research is of great importance – for understanding consumers' needs, life styles and decision making processes. The main objective of this paper is to analyze empirical determinants of organic food consumption using the data on sample of consumers from Serbia. Results obtained after this survey should help organic manufacturers, exploit development opportunities of Serbia in organic production. Survey is conducted to examine the preferences of the population towards the use of organic food. All the respondents answered questions and provided information about their patterns of consumption, ability and willingness to pay for organic food, their opinions on cultivation of organic food and demographic and sociodemographic information about their households.

To elicit consumers preferences toward organic food, conjoint analysis, one of the most widely used preference-based techniques, was applied in this study. The conjoint analysis is a consumer research technique developed for determining the relative contribution of multiple factors to consumer satisfaction.

The literature considers different issues related to the use of conjoint analysis in agriculture. Walisinghe and Gunaratne (2009) tried to determine consumer preferences for different quality attributes of rice. The appropriate attributes and levels were identified from a focus group discussion and subsequently a conjoint questionnaire was administered using a sample of 185 consumers under a fractional factorial design. Manalo (1990) in his paper illustrates the use of conjoint analysis in assessing consumer preferences for the attributes of an agricultural product (apple). The most important attribute was flavour instead of size, colour or price. Aizaki (2010) presented a paper whose purpose was to assemble topics related to agriculture that were treated using multi-attribute stated preference methods and conjoint analysis in Japan. Sydorovych and Wossink (2008) proposed a methodology that could be beneficial in aggregate sustainability assessment. They applied conjoint analysis to identify economic, social, and ecological attributes that are perceived as important for agricultural sustainability by different stakeholders and to assess their relative impact on the

overall sustainability measure. In USA author Evans (2008) conducted a survey in order to identify the influence certain consumer preferences have on watermelon purchasing behaviour.

2. MATERIALS AND METHOD

2.1. Conjoint analysis: Modeling of consumer preferences

Conjoint analysis is a multivariate method used to find the preferences of respondents for certain products and services (Hair, Anderson, Tatham and Black, 1999), and it is important to businesses that are evaluating new product or service attributes (Green and Srinivasan, 1978). Conjoint analysis is consistent with Lancaster's theory of utility maximization, where consumers demand attributes from a given product (Lancaster, 1971; Lusk and Hudson, 2004).

The Conjoint analysis is based on the idea that consumers evaluate the value of a product by combining the different amounts of value provided by each attribute. Thus, it is possible to elicit consumer preferences regarding the attributes of food characteristics, in this case organic products, among others. There are three main elicitation techniques: ranking (respondents rank alternative bundles from least favorite to most favorite), rating (respondents rate alternative bundles given a scale), and discrete choice (respondents are allowed to choose only one option). Ranking responses ostensibly provides more information than a single choice elicitation technique because it provides information for all profiles. A rating scale requires respondents to make judgments about the level of utility associated with each profile and assumes that this judgment directly transfers utility to the rating scale (Champ, Boyle and Brown, 2003).

The attraction of using conjoint analysis is that it asks the respondents to make choices between products defined by a unique set of product attributes in a way resembling what they normally do - by trading off features, one against the other. When asked which attributes they would like, most customers will choose everything on the wish list. Conjoint analysis can establish the relative values of particular attributes and identifies the trade-offs the customers are likely to make in choosing a product and service and the price they are willing to pay for it.

A conjoint analysis study includes the following key steps:
1. *Attribute List Formulation*. A business problem is defined and an attribute (features) list as well as their performance levels is developed to study the problem.
2. *Data collection.* Respondents are asked to express the trade-offs they are willing to make among product features by rating, sorting or choosing among hypothetical product concepts.
3. *Utility calculation*. A set of preference values (also called part worth utilities or part-worths) is derived from the interview data; they reflect the trade-offs each respondent made.
4. *Market Simulation*.

2.2. Research objective and design

The survey took place in Serbia, in January 2013. In total, 178 individuals completed the questionnaire in order to examine the preferences of the population in Serbia towards the use of organic food. Respondents provided information about their patterns of consumption, ability and willingness to pay for organic food, in this particular case – carrot, their attitudes toward the cultivation of organic food in Serbia and abroad, as well as demographic information about their households. Based on the results of this study, later it would be possible to determine the optimal organic food offer for the population in Serbia.

A list of key attributes is generated based on existing literature (Wang and Sun, 2003), market analysis and assumption that there is a correlation between them and consumers' behaviour. The attributes and levels assigned to them for the purpose of this study are: Production method and certification, Product origin, and Price. The attribute Production method and certification includes the modes of production and may be non-organic or organic, while organically produced food can be certified or without certificate. Certificate is the proof that food is controlled by those who are licensed by the state law. The Product origin represents a place of production, and refers to the fact that the food is produced in Serbia or abroad. The attribute Price represent current price of carrots in the market and has five levels: 50, 100, 150, 200 and 250 RSD/kg.

Once the attributes and their levels are defined, next step is to generate experimental design. Number of attributes (three) and the corresponding levels would lead to an unmanageable number of potential product profiles ($3\times2\times5=30$); therefore, it was necessary to generate a representative subset known as an efficient design. We generated near orthogonal and almost balanced experimental design with 18 profiles (Table 1). In order to elicit the preferences for the various profiles, in this study a rating approach was used. The

respondents expressed their preferences for a particular profile on a scale of 1 to 5, where 1 stands for definitely not buy, and 5 stands for buy for sure. The data was collected using social networks (Facebook, Twitter, www.ringeraja.rs, www.roditeljportal.com, www.kutak.forumotion.com, http://forum.b92.net/index.php) and by e-mail.

Table 1: Experimental design

ID	Production method and certification	Origin	Price
1	Non-organic production	Serbia	50 RSD/kg (0.5 €/kg)
2	Non-organic production	Serbia	100 RSD/kg (1 €/kg)
3	Non-organic production	Serbia	150 RSD/kg (1.5 €/kg)
4	Non-organic production	Abroad	50 RSD/kg (0.5 €/kg)
5	Non-organic production	Abroad	100 RSD/kg (1 €/kg)
6	Non-organic production	Abroad	150 RSD/kg (0.5 €/kg)
7	Non-certified organic production	Serbia	50 RSD/kg (0.5 €/kg)
8	Non-certified organic production	Serbia	100 RSD/kg (1 €/kg)
9	Non-certified organic production	Serbia	150 RSD/kg (1.5 €/kg)
10	Non-certified organic production	Abroad	150 RSD/kg (1.5 €/kg)
11	Non-certified organic production	Abroad	200 RSD/kg (2 €/kg)
12	Non-certified organic production	Abroad	250 RSD/kg (2.5 €/kg)
13	Certified organic production	Serbia	150 RSD/kg (1.5 €/kg)
14	Certified organic production	Serbia	200 RSD/kg (2 €/kg)
15	Certified organic production	Serbia	250 RSD/kg (2.5 €/kg)
16	Certified organic production	Abroad	150 RSD/kg (1.5 €/kg)
17	Certified organic production	Abroad	200 RSD/kg (2 €/kg)
18	Certified organic production	Abroad	250 RSD/kg (2.5 €/kg)

Conjoint analysis implies the assumption that the choice behaviour of consumers is guided by the maximization of utility. To determine the total utility, the additive model is commonly used. Considering the three attributes that are evaluated in this study, the econometric representation of the additive utility model is expressed as follows:

$$U_{ij} = \sum_{l_1=1}^{3} \beta_{i1l_1} x_{j1l_1} + \sum_{l_2=1}^{2} \beta_{i2l_1} x_{j2l_1} + \sum_{l_3=1}^{5} \beta_{i3l_1} x_{j3l_1} + \varepsilon_{ij}, \; i=1,...,I, \; j=1,...,18 \quad (1)$$

where U_{ij} represents respondent *i*'s predicted conjoint utility for profile *j*. $\beta_{i1l_1}, \beta_{i2l_2}, \beta_{i3l_3}$ are the coefficients (part-worth utilities) associated with the characteristics of each attribute, l_1 =production method (Non-organic production, certified organic production, and non-certified organic production), l_2 =product origin (Serbia and abroad), l_3 =price (50, 100, 150, 200 and 250 RSD/kg). $x_{j1l_1}, x_{j2l_2}, x_{j3l_3}$ are (0,1) variables that it equals 1 if profile *j* is characterized by corresponding attribute level, otherwise it equals 0. ε_{ij} is the error term

The relative importance of each attribute is further calculated as the utility-range (i.e. difference between the highest and the lowest utility for that attribute) divided by the sum of utility ranges of all attributes. The calculations are done separately for each respondent, and the results are then averaged to include all of the respondents.

The calculations were performed using the statistical package SPSS 16.0 (Conjoint procedure). The parameters were estimated for each respondent in the sample individually, as well as for the total sample (aggregated preferences).

3. RESULTS AND ANALYSIS

3.1. Socioeconomic and demographic variables influencing decisions on buying organic food

It has been proven that there is significant impact of some socioeconomic (education, income, and occupation) and demographic variables (gender and age) on the decisions on the buying organic food. Most studies report that "being female" positively affects purchase of organic food (Boccaletti, 2006; Rimal et al., 2001; Loureiro and McCluskey, 2001; Underhill and Figueroa, 1996).

In this study, the ratio between males and females was approximately 1:5. None of the male respondents do not buy organic food every day, and even 25% of them never buy organic food, while 4.1 % women buy organic food daily, but almost 40% of them never buy organic food (Figure 1). Those 40% of women that

never buy organic food mentioned that they often buy non-organic food on discounts in large supermarkets. There was no significant correlation between gender and frequency of buying organic products ($\chi^2(3) = 7.302, p = 0.063$).

Although, many empirical studies have found negative effect of age on probability of buying organic food (Boccaletti, 2006; Rimal et al., 2001; Wier and Calverley, 2002; Underhill and Figueroa, 1996), we found no statistically significant correlation between years and frequency of buying organic food. The interesting fact is that in the total sample, only 3.4% of respondents are aged over 46 years, have high incomes and buying organic food on a weekly basis. The age distribution of respondents was as follows: 18-25 years (18.1%), 26-35 years (55.7%), 36-45 years (22.8%), 46-66 years (3.4%).

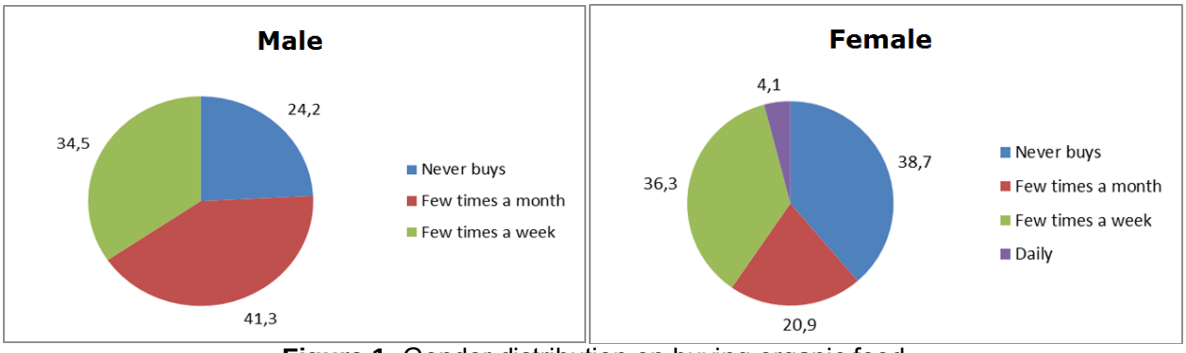

Figure 1: Gender distribution on buying organic food

Some of the studies have suggested negative effect of education on purchase of organic food (Thompson and Kidwell, 1998). Govindasamy and Italia (1999) suggested that less-educated consumers may exaggerate true risks of pesticide use, and/or higher educated respondents may have higher confidence in safety standards of non-organic production. On the other hand, some surveys have found often a positive correlation between higher education levels and increasing likelihood of purchasing organic products (Wandel and Bugge, 1997; O'Donovan, 2002). We didn't found any significant difference between education and buying organic products. We should mention that none of the respondents with primary and secondary school (24.1%) are not buying organic food on dally basis, or either consider that the use of it has positive influence on health.

Influence of income variables on buying organic food is definitely important. Some studies document that household income has positive impact on the purchase of organic food (Rimal et al., 2001) and that households with middle and higher income are more likely to purchase organic food. Verhoef (2005), Wier (2002), Thompson and Kidwell (1998), Zepeda and Li (2007) found that household income does not have necessarily significant effect on organic food purchase. However, willingness to pay price premium for organic food has been shown to rise with income (Stevens-Garmon, Chung and Biing-Hwan, 2007; Govindasamy and Italia, 1999). Table 2 represents monthly income per household member and willingness to pay for organic food of all respondents per product (1 Euro is app. 115 RSD).

Table 2: Monthly income per household member and willingness to pay for organic food

Characteristics	Description	(%)
Monthly income per household member	Less than 10.000 RSD	4.7%
	Between 10.000 and 20.000 RSD	18.1%
	Between 20.000 and 30.000 RSD	26.8%
	Over 30.000 RSD	50.3%
Willingness to pay for organic food	Up to 100 RSD	52.4%
	Between 101 and 200 RSD	40.3%
	More than 201 RSD	7.3%

It is shown that although more than half of the respondents have an income over the 30000 RSD, more than half respondents are still not willing to pay more than they usual pays for non-organic made product.

3.2. Consumers' preferences

Results from the conjoint analysis are shown in Table 3 and Figure 2. Table 3 presents the (averaged) part-worth utilities of each attribute level, while Figure 2 is the graph description of the attributes importance.

Table 3: Averaged results

Attribute	Attribute level	Part-worth utilities	Std. dev.
Production method	Non-organic production	-0.300	0.121
	Non-certified organic production	-0.340	0.097
	Certified organic production	0.640	0.121
Product origin	Serbia	0.220	0.072
	Abroad	-0.220	0.072
Price [RSD]	50 RSD/kg (0.5 €/kg)	-0.587	0.072
	100 RSD/kg (1 €/kg)	-1.174	0.145
	150 RSD/kg (1.5 €/kg)	-1.761	0.217
	200 RSD/kg (2 €/kg)	-2.348	0.290
	250 RSD/kg (2.5 €/kg)	-2.936	0.362
Constant		4.311	
Price Coefficient (β)		-0.012	
Correlations between observed and estimated preferences			
Pearson's R	*0.949*	*Significance = 0.000*	
Kendall's tau	*0.882*	*Significance = 0.000*	

The internal and predictive validity of the rating model was estimated by Pearson and Kendall's tau statistics. A high value of the Pearson coefficient, 0.949, confirms the high level of significance of the obtained results. Similarly, a high value of the Kendall's tau statistic, 0.882, indicates the strong correlation between the observed preferences and those estimated by the model. The β coefficient is related to the price attribute, because it is the only attribute defined as linear in SPSS software. This coefficient is always negative for the price and it represents the sensitivity of respondents' preferences on changes in price of products. Higher absolute value of the coefficient and steeper linear function means that respondents are more sensitive to changes in price, meaning that small increase in price leads to a sharp drop of preferences.

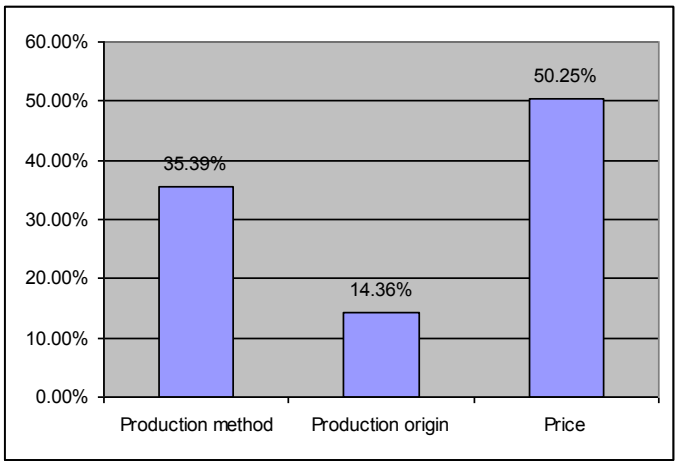

Figure 2: Relative importance of attributes

As Figure 2 shows, the most important attribute is Price, with an relative importance value of 50.25%. Than follows the attribute Production method (relative importance = 35.39%). Product origin (14.36%) is the least important attribute. Characteristics that describe „the most desirable carrot" are: Certified organic production, made in Serbia, at the price of 50 RSD/kg (0.5 €/kg).

3.3. Post hoc segmentation

A more detailed analysis of individual utilities revealed wide heterogeneity in preferences. Therefore, a cluster analysis was performed to classify respondents into more homogeneous preference groups. The part-worths are used as input for cluster analysis.

The K-means cluster procedure in SPSS 16.0 was used to perform the segmentation. A 2-cluster solution was chosen due to the size of the segments and statistical significance. An analysis of variance revealed that

the segments in the 2-cluster solution differed significantly from each other, with respect to their part-worths generated by the conjoint analysis (see Table 4 and Figure 3).

Table 4: Segment-level part-worth utilities

Attribute	Attribute level	Segment 1 (34.9%)	Segment 2 (65.1%)
		Part-worth utilities	Part-worth utilities
Production method	Non-organic production	0.11	-0.52
	Non-certified organic production	-0.24	-0.39
	Certified organic production	0.13	0.92
Product origin	Serbia	0.51	0.06
	Abroad	-0.51	-0.06
Price [RSD]	50 RSD/kg (0.5 €/kg)	-0.448	-0.661
	100 RSD/kg (1 €/kg)	-0.896	-1.323
	150 RSD/kg (1.5 €/kg)	-1.344	-1.984
	200 RSD/kg (2 €/kg)	-1.793	-2.646
	250 RSD/kg (2.5 €/kg)	-2.241	-3.307

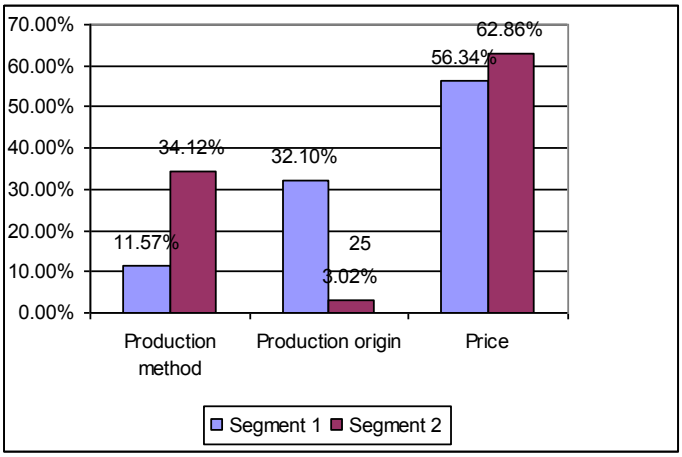

Figure 3: Segment-level attributes importance

As it is shown in Figure 3, price of the product is the most important attribute in both segments. Given the current situation and weak purchasing abilities in Serbia, as a result of the global economic crisis, it is expected that the price was determining factor when buying organically produced food (specifically carrots).

The first segment covers more than a third of the total number of respondents (34.9%). Respondents in this segment are equally important whether something is produced in non-organic or organic certified way, but this is an attribute that is not so important to them, and for that reason, they don`t find the difference between levels. On the other hand, the second segment was significantly larger (65.1%) and consists of respondents who are big supporters of organic food, which has an official certificate. The respondents from segment 2 find the origin as a lowest important attribute, and there is almost no difference whether food is produced in Serbia or abroad. Product origin almost does not affect the preferences of the members of this segment.

4. CONCLUSION

In a process of purchasing organic food, there is a significant number of factors that influence the final customer decision on purchasing organic products. Decision for purchasing is something that is evolving and maturing in customers mind and sometimes even the product itself is not main motive for decision.

The aim of this paper was to show that the production of organic food is a great development opportunity of Serbia in the future, so we explored preferences of consumers in Serbia towards the carrot. For this purpose we used conjoint analysis. The most important attribute of carrot is Price followed by attributes Production method and Product origin, which is to be expected given the current purchasing power in Serbia.

It is evident that on customers' behaviour socioeconomic and demographic variables has some influence. Faced with the dilemma of choice between organic and non-organic, consumers have different reactions. Female consumers are inherently more rational than male. Demographic results show that still a small number of respondents buy organic food. These results suggest that there is a small consumer base for

organic food and market potential is weak. We also came to conclusion that population is not familiar enough with the methods of production and the benefits of organic food.

In Serbia, above all, it is necessary to provide constant education on organic farming. From organic farming, everyone would have benefits. Our organic food can be exported to EU countries where it has already been observed that people who regularly use organic products improved their life quality. Organic farming essentially aims to save the environment along with high quality production, which is another important aspect. Successful economic development, preserved nature and healthier people - the only question is whether we will take advantage of these opportunities? But above all, the knowledge that we are eating really healthy food and still not destroying the land that feeds us, is in ourselves.

REFERENCES

Aizaki, H. (2010). Application of multi-attributes stated preference methods and conjoint analysis in agricultural economics in Japan: from the latter half of the 1990s to 2005, Technical Report of the National Institute for Rural Engineering.

Boccaletti, S. (2006). Household Behaviour and environmental policy: Review of empirical Studies on Environmental policy: Empirical Evidence and Policy Issues, OECD Environment Directorate 15-16.

Champ, P., Boyle, K., and Brown, T. (2003). A primer on nonmarket valuation. Dordrecht, The Netherlands.

Evans, C. B. (2008), Consumer Preferences For Watermelons: A Conjoint Analysis, A Thesis Submitted to the Graduate Faculty of Auburn University.

Govindasamy, R., & Italia, J. (1999). Predicting Willingness-To-Pay A Premium For Organically Grown Fresh Produce, Journal of Food Distribution Research, Food Distribution Research Society 30(2).

Green, P., and V. Srinivasan. (1978). Conjoint analysis in consumer research: issues and outlook. Journal of Consumer Research. 5: 103-123.

Hair, J., Anderson, R., Tatham, W., and Black, W. (1999). Analisis Multivariante. Quinta Edición. Prentice-hall. Iberia, Madrid, Espana.

Lancaster, K. (1971). Consumer demand: A new Approach. Columbia University Press, New York, United States. 177 pp.

Loureiro, M. L., McCluskey, J. J., & Mittelhammer, R. C. (2001). Assessing Consumer Preferences for Organic, Eco-labelled, and Regular Apples, Journal of Agricultural and Resource Economics 26(2).

Lusk, J., & Hudson, D. (2004). Willingness-to-pay estimates and their relevance to agribusiness decision making. Review of Agricultural Economics, 26: 152–169.

Manalo, A. B. (1990). Assessing The Importance Of Apple Attributes: An Agricultural Application Of Conjoint Analysis. Northeastern Journal of Agricultural and Resource Economics, 19(2).

O'Donovan,P., & McCarthy,M. (2002). Irish consumer preference for organic meat, British Food Journal, 104.

Rimal, A., Fletcher, S. M., McWatters, K. H., Misra, S. K., & Deodhar, S. (2001). Perception of food safety and changes in food consumption habits: a consumer analysis, International Journal of Consumer Studies 25(1).

Stevens-Garmon, J., Chung L. H., & Biing-Hwan, L. (2007). Organic Demand: A Profile of Consumers in the Fresh Produce Market, Choices, Agricultural and Applied Economics Association 22(2).

Sydorovych, O., & Wossink, A. (2008). An Application of Conjoint Analysis in Agricultural Sustainability Assessment, International Congress, European Association of Agricultural Economists.

Thompson, G. D., & Kidwell, J. (1998). Explaining the Choice of Organic Produce: Cosmetic Defects, Prices, and Consumer Preferences, American Journal of Agricultural Economics 80(2).

Underhill, S. E., & Figueroa, E. E. (1996). Consumer Preferences For Non-Conventionally Grown Produce, Journal of Food Distribution Research, Food Distribution Research Society, 27(2).

Verhoef, P.C. (2005). Explaining purchases of organic meat by Dutch consumers, European Review of Agricultural Economics, 32(2).

Walisinghe, R., & Gunaratne, P. (2008). Consumer Preferences for Quality Attributes of Rice: A Conjoint Analysis, Sri Lankan Journal of Agricultural Economics 10(11).

Wandel, M., & Bugge, A. (1997). Environmental concern in consumer evaluation of food quality, Food Quality and Preference, 8(1).

Wang, Q., & Sun, J. (2003). Consumer preference and demand for organic food: Evidence from a Vermont survey. American Agricultural Economics Association Annual Meeting in Montreal, Canada.

Wier, M., & Calverley, C. (2002). Market potential for organic foods in Europe, British Food Journal, 104(1).

Zepeda, L., & Li, J. (2007). Characteristics of Organic Food Shoppers, Journal of Agricultural and Applied Economics, Southern Agricultural Economics Association, 39(1).

MATHEMATICAL MODEL OF OPTIMAL ECONOMIC PLAN FOOD FOR LUNCH MEMBERS OF SERBIAN ARMY

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Abstract: *In order to improve the economy of nutrition in the army of Serbia (hereinafter referred to as AS) there is a need to organize food surcharge during the working hours of professional members AS. Insufficient employment existing workforce and high overheads, the barriers are to reduce the amount of the total cost of food in AS. By using the software package LP Solve with multi-criteria analysis, based on nutritional value and biological food products (hereafter FP), their prices and food needs of professional members of the Army, leads to the development of a mathematical model of economic optimal eating plan for lunch.*

Keywords*: Multi-criteria analysis, LP Solve, energy value of foods, nutritional value of food, nutrition in the workplace, economically optimal nutrition, eating lunch.*

1. INTRODUCTION

Tests for food in AS[1] by many authors, such as B. Tesanovic and others point to the fact that nutrition can examine the qualitative and quantitative aspects. The qualitative aspect consists in the application of highly effective nutrition programs that provide health-safe and balanced diet of consumers. In this paper, the qualitative aspect of nutrition is analyzed primarily from the perspective of developing economically optimal eating plan of AS for lunch, as lunch is the meal by which in the course of the day brings the highest volume of energy and nutritive substances in the body.

2. NUTRITION IN THE WORKPLACE PAY IN SERBIAN ARMY

The consequences of malnutrition are very common throughout the world. Eating habits are conditioned by the greater number of factors: the need to enjoy food, real needs, scientific knowledge, and other economic factors. Under the eating habits of an individual involves the selection and preparation, the amount, time and manner of consumption of FP for a longer period (Pelva, 2010).

The main normative act that regulates food in AS the Ordinance on general and logistical needs of the Department of Defense (hereafter DoD) and AS (hereinafter referred to as the Ordinance). Ordinance regulating norms belonging to FP. Prescribed norms should provide nutrition based on scientific principles and align with the physical needs of AS and specific military requirements. In order to implement the provisions of the Regulations are made diet plans that are based on the statutory structure of FP , norms belonging and recipes for cooking in AS.

Abolition of compulsory military service (Jovic , 2013) the number of persons who are entitled to free meals, reduced to 4.000 persons. In order to develop the economy of nutrition, and increase the level of installed capacity employment military Restaurant (hereafter MR) there is a need to organize meals for a fee, which must meet the energy and nutritional needs in food.

Activities carried out by members of the AS can be classified as medium hard physical work, and to satisfy their daily energy needs should be provided daily meals (hereinafter referred to as d/m) feed containing about 14.700 KJ (Jokic, 1998). From that lunch should provide about 40% of the energy value of d/m food. According to the recommendations of the World Health Organization's share of nutrients in the total energy value of d/m is: for protein - 10 to 15 % ; the fat content - 15 to 30 % of carbohydrates, and - 55 to 75 %.

[1] According to the Regulations on general logistics needs of DoD and "nutrition personnel the task of the general logistic function, which is achieved on the basis of scientific knowledge, technological capabilities, experiences, habits and traditions in the diet of the population, in line with the psychological and physical stresses and demands concerted command and management as prescribed, regular health and proper way provides high quality and totally satisfying energy-biological needs of the professional members of AS. Nutrition in AS is planned, programmed and organized by the eating plan in AS."

Interest in nutrition surcharge in AS so far is small. Insufficient employment installed capacity of MR, the existing workforce and high overheads, the barriers are to reduce the amount of the total cost of providing food services at the workplace, thereby preventing an increase in the number of people who would be interested for this type of diet.

In order to provide all members of the MS one meal during the working time necessary to plan adequate funds to pay for it in the form of refunds from the approved budget allocations for food (Jovic, 2010). In order to achieve quality food, which is the economic aspect of production is acceptable, and which also meets the nutritional standards of quality, it is necessary to produce food that has an acceptable level of costs, and that is an acceptable range by members of the AS. It is necessary to create a proposal for a diet plan for lunch, which will ensure the proper and balanced diet for this meal, with the use of nutritional and economic criteria. This diet plan ought to include standardized menus , application menu cycle, plan expenditure of FP and an explanation of its use, but which are related to food during working hours and that includes just one meal instead of all day d/m food. Normative consumption of FP and food preparation should be adapted to the needs of the organism, since it would be realized only one meal, and that the remaining two lunch time staff consumed outside the workplace. The next section of the paper presents a general and then a special mathematical model diet surcharge in the Army, based on the study of optimal model diet plan for lunch.

3. DRAFT ANNUAL PLAN OF SERBIAN FOOD IN THE ARMY FOR LUNCH - GENERAL MATHEMATICAL MODEL

The main objective of the research in this paper is the Definition of diet plans for lunch, to establish a cost-effective nutrition surcharge ie. build a model that is optimal from an economic point of view, and that meets the predetermined energy and biological constraints and needs of the AS in the diet. Problem diet surcharge aims to making a diet plan for lunch, while minimizing the cost of food and meeting pre-defined energy and biological constraints and needs of the AS. For solving this problem affected by many factors, such as price FP, meals and menus, Percentage of different types of FP in nutrition and others.

Taking into account the limiting factors can be obtained as a result of Plan meals for lunch, which is the optimal solution from an economic point of view. The daily menus using the multi-criteria analysis, based on the analysis of energy and biological value of FP, FP prices and food needs of AS, leads to the development of combination dishes that. Daily menu for lunch. Each set contains: name of FP, quantity, energy value and amounts of nutrients. Determining the number of application of certain foods that are part of the handle defines a cycle of application meals. When preparing meals Cycle application, you need to meet several criteria: variety of food; appreciation of the seasonal character of FP; achieve the planned average energy-biological value lunch and planned expenditure FP. Price changes FP from the economic point of view is a significant limitation in the development cycle, the application meals.

In developing the model diet plan for lunch, as a starting point for the implementation recipes for making lunch, we used data from the eating plan in AS. In this diet plan defines the 133 recipes that can become part of lunch. By using the software package LP Solve, set the basic - a general mathematical model for the development of the Plan daily menus, with appropriate mathematical assumptions and limitations. Of the initial parameters for the development of a model diet plan are: FP, meal and menu. Based on these recipes for making lunch in the eating plan in AS and quantitative participation of FP, which are included in the prices of certain food dishes.

Mathematical assumptions are: a) the linearity of the objective function, b) linearity constraints, c) a finite number of constraints and d) additivity constraints and objective functions.

Based on these assumptions math was done setting the general mathematical model of cost-effective nutrition surcharge ie. build a model that will be the economic aspect of optimal, and that will meet predetermined energy and biological constraints and needs of the VS in the diet:

The criterion of optimality of linear objective function with respect to the restrictions:

$$F = \sum_{i=1}^{n} C_i X_i \rightarrow min \tag{1}$$

where: F (objective function), C (the coefficients of the variables in the objective function) and Xi (variable) .

Restrictions:
$a_{11}X_1 + a_{12}X_2 + ... + a_{1n}X_n \leq b_1$
$a_{21}X_1 + a_{22}X_2 + ... + a_{2n}X_n \leq b_2$
.....
$a_{m1}X_1 + a_{m2}X_2 + ... + a_{mn}X_n \leq b_m$

where: aij (the coefficients of the variables in constraints), C (coefficient restrictions) and Xi (variable).

On the basis of a general plan daily menus are made suggestions of specific models of the Plan daily menus for lunch.

4. PROPOSAL OF THE YEARLY DIET PLANS IN THE SERBIAN ARMY FOR LUNCH

In order to develop a specific model plan daily menus for lunch, it is necessary for a total of 83 main dishes, 11 types of soup (broth), 12 salads, 18 types of cakes and 9 species of fruit eating plan approved in AS find the frequency of each of them on an annual basis for 252 working days, taking into account the biological and energy constraints, to achieve the minimum total cost of the food. It is necessary to take into account that the number of cakes and fruit number of alternative variables, ie. that their sum total is 252 for lunch as part of the diet plan participates cake or fruit.

On the basis of standardized meals for lunch and preparation of statistical data on the average energy value and composition of nutrients shown to diet plans in the AS, and the price of individual FP forming part of the meal was made the budget share of proteins, fats and carbohydrates in each of dishes, as well as the price of food, which are used in the preparation of the handles. The above data are shown in Tables *1 – 5.*

Table 1. The percentage share of protein, fat and carbohydrate composition of the soup

Variable	Kind of soup	The energy value (Cal)	% Of the amount of food			Price in dinars
			Proteins	Fat	Carbohydrates	
X_{96}	Soup of the concentrate with stars	123,10	12,3	2,8	84,9	2,10
X_{97}	Beef soup with stars	177,32	9,7	24,3	66,0	1,77
X_{98}	Chicken soup with stars	318,95	23,7	39,6	36,7	6,39
X_{99}	Chicken soup	662,96	15,5	49,0	35,5	11,14
X_{100}	Beef soup	743,29	13,9	54,4	31,7	20,44
X_{101}	Cream of mushroom soup	567,17	10,7	44,3	45,0	13,46
X_{102}	Split pea soup	634,95	17,4	33,0	49,6	4,34
X_{103}	Tomato soup with rice	464,68	5,9	44,4	49,7	6,22
X_{104}	Potato soup	463,23	6,2	43,4	50,4	5,16
X_{105}	Vegetable soup	464,47	7,3	43,7	49,0	9,08
X_{106}	Fish soup	642,18	22,0	43,6	34,4	15,18
Average		**478,39**	**13,15**	**38,41**	**48,45**	**8,66**

Source: Plan meals in AS and authors' calculations

Table 2. The percentage share of protein, fat and carbohydrate composition of the main dishes

Variable	Types of main dishes	The energy value (Cal)	% Of the amount of food			Price in dinars
			Proteins	Fat	Carbohydrates	
X_1	Bean soup with smoked pork	1050,02	16,9	21,5	61,6	62,30
X_2	Dry bean soup with bacon	1361,05	13,1	39,4	47,5	58,06
X_3	Military beans	1144,85	18,3	22,8	58,9	81,02
X_4	Roast pork and beans	1326,90	16,0	30,2	53,8	68,77
X_5	Fried fish and beans	1275,62	23,6	18,9	57,5	81,94
X_6	Steak, braised green beans and potatoes	1257,44	15,0	32,9	52,1	126,67
X_7	Steak, mashed spinach and rice	1234,73	15,3	33,9	50,8	113,51
X_8	Leskovac shaker and salted potatoes	1063,00	13,7	24,8	61,5	88,69
X_9	Cooked beef in tomatoes sauce, potatoes and cauliflower	1163,74	13,2	33,3	53,5	91,40
X_{10}	Cooked beef in tomatoes sauce, roasted potatoes and braised peas	1026,79	16,2	31,6	52,2	104,25
X_{11}	Beef, cooked fresh pasta and braised cabbage	931,90	14,8	38,6	46,6	81,17
X_{12}	Beef and potatoes	1113,98	14,3	28,6	57,1	84,00
X_{13}	Sirloin in natural jus and a fine stew	1153,01	15,3	30,5	54,2	124,06
X_{14}	Beef sirloin, baked potato and braised cabbage	1040,26	14,2	41,2	44,6	85,92
X_{15}	Braised beef steak, braised carrots and roasted potatoes	982,17	13,0	35,7	51,3	76,18
X_{16}	Braised beef steak, braised green beans and braised rice	1118,82	13,4	31,9	54,7	106,55
X_{17}	Beef stew, cooked pasta and braised cabbage	899,45	14,0	35,7	50,3	95,87
X_{18}	Beef stew and mashed potatoes	1081,40	13,6	25,9	60,5	101,21
X_{19}	Meat loaf, mashed potatoes with spinach and roasted potatoes	944,09	15,7	29,6	54,7	91,50
X_{20}	Meat loaf and rice	1104,82	13,9	19,8	66,3	66,35
X_{21}	Meat loaf, braised peas and mashed potatoes	1127,65	15,3	22,8	61,9	94,30
X_{22}	Saute beef "stroganoff" and potatoes	1112,20	13,7	29,2	57,1	94,56

X_{23}	Parisian steak and baked potato	884,77	14,3	36,9	48,8	73,51
X_{24}	Parisian steak, braised green beans and salted potatoes	1078,96	13,7	32,2	54,1	108,53
X_{25}	Wiener schnitzel, braised peas and mashed potatoes	1199,17	14,9	28,6	56,5	85,46
X_{26}	Wiener schnitzel, braised cabbage and roasted sweet potatoes	990,07	13,8	38,8	47,4	76,11
X_{27}	Kebabs and roasted potatoes	859,34	14,1	38,7	47,2	75,37
X_{28}	Burger, braised peas and roasted potatoes	1027,74	15,2	36,3	48,5	104,45
X_{29}	Natur steak and fine stew	1197,72	12,6	36,3	51,1	76,24
X_{30}	Natur steak, braised cabbage and sweet braised rice	1163,25	10,5	41,4	48,1	54,84
X_{31}	Roast pork, cabbage and mashed potatoes	1247,83	11,2	42,4	46,4	63,74
X_{32}	Pork roast, braised peas and potatoes	1026,57	12,8	39,6	47,6	81,85
X_{33}	Pork roast, braised cabbage and roasted potatoes	979,30	11,1	45,7	43,2	60,80
X_{34}	Pork chop in garlic and roasted potatoes	925,46	11,7	44,3	44,0	60,60
X_{35}	Skewered and roasted potatoes	907,92	11,2	44,1	44,7	56,62
X_{36}	Chop (grilled) stewed green beans and baked potato	1066,75	11,1	47,4	41,5	98,00
X_{37}	Chicken (grilled), fried cauliflower and tartar soup	939,27	19,0	32,8	48,2	68,41
X_{38}	Chicken (grilled), pureed spinach and mashed potatoes	960,43	20,7	17,9	61,4	83,54
X_{39}	Chicken (grilled), stewed peas and potatoes	980,16	20,7	15,6	63,7	89,34
X_{40}	Sauteed chicken, braised rice and sweet cabbage	1115,43	17,5	31,5	51,0	67,98
X_{41}	Fried chicken, braised carrots and mashed potatoes	1086,17	16,9	21,6	61,5	60,63
X_{42}	Fried chicken, braised green beans and potatoes	903,71	18,4	27,9	53,7	121,10
X_{43}	Roast chicken, cabbage and mashed potatoes	1124,36	18,9	29,6	51,5	64,99
X_{44}	Roast chicken, braised peas and roasted potatoes	921,61	22,2	24,8	53,0	80,10
X_{45}	Stew and polenta	1097,46	20,3	27,2	52,5	62,10
X_{46}	Grilled fish and asparagus in coastal way	979,60	19,0	27,9	53,1	57,74
X_{47}	Baked fish on onions and salted potatoes	1039,71	18,5	21,7	59,8	58,88
X_{48}	Baked fish (grilled) and Swiss chard fashioned	887,77	21,9	19,5	58,6	149,22
X_{49}	Baked fish (grilled) and salted potatoes	936,80	21,4	13,4	65,2	117,52
X_{50}	Fried fish and potato salad	844,58	23,6	28,3	48,1	67,06
X_{51}	Fried fish, mashed spinach and roasted potatoes	985,23	21,0	32,2	46,8	92,76
X_{52}	Fried fish and fried potatoes	871,82	20,7	33,0	46,3	67,06
X_{53}	Roasted lamb, braised peas and roasted potatoes	986,93	15,6	34,9	49,5	155,17
X_{54}	Sheep roast, braised peas and roasted potatoes	949,75	15,5	33,1	51,4	141,37
X_{55}	Roast turkey and baked potatoes	853,40	17,4	34,6	48,0	107,82
X_{56}	Roast turkey and cabbage	945,99	18,3	34,5	47,2	110,80
X_{57}	Moussaka cauliflower	878,65	16,3	31,1	52,6	91,18
X_{58}	Sauerkraut with smoked pork	886,75	14,4	34,5	51,1	64,36
X_{59}	Lamb caps	911,17	15,4	34,3	50,3	135,71
X_{60}	Moussaka of eggplant blue	1101,88	14,8	36,8	48,4	128,30
X_{61}	Zucchini moussaka	964,16	16,2	32,0	51,8	80,61
X_{62}	Beef in vegetables	1018,07	14,9	29,1	56,0	82,20
X_{63}	Hunting potatoes with meat	1055,21	13,5	26,2	60,3	73,30
X_{64}	Moussaka potato	837,20	16,4	34,1	49,5	66,91
X_{65}	Sarma with sauerkraut	1330,74	12,5	36,4	51,1	91,44
X_{66}	Stuffed peppers	1100,60	13,5	27,0	59,5	83,94
X_{67}	Stuffed zucchini	1150,13	13,1	29,9	57,0	85,34
X_{68}	Greek meatballs	958,11	16,3	24,6	59,1	72,08
X_{69}	Potato stew with beef meat	1072,06	13,1	27,4	59,5	71,78
X_{70}	Soy steak with sautéed mushrooms and potatoes	937,10	17,7	26,5	55,8	62,90
X_{71}	Soy steak and beans	1345,67	19,3	20,7	60,0	45,00
X_{72}	Beans military (fasting)	1240,06	19,3	21,0	59,7	38,04
X_{73}	Pasta in tomato sauce with tuna	966,03	29,9	27,0	43,1	99,82
X_{74}	Risotto with fish	1107,38	21,5	19,9	58,6	77,53
X_{75}	Risotto with mushrooms	912,80	12,7	15,0	72,3	73,90
X_{76}	Peppers stuffed with beans	1035,25	15,3	20,6	64,1	46,54
X_{77}	Peppers stuffed (fasting)	980,18	13,4	30,1	56,5	74,03
X_{78}	Sarma with sauerkraut (fasting)	1077,75	13,8	32,4	53,8	34,83
X_{79}	Soy steak, cabbage (fasting) and baked potato	1139,08	15,1	37,6	47,3	40,35
X_{80}	Fried mushrooms and fried potatoes	658,59	15,2	19,3	65,5	99,44
X_{81}	Braised mushrooms and braised rice	1027,25	12,2	18,2	69,6	96,53
X_{82}	Soy steak, stewed peas and potatoes (in water)	1239,34	17,1	23,0	59,9	58,46
X_{83}	Stew of soybean and potato (water)	1017,34	16,1	22,5	61,4	28,25

Source: Plan meals in AS and authors' calculations

Table 3. The percentage share of protein, fat and carbohydrate composition of the salad

Variable	Types of salad	The energy value (Cal)	% Of the amount of food			Price in dinars
			Proteins	Fat	Carbohydrates	
X_{84}	Green salad	174,47	9,1	69,1	21,8	18,58
X_{85}	Spring onions	43,93	14,9	4,3	80,8	20,00
X_{86}	Fresh cucumbers	166,86	10,1	50,0	39,9	6,10
X_{87}	Tarator salad	342,99	21,8	50,5	27,7	14,57
X_{88}	Fresh tomatoes	324,01	11,9	43,1	45,0	49,00
X_{89}	Fresh cabbage	295,44	6,7	67,2	26,1	5,00
X_{90}	Roasted peppers	385,95	8,6	53,6	37,8	11,80

X_{91}	Mixed fresh vegetables	371,35	8,6	56,8	34,6	30,30
X_{92}	Pickles	68,20	26,4	17,1	56,5	34,50
X_{93}	Salad with sour peppers	155,62	19,8	7,5	72,7	31,50
X_{94}	Pickled cabbage	323,21	11,2	65,8	23,0	3,51
X_{95}	Beetroot (pasteurized)	232,01	9,9	2,5	87,6	22,50
Average		**240,34**	**13,25**	**40,63**	**46,13**	**20,61**

Source: Plan meals in AS and authors' calculations

Table 4. The percentage share of protein, fat and carbohydrate composition of the pie

Variable	Types of pie	The energy value (Cal)	% Of the amount of food			Price in dinars
			Proteins	Fat	Carbohydrates	
X_{107}	Pudding	244,20	9,9	18,3	71,8	16,71
X_{108}	Cake with eggs	363,50	9,1	17,7	73,2	13,76
X_{109}	Rice cakes	298,80	14,1	18,9	67,0	15,30
X_{110}	Cake frozen	369,25	10,0	10,0	80,0	120,01
X_{111}	Donuts frozen	369,25	10,0	10,0	80,0	120,85
X_{112}	Cherry pie frozen	384,63	5,1	35,2	59,7	120,00
X_{113}	Apple pie frozen	371,48	5,0	38,2	56,8	170,00
X_{114}	Cream pie with biscuit	195,18	9,4	20,9	69,7	35,38
X_{115}	Turkish pole	413,35	4,1	25,2	70,7	17,74
X_{116}	Princes donuts	305,85	10,2	46,9	42,9	13,04
X_{117}	Ice asks	377,17	4,8	49,6	45,6	7,20
X_{118}	Fruit cake, industrial	369,25	10,0	10,0	80,0	386,00
X_{119}	Chocolate rolls, industrial	369,25	10,0	10,0	80,0	386,00
X_{120}	Chocolate cake	378,06	4,3	52,0	43,7	18,61
X_{121}	Fruit roll	320,21	4,6	47,7	47,7	18,44
X_{122}	Pie pumpkin	545,28	8,8	35,0	56,2	10,20
X_{123}	Ice cream, industrial	158,30	7,8	35,2	57,0	22,00
X_{124}	Fruit salad	228,03	2,8	4,4	92,8	23,95
Average		**336,72**	**7,78**	**26,96**	**65,27**	**84,18**

Source: Plan meals in AS and authors' calculations

Table 5. The percentage share of protein, fat and carbohydrate composition of the fruit

Variable	Types of fruit	The energy value (Cal)	% Of the amount of food			Price in dinars
			Proteins	Fat	Carbohydrates	
X_{125}	Pears	97,39	3,5	5,9	90,6	24,00
X_{126}	Grapes	159,47	4,1	5,3	90,6	32,50
X_{127}	Watermelon	56,66	8,1	6,1	85,8	21,00
X_{128}	Orange	65,87	6,7	2,5	90,8	25,00
X_{129}	Bananas	142,69	4,5	3,7	91,8	22,00
X_{130}	Tangerine	136,53	44,4	0,0	55,6	27,50
X_{131}	Apple	109,46	2,3	5,3	92,4	20,00
X_{132}	Cherry	140,92	6,6	6,0	87,4	25,00
X_{133}	Peach	103,30	6,1	3,9	90,0	19,50
Average		**112,48**	**9,59**	**4,30**	**86,11**	**24,06**

Source: Plan meals in AS and authors' calculations

Assuming that the total number of main dishes, salads, soups, cakes and fruit per annum equal to the number of working days, set limits are shown in Table 6.

Table 6. Frequency limits on the types of food for lunch

Type of food	Limitations
Entrees	$X_1+X_2+X_3+....+X_{81}+X_{82}+X_{83}= 252$
Salads	$X_{84}+X_{85}+X_{86}+X_{87}+X_{88}+X_{89}+X_{90}+X_{91}+X_{92}+X_{93}+X_{94}+X_{95}=252$
Soup-stew	$X_{96}+X_{97}+X_{98}+X_{99}+X_{100}+X_{101}+X_{102}+X_{103}+X_{104}+X_{105}+X_{106}=252$
Cakes and Fruit	$X_{107}+X_{108}+X_{109}+...+X_{131}+X_{132}+X_{133}=252$

Source: Authors' calculations

Due to the high cost of input points, and in relation to the need to meet the biological and energetic constraints placed additional restrictions on the minimum number of occurrences of certain cakes and dishes, presented in Table 7 and:

Table 7. The default limits the minimum number of occurrences of dishes

$X_{107}+X_{108}+X_{109}+X_{110}+X_{111}+X_{112}+X_{113}+X_{114}+X_{115}+X_{116}+X_{117}+X_{118}+X_{119}+X_{120}+X_{121}+X_{122}+X_{123}+X_{124}>=26$	
$X_{22}+X_{23}>=1$	$X_{24}+X_{25}>=1$
$X_{26}+X_{27}>=1$	$X_{48}+X_{64}+X_{65}+X_{73}+X_{74}>=1$

Source: Authors' calculations

Taking into account that the composition of the meal for lunch has a larger number of components, ie. soup - soup, main course, salad and dessert or fruit, set the share of each of these dishes in the composition of the

handle on the quantitative amount of their shares, based on which further set linear constraints in relation to the biological requirements, as well as in relation to the demand:

a) For proteins:

$$6{,}2X_1+4{,}8X_2+6{,}7X_3+5{,}9X_4+8{,}7X_5+5{,}5X_6+5{,}6X_7+5X_8+4{,}8X_9+5{,}9X_{10}+5{,}4X_{11}+5{,}3X_{12}+5{,}6X_{13}+5{,}2X_{14}+4{,}8X_{15}+4{,}9X_{16}+5{,}1X_{17}+5X_{18}+5{,}8X_{19}+5{,}1X_{20}+5{,}6X_{21}+5X_{22}+5{,}3X_{23}+5X_{24}+5{,}5X_{25}+5{,}1X_{26}+5{,}2X_{27}+5{,}6X_{28}+4{,}6X_{29}+3{,}8X_{30}+4{,}1X_{31}+4{,}7X_{32}+4{,}1X_{33}+4{,}3X_{34}+4{,}1X_{35}+4{,}1X_{36}+7X_{37}+7{,}6X_{38}+7{,}6X_{39}+6{,}4X_{40}+6{,}2X_{41}+6{,}8X_{42}+6{,}9X_{43}+8{,}2X_{44}+7{,}5X_{45}+7X_{46}+6{,}8X_{47}+8{,}1X_{48}+7{,}9X_{49}+8{,}7X_{50}+7{,}7X_{51}+7{,}6X_{52}+5{,}8X_{53}+5{,}8X_{54}+6{,}4X_{55}+6{,}8X_{56}+6X_{57}+5{,}3X_{58}+5{,}7X_{59}+5{,}4X_{60}+6X_{61}+5{,}5X_{62}+5X_{63}+6X_{64}+4{,}6X_{65}+5X_{66}+4{,}8X_{67}+6X_{68}+4{,}8X_{69}+6{,}5X_{70}+7{,}1X_{71}+7{,}1X_{72}+11X_{73}+7{,}9X_{74}+4{,}7X_{75}+5{,}6X_{76}+4{,}9X_{77}+5{,}1X_{78}+5{,}5X_{79}+5{,}5X_{80}+4{,}5X_{81}+6{,}3X_{82}+5{,}9X_{83}+1X_{84}+1{,}6X_{85}+1{,}1X_{86}+2{,}4X_{87}+1{,}3X_{88}+0{,}7X_{89}+0{,}9X_{90}+0{,}9X_{91}+2{,}9X_92+2{,}1X_{93}+1{,}2X_{94}+1X_{95}+2{,}7X_{96}+2{,}1X_{97}+5{,}2X_{98}+3{,}4X_{99}+3_{X100}+2{,}3X_{101}+3{,}8X_{102}+1{,}3X_{103}+1{,}3X_{104}+1{,}6X_{105}+4{,}8X_{106}+1X_{107}+1X_{108}+1{,}5X_{109}+1{,}1X_{110}+1{,}1X_{111}+0{,}5X_{112}+0{,}5X_{113}+1X_{114}+0{,}4X_{115}+1{,}1X_{116}+0{,}5X_{117}+1{,}1X_{118}+1{,}1X_{119}+0{,}4X_{120}+0{,}5X_{121}+0{,}9X_{122}+0{,}8X_{123}+0{,}3X_{124}+0{,}6X_{125}+0{,}7X_{126}+1{,}5X_{127}+1{,}2X_{128}+0{,}8X_{129}+8{,}4X_{130}+0{,}4X_{131}+1{,}2X_{132}+1{,}1X_{133} \geq 2.520;$$

$$6{,}2X_1+4{,}8X_2+6{,}7X_3+5{,}9X_4+8{,}7X_5+5{,}5X_6+5{,}6X_7+5X_8+4{,}8X_9+5{,}9X_{10}+5{,}4X_{11}+5{,}3X_{12}+5{,}6X_{13}+5{,}2X_{14}+4{,}8X_{15}+4{,}9X_{16}+5{,}1X_{17}+5X_{18}+5{,}8X_{19}+5{,}1X_{20}+5{,}6X_{21}+5X_{22}+5{,}3X_{23}+5X_{24}+5{,}5X_{25}+5{,}1X_{26}+5{,}2X_{27}+5{,}6X_{28}+4{,}6X_{29}+3{,}8X_{30}+4{,}1X_{31}+4{,}7X_{32}+4{,}1X_{33}+4{,}3X_{34}+4{,}1X_{35}+4{,}1X_{36}+7X_{37}+7{,}6X_{38}+7{,}6X_{39}+6{,}4X_{40}+6{,}2X_{41}+6{,}8X_{42}+6{,}9X_{43}+8{,}2X_{44}+7{,}5X_{45}+7X_{46}+6{,}8X_{47}+8{,}1X_{48}+7{,}9X_{49}+8{,}7X_{50}+7{,}7X_{51}+7{,}6X_{52}+5{,}8X_{53}+5{,}8X_{54}+6{,}4X_{55}+6{,}8X_{56}+6X_{57}+5{,}3X_{58}+5{,}7X_{59}+5{,}4X_{60}+6X_{61}+5{,}5X_{62}+5X_{63}+6X_{64}+4{,}6X_{65}+5X_{66}+4{,}8X_{67}+6X_{68}+4{,}8X_{69}+6{,}5X_{70}+7{,}1X_{71}+7{,}1X_{72}+11X_{73}+7{,}9X_{74}+4{,}7X_{75}+5{,}6X_{76}+4{,}9X_{77}+5{,}1X_{78}+5{,}5X_{79}+5{,}5X_{80}+4{,}5X_{81}+6{,}3X_{82}+5{,}9X_{83}+1X_{84}+1{,}6X_{85}+1{,}1X_{86}+2{,}4X_{87}+1{,}3X_{88}+0{,}7X_{89}+0{,}9X_{90}+0{,}9X_{91}+2{,}9X_92+2{,}1X_{93}+1{,}2X_{94}+1X_{95}+2{,}7X_{96}+2{,}1X_{97}+5{,}2X_{98}+3{,}4X_{99}+3_{X100}+2{,}3X_{101}+3{,}8X_{102}+1{,}3X_{103}+1{,}3X_{104}+1{,}6X_{105}+4{,}8X_{106}+1X_{107}+1X_{108}+1{,}5X_{109}+1{,}1X_{110}+1{,}1X_{111}+0{,}5X_{112}+0{,}5X_{113}+1X_{114}+0{,}4X_{115}+1{,}1X_{116}+0{,}5X_{117}+1{,}1X_{118}+1{,}1X_{119}+0{,}4X_{120}+0{,}5X_{121}+0{,}9X_{122}+0{,}8X_{123}+0{,}3X_{124}+0{,}6X_{125}+0{,}7X_{126}+1{,}5X_{127}+1{,}2X_{128}+0{,}8X_{129}+8{,}4X_{130}+0{,}4X_{131}+1{,}2X_{132}+1{,}1X_{133} \leq 3.780;$$

b) For fat:

$$7{,}9X_1+14{,}7X_2+8{,}4X_3+11{,}1X_4+7X_5+12{,}1X_6+12{,}5X_7+9{,}1X_8+12{,}3X_9+11{,}7X_{10}+14{,}2X_{11}+10{,}5X_{12}+11{,}2X_{13}+15{,}2X_{14}+13{,}2X_{15}+11{,}8X_{16}+13{,}2X_{17}+9{,}5X_{18}+10{,}9X_{19}+7{,}3X_{20}+8{,}4X_{21}+10{,}8X_{22}+13{,}6X_{23}+11{,}9X_{24}+10{,}6X_{25}+14{,}3X_{26}+14{,}3X_{27}+13{,}5X_{28}+13{,}5X_{29}+15{,}3X_{30}+15{,}6X_{31}+14{,}6X_{32}+16{,}9X_{33}+16{,}3X_{34}+16{,}3X_{35}+17{,}5X_{36}+12{,}1X_{37}+6{,}6X_{38}+5{,}7X_{39}+11{,}6X_{40}+8X_{41}+10{,}3X_{42}+10{,}9X_{43}+9{,}1X_{44}+10X_{45}+10{,}3X_{46}+8X_{47}+7{,}2X_{48}+4{,}9X_{49}+10{,}4X_{50}+11{,}9X_{51}+12{,}2X_{52}+12{,}9X_{53}+12{,}2X_{54}+12{,}8X_{55}+12{,}7X_{56}+11{,}5X_{57}+12{,}7X_{58}+12{,}7X_{59}+13{,}6X_{60}+11{,}8X_{61}+10{,}7X_{62}+9{,}7X_{63}+12{,}6X_{64}+13{,}4X_{65}+10X_{66}+11X_{67}+9{,}1X_{68}+10{,}1X_{69}+9{,}8X_{70}+7{,}6X_{71}+7{,}7X_{72}+10X_{73}+7{,}3X_{74}+5{,}5X_{75}+7{,}6X_{76}+11{,}1X_{77}+12X_{78}+13{,}9X_{79}+7{,}13X_{80}+6{,}7X_{81}+8{,}5X_{82}+8{,}3X_{83}+7{,}6X_{84}+0{,}4X_{85}+5{,}5X_{86}+5{,}7X_{87}+4{,}7X_{88}+7{,}3X_{89}+5{,}9X_{90}+6{,}2X_{91}+1{,}8X_{92}+0{,}8X_{93}+7{,}2X_{94}+0{,}2X_{95}+0{,}6X_{96}+5{,}3X_{97}+8{,}7X_{98}+10{,}7X_{99}+11{,}9X_{100}+9{,}7X_{101}+7{,}26X_{102}+9{,}7X_{103}+9{,}5X_{104}+9{,}6X_{105}+9{,}6X_{106}+2X_{107}+1{,}9X_{108}+4{,}1X_{109}+1{,}1X_{110}+1{,}1X_{111}+3{,}8X_{112}+4{,}2X_{113}+4{,}6X_{114}+5{,}4X_{115}+10{,}3X_{116}+5{,}4X_{117}+1{,}1X_{118}+1{,}1X_{119}+5{,}7X_{120}+5{,}2X_{121}+3{,}8X_{122}+3{,}8X_{123}+0{,}4X_{124}+1{,}1X_{125}+1X_{126}+1{,}1X_{127}+0{,}4X_{128}+0{,}7X_{129}+0X_{130}+1X_{131}+1{,}1X_{132}+0{,}7X_{133} \geq 3.780;$$

$$7{,}9X_1+14{,}7X_2+8{,}4X_3+11{,}1X_4+7X_5+12{,}1X_6+12{,}5X_7+9{,}1X_8+12{,}3X_9+11{,}7X_{10}+14{,}2X_{11}+10{,}5X_{12}+11{,}2X_{13}+15{,}2X_{14}+13{,}2X_{15}+11{,}8X_{16}+13{,}2X_{17}+9{,}5X_{18}+10{,}9X_{19}+7{,}3X_{20}+8{,}4X_{21}+10{,}8X_{22}+13{,}6X_{23}+11{,}9X_{24}+10{,}6X_{25}+14{,}3X_{26}+14{,}3X_{27}+13{,}5X_{28}+13{,}5X_{29}+15{,}3X_{30}+15{,}6X_{31}+14{,}6X_{32}+16{,}9X_{33}+16{,}3X_{34}+16{,}3X_{35}+17{,}5X_{36}+12{,}1X_{37}+6{,}6X_{38}+5{,}7X_{39}+11{,}6X_{40}+8X_{41}+10{,}3X_{42}+10{,}9X_{43}+9{,}1X_{44}+10X_{45}+10{,}3X_{46}+8X_{47}+7{,}2X_{48}+4{,}9X_{49}+10{,}4X_{50}+11{,}9X_{51}+12{,}2X_{52}+12{,}9X_{53}+12{,}2X_{54}+12{,}8X_{55}+12{,}7X_{56}+11{,}5X_{57}+12{,}7X_{58}+12{,}7X_{59}+13{,}6X_{60}+11{,}8X_{61}+10{,}7X_{62}+9{,}7X_{63}+12{,}6X_{64}+13{,}4X_{65}+10X_{66}+11X_{67}+9{,}1X_{68}+10{,}1X_{69}+9{,}8X_{70}+7{,}6X_{71}+7{,}7X_{72}+10X_{73}+7{,}3X_{74}+5{,}5X_{75}+7{,}6X_{76}+11{,}1X_{77}+12X_{78}+13{,}9X_{79}+7{,}13X_{80}+6{,}7X_{81}+8{,}5X_{82}+8{,}3X_{83}+7{,}6X_{84}+0{,}4X_{85}+5{,}5X_{86}+5{,}7X_{87}+4{,}7X_{88}+7{,}3X_{89}+5{,}9X_{90}+6{,}2X_{91}+1{,}8X_{92}+0{,}8X_{93}+7{,}2X_{94}+0{,}2X_{95}+0{,}6X_{96}+5{,}3X_{97}+8{,}7X_{98}+10{,}7X_{99}+11{,}9X_{100}+9{,}7X_{101}+7{,}26X_{102}+9{,}7X_{103}+9{,}5X_{104}+9{,}6X_{105}+9{,}6X_{106}+2X_{107}+1{,}9X_{108}+4{,}1X_{109}+1{,}1X_{110}+1{,}1X_{111}+3{,}8X_{112}+4{,}2X_{113}+4{,}6X_{114}+5{,}4X_{115}+10{,}3X_{116}+5{,}4X_{117}+1{,}1X_{118}+1{,}1X_{119}+5{,}7X_{120}+5{,}2X_{121}+3{,}8X_{122}+3{,}8X_{123}+0{,}4X_{124}+1{,}1X_{125}+1X_{126}+1{,}1X_{127}+0{,}4X_{128}+0{,}7X_{129}+0X_{130}+1X_{131}+1{,}1X_{132}+0{,}7X_{133} \leq 7.560;$$

c) For carbohydrates:

$$22{,}7X_1+15{,}5X_2+21{,}8X_3+19{,}9X_4+21{,}2X_5+19{,}2X_6+18{,}8X_7+22{,}7X_8+19{,}8X_9+19{,}3X_{10}+17{,}2X_{11}+21{,}1X_{12}+20X_{13}+16{,}5X_{14}+18{,}9X_{15}+20{,}2X_{16}+18{,}6X_{17}+22{,}3X_{18}+20{,}2X_{19}+24{,}5X_{20}+22{,}9X_{21}+21{,}1X_{22}+18X_{23}+20X_{24}+20{,}9X_{25}+17{,}5X_{26}+17{,}4X_{27}+17{,}9X_{28}+18{,}9X_{29}+17{,}7X_{30}+17{,}1X_{31}+17{,}6X_{32}+15{,}9X_{33}+16{,}2X_{34}+16{,}5X_{35}+15{,}3X_{36}+17{,}8X_{37}+22{,}7X_{38}+23{,}5X_{39}+18{,}8X_{40}+22{,}7X_{41}+19{,}8X_{42}+19X_{43}+19{,}6X_{44}+19{,}4X_{45}+19{,}6X_{46}+22{,}1X_{47}+21{,}6X_{48}+24{,}1X_{49}+17{,}7X_{50}+17{,}3X_{51}+17{,}1X_{52}+18{,}3X_{53}+19X_{54}+17{,}7X_{55}+17{,}4X_{56}+19{,}4X_{57}+18{,}9X_{58}+18{,}6X_{59}+17{,}9X_{60}+19{,}1X_{61}+20X_{62}+22{,}3X_{63}+18{,}3X_{64}+18{,}9X_{65}+22X_{66}+21X_{67}+21{,}_{8X68}+22X_{69}+20{,}6X_{70}+22{,}2X_{71}+22X_{72}+15{,}9X_{73}+21{,}6X_{74}+26{,}7X_{75}+23{,}7X_{76}+20{,}9X_{77}+19{,}9X_{78}+17{,}5X_{79}+24{,}2X_{80}+25{,}7X_{81}+22{,}1X_{82}+22{,}7X_{83}+2{,}4X_{84}+8{,}9X_{85}+4{,}3X_{86}+3X_{87}+4{,}9X_{88}+2{,}8X_{89}+4{,}1X_{90}+3{,}8X_{91}+6{,}2X_{92}+8X_{93}+2{,}5X_{94}+9{,}6X_{95}+18{,}6X_{96}+14{,}5X_{97}+8X_{98}+7{,}8X_{99}+6{,}9X_{100}+9{,}9X_{101}+10{,}9X_{102}+10{,}9X_{103}+11X_{104}+10{,}7X_{105}+7{,}5X_{106}+7{,}9X_{107}+8X_{108}+7{,}3X_{109}+8{,}8X_{110}+8{,}8X_{111}+6{,}5X_{112}+6{,}2X_{113}+7{,}6X_{114}+7{,}7X_{115}+4{,}7X_{116}+5X_{117}+8{,}8X_{118}+8{,}8X_{119}+4{,}8X_{120}+5{,}2X_{121}+6{,}1X_{122}+6{,}2X_{123}+10{,}2X_{124}+17{,}1X_{125}+17{,}1X_{126}+16{,}3X_{127}+17{,}1X_{128}+17{,}4X_{129}+10{,}5X_{130}+17{,}4X_{131}+16{,}6X_{132}+17{,}1X_{133} \geq 13.860;$$

$22,7X_1+15,5X_2+21,8X_3+19,9X_4+21,2X_5+19,2X_6+18,8X_7+22,7X_8+19,8X_9+19,3X_{10}+17,2X_{11}+21,1X_{12}+20X_{13}+16$
$,5X_{14}+18,9X_{15}+20,2X_{16}+18,6X_{17}+22,3X_{18}+20,2X_{19}+24,5X_{20}+22,9X_{21}+21,1X_{22}+18X_{23}+20X_{24}+20,9X_{25}+17,5X_{26}+$
$17,4X_{27}+17,9X_{28}+18,9X_{29}+17,7X_{30}+17,1X_{31}+17,6X_{32}+15,9X_{33}+16,2X_{34}+16,5X_{35}+15,3X_{36}+17,8X_{37}+22,7X_{38}+23$
$,5X_{39}+18,8X_{40}+22,7X_{41}+19,8X_{42}+19X_{43}+19,6X_{44}+19,4X_{45}+19,6X_{46}+22,1X_{47}+21,6X_{48}+24,1X_{49}+17,7X_{50}+17,3X_5$
$_1+17,1X_{52}+18,3X_{53}+19X_{54}+17,7X_{55}+17,4X_{56}+19,4X_{57}+18,9X_{58}+18,6X_{59}+17,9X_{60}+19,1X_{61}+20X_{62}+22,3X_{63}+18,$
$3X_{64}+18,9X_{65}+22X_{66}+21X_{67}+21,_{8X68}+22X_{69}+20,6X_{70}+22,2X_{71}+22X_{72}+15,9X_{73}+21,6X_{74}+26,7X_{75}+23,7X_{76}+20,9$
$X_{77}+19,9X_{78}+17,5X_{79}+24,2X_{80}+25,7X_{81}+22,1X_{82}+22,7X_{83}+2,4X_{84}+8,9X_{85}+4,3X_{86}+3X_{87}+4,9X_{88}+2,8X_{89}+4,1X_{90}$
$+3,8X_{91}+6,2X_{92}+8X_{93}+2,5X_{94}+9,6X_{95}+18,6X_{96}+14,5X_{97}+8X_{98}+7,8X_{99}+6,9X_{100}+9,9X_{101}+10,9X_{102}+10,9X_{103}+11X$
$_{104}+10,7X_{105}+7,5X_{106}+7,9X_{107}+8X_{108}+7,3X_{109}+8,8X_{110}+8,8X_{111}+6,5X_{112}+6,2X_{113}+7,6X_{114}+7,7X_{115}+4,7X_{116}+5X_{11}$
$_7+8,8X_{118}+8,8X_{119}+4,8X_{120}+5,2X_{121}+6,1X_{122}+6,2X_{123}+10,2X_{124}+17,1X_{125}+17,1X_{126}+16,3X_{127}+17,1X_{128}+17,4X_{12}$
$_9+10,5X_{130}+17,4X_{131}+16,6X_{132}+17,1X_{133}<=18.900;$

r) For the energy value:
$1050,02X_1+1361,45X_2+1144,85X_3+1326,9X_4+1275,62X_5+1257,44X_6+1234,73X_7+1063X_8+1163,74X_9+1026,7$
$9X_{10}+931,9X_{11}+1113,98X_{12}+1153,01X_{13}+1040,26X_{14}+982,17X_{15}+1118,82X_{16}+899,45X_{17}+1081,40X_{18}+944,09$
$X_{19}+1104,82X_{20}+1127,65X_{21}+1112,2X_{22}+884,77X_{23}+1078,96X_{24}+1199,17X_{25}+990,07X_{26}+859,34X_{27}+1027,74$
$X_{28}+1197,72X_{29}+1163,25X_{30}+1247,83X_{31}+1026,57X_{32}+979,3X_{33}+925,46X_{34}+907,92X_{35}+1066,75X_{36}+939,27X$
$_{37}+960,43X_{38}+980,16X_{39}+1115,43X_{40}+1086,17X_{41}+903,71X_{42}+1124,36X_{43}+921,61X_{44}+1097,46X_{45}+979,6X_{46}$
$+1039,71X_{47}+887,77X_{48}+936,80X_{49}+844,58X_{50}+985,23X_{51}+871,82X_{52}+986,93X_{53}+949,75X_{54}+853,4X_{55}+945,$
$99X_{56}+878,65X_{57}+886,75X_{58}+911,17X_{59}+1101,88X_{60}+964,16X_{61}+1018,07X_{62}+1055,21X_{63}+837,20X_{64}+1330,7$
$4X_{65}+1100,60X_{66}+1150,13X_{67}+958,11X_{68}+1072,06X_{69}+937,1X_{70}+1345,67X_{71}+1240,06X_{72}+966,03X_{73}+1107,3$
$8X_{74}+912,8X_{75}+1035,25X_{76}+980,18X_{77}+1077,75X_{78}+1139,08X_{79}+658,59X_{80}+1027,25X_{81}+1239,34X_{82}+1017,3$
$4X_{83}+174,47X_{84}+43,93X_{85}+166,86X_{86}+342,99X_{87}+324,01X_{88}+295,44X_{89}+385,95X_{90}+371,35X_{91}+68,20X_{92}+15$
$5,62X_{93}+323,21X_{94}+232,01X_{95}+123,10X_{96}+177,32X_{97}+318,95X_{98}+662,96X_{99}+743,29X_{100}+567,17X_{101}+634,95$
$X_{102}+464,68X_{103}+463,23X_{104}+464,47X_{105}+642,18X_{106}+244,2X_{107}+363,5X_{108}+298,80X_{109}+369,25X_{110}+369,25X$
$_{111}+384,63X_{112}+371,48X_{113}+195,18X_{114}+413,35X_{115}+305,85X_{116}+377,17X_{117}+369,25X_{118}+369,25X_{119}+378,06$
$X_{120}+320,21X_{121}+545,28X_{122}+158,30X_{123}+228,03X_{124}+97,39X_{125}+159,47X_{126}+56,66X_{127}+65,87X_{128}+142,69X_1$
$_{29}+136,53X_{130}+109,46X_{131}+140,92X_{132}+103,30X_{133}>= 384.804;$

$1050,02X_1+1361,45X_2+1144,85X_3+1326,9X_4+1275,62X_5+1257,44X_6+1234,73X_7+1063X_8+1163,74X_9+1026,7$
$9X_{10}+931,9X_{11}+1113,98X_{12}+1153,01X_{13}+1040,26X_{14}+982,17X_{15}+1118,82X_{16}+899,45X_{17}+1081,40X_{18}+944,09$
$X_{19}+1104,82X_{20}+1127,65X_{21}+1112,2X_{22}+884,77X_{23}+1078,96X_{24}+1199,17X_{25}+990,07X_{26}+859,34X_{27}+1027,74$
$X_{28}+1197,72X_{29}+1163,25X_{30}+1247,83X_{31}+1026,57X_{32}+979,3X_{33}+925,46X_{34}+907,92X_{35}+1066,75X_{36}+939,27X$
$_{37}+960,43X_{38}+980,16X_{39}+1115,43X_{40}+1086,17X_{41}+903,71X_{42}+1124,36X_{43}+921,61X_{44}+1097,46X_{45}+979,6X_{46}$
$+1039,71X_{47}+887,77X_{48}+936,80X_{49}+844,58X_{50}+985,23X_{51}+871,82X_{52}+986,93X_{53}+949,75X_{54}+853,4X_{55}+945,$
$99X_{56}+878,65X_{57}+886,75X_{58}+911,17X_{59}+1101,88X_{60}+964,16X_{61}+1018,07X_{62}+1055,21X_{63}+837,20X_{64}+1330,7$
$4X_{65}+1100,60X_{66}+1150,13X_{67}+958,11X_{68}+1072,06X_{69}+937,1X_{70}+1345,67X_{71}+1240,06X_{72}+966,03X_{73}+1107,3$
$8X_{74}+912,8X_{75}+1035,25X_{76}+980,18X_{77}+1077,75X_{78}+1139,08X_{79}+658,59X_{80}+1027,25X_{81}+1239,34X_{82}+1017,3$
$4X_{83}+174,47X_{84}+43,93X_{85}+166,86X_{86}+342,99X_{87}+324,01X_{88}+295,44X_{89}+385,95X_{90}+371,35X_{91}+68,20X_{92}+15$
$5,62X_{93}+323,21X_{94}+232,01X_{95}+123,10X_{96}+177,32X_{97}+318,95X_{98}+662,96X_{99}+743,29X_{100}+567,17X_{101}+634,95$
$X_{102}+464,68X_{103}+463,23X_{104}+464,47X_{105}+642,18X_{106}+244,2X_{107}+363,5X_{108}+298,80X_{109}+369,25X_{110}+369,25X$
$_{111}+384,63X_{112}+371,48X_{113}+195,18X_{114}+413,35X_{115}+305,85X_{116}+377,17X_{117}+369,25X_{118}+369,25X_{119}+378,06$
$X_{120}+320,21X_{121}+545,28X_{122}+158,30X_{123}+228,03X_{124}+97,39X_{125}+159,47X_{126}+56,66X_{127}+65,87X_{128}+142,69X_1$
$_{29}+136,53X_{130}+109,46X_{131}+140,92X_{132}+103,30X_{133}<= 480816;$

Due to the high input price of certain FP, automatic programming would be favored foods with lower input cost, and in the mathematical model is set following restrictions on the minimum number of incidence of the components of the composition handle, which are shown in Table *8*.

Table 8. The default limit minimum frequency components lunch

$X_{1-84}<=12$	$X_{85-95}<=12$	$X_{96-106}<=21$	$X_{107-124}<=23$	$X_{125-128}<=14$	$X1_{29-133}<=29$

Source: Authors' calculations using the program LP Solve

As one of the constraints in the model is set to complete the request frequency number Breakfast on integers and - int H1 - H133. With the objective function (the coefficients of the variables are prices for individual dishes that are part of the handle) and a basic constraint (the sum of all variables is 252) and we have a full model setting for lunch with the criterion function that reads:

Fmin=$62,30X_1+58,06X_2+81,02X_3+68,77X_4+81,94X_5+126,67X_6+113,51X_7+88,69X_8+91,4X_9+104,25X_{10}+81,17$
$X_{11}+84X_{12}+124,06X_{13}+85,92X_{14}+76,18X_{15}+106,55X_{16}+95,87X_{17}+101,21X_{18}+91,5X_{19}+66,35X_{20}+94,3X_{21}+94,5$
$6X_{22}+73,51X_{23}+108,53X_{24}+85,46X_{25}+76,11X_{26}+75,37X_{27}+104,451X_{28}+76,24X_{29}+54,84X_{30}+63,74X_{31}+81,85X_3$

$_2$+60,8X_{33}+60,6X_{34}+56,62X_{35}+98X_{36}+68,41X_{37}+83,54X_{38}+89,34X_{39}+67,98X_{40}+60,63X_{41}+121,10X_{42}+64,99X_{43}+80,1X_{44}+62,10X_{45}+57,74X_{46}+58,88X_{47}+149,22X_{48}+117,52X_{49}+67,06X_{50}+92,76X_{51}+67,06X_{52}+115,17X_{53}+141,37X_{54}+107,72X_{55}+101,80X_{56}+91,18X_{57}+64,36X_{58}+135,71X_{59}+128,30X_{60}+80,61X_{61}+82,2X_{62}+73,3X_{63}+66,91X_{64}+91,44X_{65}+83,94X_{66}+85,34X_{67}+72,08X_{68}+71,78X_{69}+69,9X_{70}+45X_{71}+38,04X_{72}+99,82X_{73}+77,53X_{74}+73,9X_{75}+46,54X_{76}+74,03X_{77}+34,83X_{78}+40,35X_{79}+99,44X_{80}+96,53X_{81}+58,46X_{82}+28,25X_{83}+18,58X_{84}+20X_{85}+6,10X_{86}+14,57X_{87}+49X_{88}+5X_{89}+11,80X_{90}+30,3X_{91}+34,5X_{92}+31,5X_{93}+3,51X_{94}+22,5X_{95}+2,10X_{96}+1,77X_{97}+6,39X_{98}+11,14X_{99}+20,44X_{100}+13,46X_{101}+4,34X_{102}+6,22X_{103}+5,16X_{104}+9,08X_{105}+15,18X_{106}+16,71X_{107}+13,76X_{108}+15,3X_{109}+120,01X_{110}+120,85X_{111}+120X_{112}+170X_{113}+35,38X_{114}+17,74X_{115}+13,04X_{116}+7,20X_{117}+386X_{118}+386X_{119}+18,61X_{120}+18,44X_{121}+10,20X_{122}+22X_{123}+23,95X_{124}+24X_{125}+32,5X_{126}+21X_{127}+25X_{128}+22X_{129}+27,5X_{130}+20X_{131}+25X_{132}+19,5X_{133};

By using the software package LP Solve the proposed model to obtain the optimal solution from an economic point of view, where food costs are minimized and met predetermined energy and biological constraints and needs of the AS, achieved with Fmin = 33.126,77 dinars annually, which represents optimal solution for lunch with the specified limits. Solving this set of model gives us important planning elements for the development of a plan for eating lunch, because as the output parameter data obtained on the number of frequencies dishes that are part of the handle annually.

The frequency of certain types of foods that are part of the lunch on an annual basis, which are shown in Table 9, satisfy criterion optimal combination of dishes for lunch with the economic aspects while satisfying energy and biological constraints and needs of AS.

Table 9. The frequency glavanih meals annually

$X_{1,3,8,18,20,21,38,39,41,49,63,71,72,75,76,80-83,}$=12	X_5=2	$X_{22,25-27,74}$=1
$X_{2,4,6,7,9-17,19,23,24,28-37,40,42-46,48,50-62,64,65,67-70,73,77-79,107-118,130}$=0	$X_{47,66}$=9	X_{84-95}=21
X_{96-106}=23; X_{124}=14	$X_{125-128}$=28	$X_{129-133}$=29

Source: Authors' calculations using the program LP Solve

Based on the defined share of certain types of food that are part of the handle, which is an optimal solution to The specified limitations, and can still access the development cycle, the application of food and the preparation of the Plan daily menus for lunch. From the above it can be seen that the cost of meals for lunch is 131,45 dinars on a daily basis, which is 285.55 dinars lower price than the price at AS.

5. CONCLUSION

Economic factors have a crucial impact on the eating habits of professional members AS. Abolition of compulsory military service, the number of persons who are entitled to free meals, reduced to 4.000 persons, which is imposed by the need to organize food for a fee, which must meet the energy and nutritional needs in food professional members AS.

By defining model diet plan for lunch, to establish cost-effective nutrition surcharge ie. build a model that is optimal from an economic point of view, and that meets the predetermined energy and biological constraints and needs of the AS in the diet contributes to increased economies of food in AS.

By using the software package LP Solve, set the basic - a general mathematical model, with appropriate mathematical assumptions and limitations, and then the specific model diet plan for lunch. Using 133 recipes suggested the frequency of application of each of them annually. By using the software package LP Solve the proposed model to obtain the optimal solution from an economic point of view, where food costs are minimized and met predetermined energy and biological constraints and the needs of the Army, achieved with Fmin = 33.126,77 dinars annually, which represents optimal solution for lunch with the specified limits, with price meals for lunch is 131,45 dinars on a daily basis, which is 285,55 dinars lower price than the price of lunch at AS.

REFERENCES

Jokić N. (1998). Proper nutrition and food preparation, MPH, Belgrade

Jović S. (2010). Reform of the Army and the impact on the food needs of its members, the Military Academy, Belgrade

Jovic S. (2013). Mathematical model of optimal economic plan for breakfast professional Army Serbian, SYM-OP-IS 2013, Zlatibor

Pelva D. (2010). Improving the nutrition of the Army of Serbia with specific habits, Military Academy, Belgrade

Plan meals in AS (2010). Of the General Logistics, Belgrade

„OMG“ broj 9/12 (2012). Price list of service provision from the general logistics, Belgrade

INVENTORY MODEL FOR DIFFERENT KIND OF PRODUCTS – THE CAPACITY OF STORAGE SPACE AS A CONSTRAINING FACTOR

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Abstract: *Inventory management is one of the most important logistic tasks in the decision making process. Many companies are faced with problems of finding an optimal order policy when there are constraints on some operations. Problems of this type can become rather complicated, so we will illustrate some principles by looking at problems with constraints in inventory levels. This paper presents an inventory model where there is a limited amount of storage place. The research is based on data from the warehouse of a company in Strumica, Republic of Macedonia, which has a chain of supermarkets where there is a different kind of products. Our purpose in this paper is to calculate the optimal order quantities for different kinds of products which are determined by the capacity of warehouse place and also minimizing the total order costs and different inventory costs. In the research we use analytical and simulation methods and the results and suggested solutions will be discussed.*

Keywords*: inventory models with limited storage place, optimal order quantities, analytical methods, simulation, minimum total order cost, data analysis*

1. INTRODUCTION

Inventories are one of the main sources of costs within the companies. Therefore, the aim of inventory management is to keep inventories as much as possible on lower level, but always sufficient to meet the needs of customers. Waters (1949) discussed the reasons for holding inventories. He considered that there are several answers why organizations hold inventories, including: to allow demands that are larger than expected, or at unexpected times; to allow deliveries that are delayed or too small; to take advantage of price discounts on large orders; to avoid delays in passing products to customers; to make full loads for delivery and reduce transport costs; to give cover for emergencies etc. (p.8). Ravindran (2008) explained that keeping products in inventory causes certain costs. In this context, in the list of inventory costs he presented: the interest on the capital invested in the products retained, the cost of operating the physical warehousing facility where the items are held, the cost of obsolescence and spoilage, taxes that are based on the inventories on hand (p.305).

The excessive quantities of inventory causes unjustified high holding costs, while too low level of inventory initiate many problems, difficulties and negative effects on trade and distribution. Losses of inventory which take range to 1% of sales in retail trade are assessed as good, while in a lot of retail outlets they amount to more than 3% of sales. In this context, inventory management includes ensuring the optimal order quantity, storing it in an adequate way and also minimizing total order costs and other inventory costs. Thus are determined the basic decision variables in inventory models.

Waters (1949) considered the inventory cycle where he gave a picture for a typical use of inventory in a supermarket. He also listed the basic elements which are included in each inventory cycle (p.6).
Felea (2008) studied the importance of inventory in the supply chain. It was concluded that the changes in the inventory policies can lead to a dramatic alteration of the supply chain's efficiency and responsiveness (p.112). Roumiantsev and Netessine (2007) established that many of the predictions from classical inventory models extend beyond individual products to the more aggregate firm level; hence, these models can help with high-level strategic choices in addition to tactical decisions (p.421). Su and Lin (2013) established EPQ models concerning about the total relevant costs given in their study. In their research was determined the optimal order policy and the obtained results were practically used (p.10). Dukič, Sesar and Dukič (2007) gave an inventory model with storage limitation and simulated demand. They determined the optimal order quantities for different products with minimum holding costs using the Lagrange multiplier (p.223)

The subject of the research in this paper is an inventory model with possible constraints. In practice, there are many problems with constrains in inventory level and they mostly refer to capacity of the storage space, maximum acceptable investment in inventory holding, storage conditions, all the costs related to inventory etc.

We will analyze an example when there is a limited warehouse space in a supermarket where are ordered different kinds of products. In this case of many different products in the warehouse of the supermarket, we will calculate the optimal order quantities for each product with minimum total order costs and other inventory costs. It will also be given the amount of space occupied by one product from the available capacity of the warehouse. If it turns out that the storage space required for keeping the determined quantities of products is larger than available warehouse space, we keep decreasing simultaneously the initially determined values by changes in Lagrange multiplier (λ) until storage limitation is satisfied.

2. METHODOLOGY

Our research was conducted for a period of 1 month, including the time period when the supermarket makes an order for a different kind of products. During the research quantitative analysis was made which is based on quantitative optimization methods. Received data from the company that were processed are presented in a table below. The model will emphasize the capacity of the warehouse of the supermarket which is a constraining factor in this case. Therefore, the volume that occupies each product from the total available space was given in the table. The optimal order quantities for the products and minimum total order costs were calculated in Microsoft Office Excel 2007 and in determining the optimum quantity the Lagrange multiplier λ was decreased until the available storage place is used to the full. The results obtained from the research represent the optimal order quantity of all products and they are presented graphically.

3. RESULTS AND DISCUSSION

The inventory model with limited storage space is characterized by many assumptions**,** where the basic is that there are at least two different products with determined demand for a certain time period. We introduce the following parameters:

n - Number of products.
k_j - Demand rate per unit time of the j-th product.
c_1 - fixed costs of the company.
r_j - Storage costs of the j-th product expressed in percentage of the value of inventory per unit time.
a_j - Procurement costs per unit j-th product.
q_{j0} - Optimal order quantity of the j-th product.
v_j - Volume occupied by j-th product.
V - Total available storage place.

First, are determined the optimal order quantities for each j-th product in terms of minimum total order costs. To determine the optimum order quantity accompanied with minimum costs, the objective function must meet the condition (1):

$$\frac{\partial F(q_j)}{\partial q_j} = \frac{1}{2} r_j a_j - \frac{c_j}{{q_j}^2} k_j = 0 \qquad (1)$$

In this case we can calculate the optimal order quantity per product using the formula below:

$$q_{j0} = \sqrt{\frac{2c_j k_j}{r_j a_j}} \qquad (2)$$

The minimum total order costs of the model can be determined by the expression:

$$F(q_{j0}) = \sum_{j=1}^{n} \left[a_j k_j + \frac{c_j}{q_{j0}} k_j + \frac{r_j}{2} (a_j q_{j0} + c_j) \right] \qquad (3)$$

We will analyze an example where the constraining factor is the capacity of the storage space in a supermarket. So, in this case we introduce the following expression:

$\frac{q_j}{2} v_j$ – Space needed for average quantity of inventory for the j-th product.

The total required space for average inventory for all products is defined as follows:

$$\frac{1}{2}\sum_{j=1}^{n} v_j q_j \qquad (4)$$

In order to determine all optimal order quantities that will not exceed the available storage place, we will apply the Lagrange function defined in the expression (5):

$$F(q_j) = \sum_{j=1}^{n}\left[a_j k_j + \frac{c_j}{q_j} k_j + \frac{r_j}{2}(a_j q_j + c_j)\right] + \lambda\left(V - \frac{1}{2}\sum_{j=1}^{n} v_j q_j\right) \qquad (5)$$

The optimal order quantity for the j-th product using the Lagrange multiplier λcan be defined with the expression:

$$q_{j0} = \sqrt{\frac{2c_j k_j}{r_j a_j - \lambda v_j}} \qquad (6)$$

In the relation (6) it is very important to be made a quantification of the Lagrange multiplier λ. Tabular method was applied. Considering that $q_j > 0$, λ must meet the condition $r_j a_j - \lambda v_j > 0$, where λ is defined as follows $\lambda < \frac{r_j a_j}{v_j}$. But, $\lambda \leq 0$ because according to the existing problem the limited capacity of the storage space will affect the order quantity that will decrease, because otherwise the construction will be without impact on solving of the problem. Based on the relation for different values of λ , $\lambda \leq 0$are determined the order quantities for the products and the values of the expression (7) below:

$$\frac{1}{2}\sum_{j=1}^{n} v_j q_j \qquad (7)$$

Obtained values are presented in an appropriate table using the different values of Lagrange multiplier λ.

It was conducted a research in a supermarket and the received data from the company's storage are presented below. The results from the research are discussed.

In our research were taken 20 different products which are ordered every month by the supermarket. The optimal quantities are determinate according to the available storage space.

Table 1: Review of a different kind of products of a supermarket and their main characteristics

Products	**Demand (pcs) k_j**	**fixed costs c_1 (MKD)[1]**	**procurement costs a_j (MKD)**	**storage costs r_j (MKD)**	**storage space per product v_j (m^3)**
I	15	150000	3308	0.002	0.2
II	20	150000	3530	0.002	0.3
III	22	150000	8409	0.002	0.3
IV	24	150000	3739	0.002	0.5
V	30	150000	2322	0.002	0.4
VI	31	150000	2674	0.002	0.6
VII	32	150000	4454	0.003	0.6

[1] Expressed in Macedonian currency (MKD)

VIII	35	150000	14315	0.003	0.6
IX	38	150000	12103	0.003	0.5
X	42	150000	5040	0.002	0.9
XI	44	150000	15523	0.003	0.5
XII	46	150000	44850	0.004	0.7
XIII	50	150000	22750	0.004	0.9
XIV	51	150000	48705	0.004	0.9
XV	53	150000	6360	0.002	1.2
XVI	55	150000	14443	0.003	1.1
XVII	57	150000	11617	0.003	1
XVIII	59	150000	15611	0.003	1.1
XIX	60	150000	14440	0.003	1.2
XX	61	150000	25705	0.004	1.2

The Lagrange multiplier λ is taken as an appropriate for the values of q_{j0} if their common volume is closest to the constraint below:

$$\frac{1}{2}\sum_{j=1}^{n} v_j q_j \leq \mathrm{V}; \qquad q_j > 0, \qquad \mathrm{j} = 1,2,\dots,\mathrm{n} \tag{8}$$

Based on the processed data given in the Table 1 is calculated the optimal order quantity for the 20th different products of the supermarket for an available storage place of **5000 m^3** and the calculation is given in the Figure 2 in Microsoft Office Excel 2007.

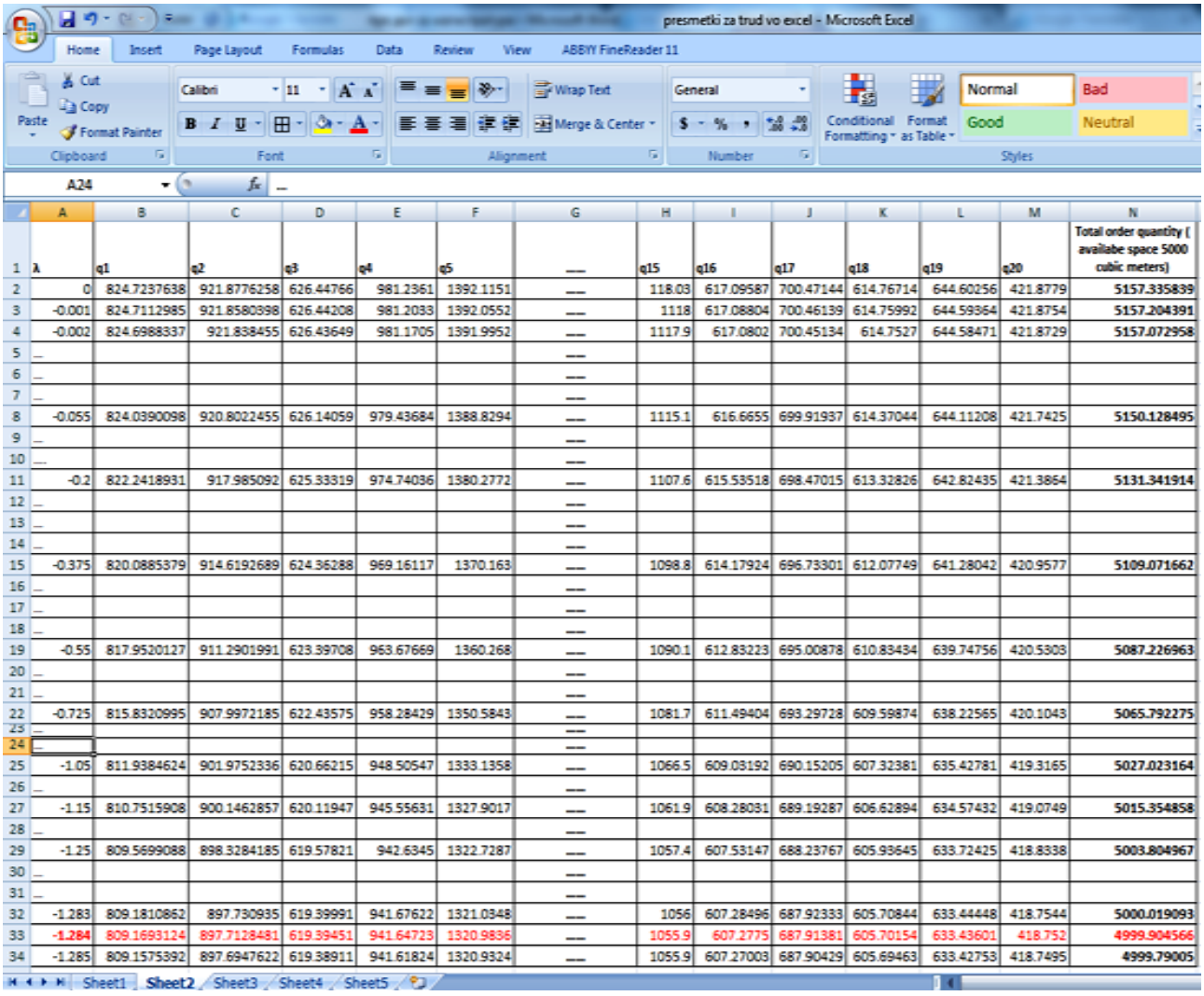

Figure 1: Calculation of optimal order quantity for 20 different products in a limited storage space

As the Figure 1 shows, based on assessments, we should calculate the values that are closing to the optimal quantity, which must be closest to the given available storage space of 5000 m^3.

In our case the optimal order quantity for each product is: q_1 =809.1693124; q_2 =897.7128481; q_3 =619.3945056; q_4 =941.6472309; q_5 =1320.983601; q_6 =1232.884922; q_7 =824.190598; q_8 =490.0917832; q_9 =555.4427822; q_{10} =1058.978488; q_{11} =528.768245; q_{12} =276.6579312; q_{13} =403.4453962; q_{14} =279.4117813; q_{15} =1055.909306; q_{16} =607.2774956; q_{17} =687.9138062; q_{18} =605.7015394; q_{19} =633.4360052; q_{20} =418.7519525.

Their common volume is **4999,904566 m^3** which not exceeds the available storage space of **5000 m^3**.

The results from the Figure 1 are graphically presented and it is given a comment based on the obtained values.

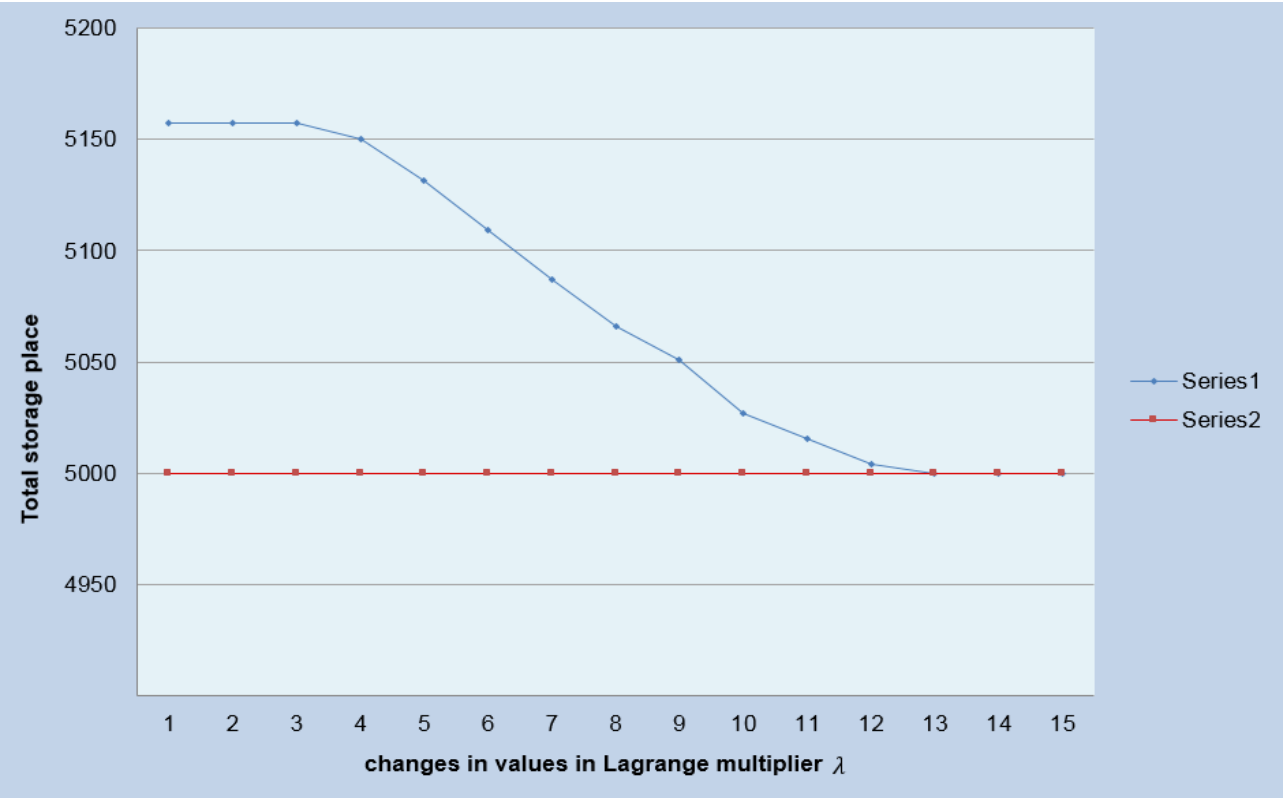

Figure 2: Graphic presentation of the optimal order quantity for determined values $\lambda \leq 0$

From the graphic presentation on Figure 2 is conclude that as much as is smaller the value of Lagrange multiplier ($\lambda \leq 0$), the total required space for average quantity of inventory for all 20 products is decreasing and is closer to 5000 m^3, which is the total available capacity of the storage of the supermarket.

The Series 1 show the total order quantity for all 20 products when there are changes in values in Lagrange multiplier when $\lambda \leq 0$ and Series 2 show the total available storage space of 5000 m^3.

As can be seen from the Figure 2 and Series 1 the order quantity for the first value for Lagrange multiplier ($\lambda = 0$) is 5157.335839. Than we took another value for the Lagrange multiplier ($\lambda = -0{,}001$) in order to decrease the occupied storage space and do not exceed the limited capacity of the warehouse of the supermarket. Next value for the Lagrange multiplier is $\lambda = -0{,}002$ where the order quantity decreases and amount 5157,072958. For $\lambda = -0{,}055$ the order quantity for all 20 products is 5150,128495. As the Lagrange multiplier decrease, so the order quantity is decreasing too. Therefore, our aim is to determine for which value of Lagrange multiplier the order quantity is optimal, so in our analysis the number of changed values for Lagrange multiplier (λ) was over 60 values. From the graphic presentation we can see that for the first few values of Lagrange multiplier, the order quantities are approximately same, until the order quantity decreases on a 5087,226963 for $\lambda = -0{,}55$.The last three values for Lagrange multiplier are very identical and all of them are very close to the amount of limited storage place. So, we calculated that for $\lambda = -1{,}284$, the order quantity is most suitable to the limited amount of storage space of 5000 m^3.

In this case, when the optimal order quantity is determinate by the results from research, the minimum total order costs were also calculated with the Lagrange function given in the expression (5).

$$F(q_{20}) = \sum_{j=1}^{n} \left[a_j k_j + \frac{c_j}{q_j} k_j + \frac{r_j}{2}(a_j q_j + c_j) \right] + \lambda \left(V - \frac{1}{2} \sum_{j=1}^{n} v_j q_j \right) \quad (9)$$

Thus, the amount of minimum total order costs is **125.133 797, 2 MKD.**

4. CONCLUSION

Optimal inventory management is very important for efficient working of the companies of the all industries. Inventories are one of the most expensive types of assets of the company, accounting for over 50% of the total invested capital. Inappropriate inventory management causes negative consequences, particularly high costs and big losses in profits of the companies.

There are many types of classification of inventory models. In this paper was elaborated the inventory model with constraints in capacity of the warehouse of a supermarket where there is a different kind of products. An important point of reference in this model is the estimate of the volume of storage space which is occupied by all products. Using this model the decision maker can easier determine the optimal order quantity which will have a volume that will not be larger than the available capacity, and will also result in a decreasing of total costs and setting them on minimum level.
Today, in reality, companies have very little scientific support for their operations, so with our researches we can help them to improve operations and achieve positive results. Our suggestion is in the future trade companies to apply merging of the process of trade operations with process of the modeling, because the models thus created may enable prediction of the total costs of operations and the same to be minimized.

REFERENCES

Barkovič, D. (1997), Operacijska istraživanja, Ekonomski fakultet Osijek, Osijek, 379-383.

Bonini, C. P., Hausman, W.H., & Bierman, H.Jr. (1997), Quantitative Analysis for Management, (9th edition), Irwin/McGraw- Hill, Boston, 344-358.

Choudhury, D. K., Saha, S., & Das, M. (2011). An inventory model with Lot Size Dependent carrying / holding cost, Assam University Journal of Science & Technology: Psychical Sciences and Technology, 7(2), 133-136. Retrieved from http://www.inflibnet.ac.in/ojs/index.php/AUJSAT/article/view/544

Deterministic Inventory Models (DMI) (n.d). Retrieved March 15, 2014, from http://flash.lakeheadu.ca/~avantuyl/courses/oldcourses/OR_Lecture10a_Asampana.pdf

Dukič, G., Dukić, D., & Sesar, M. (2007). A model with storage limitation and simulated demand as fresh meat inventory management support, Poljoprivreda (Agriculture) Osijek, 13(1), 222-225. Retrieved from http://www.pfos.hr/~poljo/?q=vol-13-1-48

Felea, M. (2008). The role of inventory in the supply chain, Amfiteatru Economic, 10(24), 109-121. Retrieved from http://www.amfiteatrueconomic.ro/RevistaDetalii_EN.aspx?Cod=10

Pupavac, D. (1968), Matematičke metode u ekonomiji preduzeča, Beograd, 112-136.

Ravindran, R. A. (2008), Operation research and management science, New York, 300-336.

Reyes, M. P. (2005). A mathematical example of the two-echelon inventory model with asymmetric market information, Applied Mathematics and Computation, 162(1), 257-264. Retrieved from http://www.sciencedirect.com/science/article/pii/S0096300304000864

Roumiantsev, S., & Netessine, S. (2007). What can be learned from classical inventory models: a cross – industry empirical investigation, Manufacturing & Service Operations Management, 9(4), 409-429. doi:10.1287/msom.1070.0166

Singh, Y. (2013). Optimal production policy for multi-product with inventory-level-dependent demand in segmented market, Yugoslav Journal of Operations Research, 23(2), 237-247. doi: 10.2298/YJOR130220023S

Su, S. M., & Lin, S. D. (2013). The Optimal Inventory Policy of Production Management, Engineering, 5(5A), 9-13. doi: 10.4236/eng.2013.55A002

Taha, H. A. (1995), Operations Research, (5th edition), Prentice Hall International, Singapore, 491- 494.

Waters, C. D. J. (1949), Inventory control and management (2nd edition), London, 128-135. Retrieved from http://en.bookfi.org/book/1409646

OPTIMAL VEHICLE ROUTING IN THE OIL INDUSTRY

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Abstract: *The vehicle routing problem (VRP) has been solved as an optimization problem for more than fifty years. However, any real problem of this type has its own characteristics that should be included in a specific mathematical model. In this paper, we observe the vehicle routing problem in the oil industry. Based on the characteristics of a real company, an original mathematical model for supplying gas stations from multi-depots has been formulated. The routing problem is observed as a set covering problem and is formulated as a mixed integer programming (MIP) problem. Based on real data, an analysis of the optimal routes for different company policies on the organization of gas stations fuel supply has been done.*

Keywords*: VRP, MIP, optimization, oil industry, multi-depot*

1. INTRODUCTION

The vehicle routing problem (VRP) involves the design of a set of minimum-cost vehicle routes, originating and terminating at a central depot, for a fleet of vehicles that services a set of customers with known demands (Giosa, Tansini, & Viera, 2002). The VRP is so widely studied because of its applicability and its importance in determining efficient strategies for reducing operational costs in distribution networks. Today, exact VRP methods have a size limit of 50 - 100 orders depending on the VRP variant and the time-response requirements. Consequently, current research concentrates on approximate algorithms that are capable of finding high quality solutions in limited time, in order to be applicable to real life problem instances that are characterized by large vehicle fleets and affect significantly logistics and distribution strategies (Kumar & Panneerselvam, 2012).

The pioneers of the VRP were Dantzig and Ramser. Their paper was concerned with the optimum routing of a fleet of gasoline delivery trucks between a bulk terminal and a large number of service stations supplied by the terminal. The shortest routes between any two points in the system were given and a demand for one or several products was specified for a number of stations within the distribution system. It was intended to find a way to assign stations to trucks in such a manner that station demands were satisfied and total mileage covered by the fleet was a minimum. A procedure based on a linear programming formulation was given for obtaining a near optimal solution (Dantzig & Ramser, 1959).

A few years later, Clark and Wright (Clarke & Wright, 1964) improved the Dantzig/Ramser approach by proposing a heuristic. Following these two papers, many researchers studied algorithms and models for different versions of the VRP.

Researchers are interested in studying the VRP for two reasons: its practical relevance and its difficulty. Lenstra and Rinnooy Kan (Lenstra & Rinnooy Kan, 1981) have analyzed the complexity of the VRP and concluded that practically all of the VRP problems are nondeterministic polynomial-time hard (NP-hard). VRP has many applications in real-world cases. Some applications are solidwaste collection, street cleaning, school bus routing, routing of salespeople and maintenance units, transportation of handicapped people, and so forth. The VRP can also be defined as the problem of designing least cost delivery routes from a depot to a set of geographically dispersed locations (customers) subject to a set of constraints (Daneshzand, 2011).

An important characteristic of VRP is the homogeneity of the fleet of vehicles (Baldacci, Battarra, & Vigo, 2008). In this paper, we observe the heterogeneous fleet of vehicles. Also, the number of depots makes great difference in modelling and solving VRP (Crevier, Cordeau, & Laporte, 2007). Our problem involves the multi-depot from which the demand could be met.

Fundamental components of the VRP are road network, customers, depots, vehicles, and drivers. To make different versions of VRP, different constraints and situations can be imposed on each component, and each of them can be supposed to achieve particular objectives (Toth & Vigo, 2002). Basic variants are capacitated VRP (CVRP), distance-constrained and capacitated VRP (DCVRP), VRP with time window (VRPTW), VRP with backhauls (VRPB), VRP with pickup and delivery (VRPPD), and any combination of these variants.

This paper is related to the problem of optimal vehicle routing of an oil company in the Republic of Serbia. In the oil industry, the delivery of petroleum products can be divided in two parts (Sear, 1993): the transport of the first type, which is done through pipelines or railway, that includes transportation from refineries to storage depots; and the transport of the second type that includes transportation from storage depots to gas stations, and is done mostly by tanks. The subject of this paper is the other type of transport that includes a network of gas stations, which are being supplied via tanks from several storage depots.

This paper consists of five parts. After the introductory part, in the section two, the characteristics of the observed routing problem in the oil industry will be described. In the third section, we present the original MIP mathematical model that includes the basic characteristics of the routing problem in the observed company, and in the fourth, the results of the experiments are presented. Concluding remarks and directions for further work are given in the section five.

2. PROBLEM DESCRIPTION

The observed oil company supplies a network of over 300 gas stations from multi-depots. Each of these stations has a specific demand for petroleum products, and the delivery is done once their level falls under a certain limit. In the depots, tanks are assigned to transport the designated derivative, and the speed of supplying the gas station with the missing quantity depends on the demand for it, the distance between the station and the storage depot, as well as on the driving speed of the assigned tank.

Vehicle routing problem in the oil industry has certain particularities. The demand for derivatives fluctuates depending on the season, so the companies have a number of vehicles at their disposal during longer periods, and during seasonal peaks they outsource the missing vehicles. At the same time, oil companies use their vehicles for third party deliveries in return for a certain compensation, and this further complicates the formulation of the problem. It is necessary to take into account the existence of a window of time during which it is possible or, however, prohibited to deliver petroleum products.

Considering the nature of the goods being transported, it is impossible to transport together two different types of products due to their physicochemical characteristics. Based on this fact, the types of vehicles in the oil companies have been classified. It is also important to mention a series of regulations related to the transportation of hazardous matters and their manipulation, which are specific compared to the traditional problems. Once we take into consideration numerous existing limitations and assumptions, this problem presents a challenge for every oil company primarily due to data collection problems, the creation of the model and its dimension, and finally because of the difficulties with the implementation of the solution and maintenance over time.

In this paper, only some of the characteristics of the routing problem in the observed company will be considered. Given that the capacity of the vehicles varies, multi-depot CVRP will be used in the paper, whereas the maximum capacity for each tank will be defined. It should be noted that the tanks are never completely filled which will also be taken into account when defining the maximum capacity of the vehicle. Only the most common derivatives at the gas stations will be considered, such as petrol and diesel, as well as the vehicles intended for their transport. The basic assumption was that the demand at a gas station is met entirely by only one vehicle, but later this assumption was extended by the possibility of supplying one gas station from multi-depots. Two depots were considered, as well as their respective gas stations, while some routes, which implicated that the demand of one gas station could be met by only one or both depots, were also predefined.

Therefore, the observed problem has the following characteristics:

- More storage depots; each of them owns a certain number of vehicles of different capacity at disposal;
- Large number of gas stations; some of them may be supplied from only one, while others may be supplied from a variety of storage depots;
- Limited maximum length of the route that complies with legal regulation and consists of time spent driving between storage depots and gas stations and the retention time at the gas station;
- Maximum and minimum capacities of the vehicle. Due to technical limitations, the gases that are produced during transport, etc., the vehicle cannot be filled to the brim but there is a minimum level of the tank that must be filled for the safety of the journey;

Thus, the routing problem observed in this paper is a multi-depot capacitated VRP with heterogeneous fleet of vehicles. For the problem described, an original MIP mathematical model has been formulated. For given

demands of gas stations, this model provides a set of routes and vehicles used for the routes in order to meet this demand with minimum total mileage.

3. MODEL FORMULATION

An approximate approach was chosen in the modelling of the observed problem, meaning that the routing problem was formulated as a set covering problem. It is more common in the literature that the routing problem is modelled as a set partitioning problem (Kumar & Panneerselvam, 2012). Nevertheless, in this paper, by introducing an additional variable, it was achieved that one gas station could belong to several optimal routes, and that the retention time at the station counts only for the route on which the vehicle supplies the gas station. Thus, the observed problem becomes a set covering problem. One of the advantages of the approach used in this paper is that fewer routes need to be predefined than in the set partitioning approach. More precisely, when one feasible route is defined in the set partitioning approach, it is also necessary to define its sub-routes in order to insure obtaining feasible solutions. In the set covering approach it is not necessary to define sub-routes. Another advantage is that this way it is possible to gain solutions by which one gas station can be supplied by several vehicles.

Once the vehicle routing problem is formulated as a set covering problem, we start from the predefined routes that could be used for supplying gas stations with petroleum. Among the predefined routes, those which cover all gas stations with demand and which have minimal total length (mileage) are chosen. The basic characteristic of this approach is that the quality of the obtained solution depends on the number and the quality of predefined routes. However, this approach allows faster solving, namely, less computational time needed for obtaining a solution.

The following notation was used to formulate a mathematical model:

Sets:

V - set of available vehicles in all depots
R - set of predefined routes that include all depots
B - set of gas stations

Parameters:

s_j - length of the *j-th* route in kilometers, $j \in R$,

p_k - the demand of the *k-th* gas station, $k \in B$,

$d_k = \begin{cases} 1 & \text{if } p_k > 0 \\ 0 & \text{if } p_k = 0 \end{cases}$ – parameter that defines whether there is a demand on the *k*-th gas station, $k \in B$

$a_{kj} = \begin{cases} 1 & \text{if the } k\text{-th gas station is on the } j\text{-th route} \\ 0 & \text{otherwise} \end{cases}$, $k \in B,\ j \in R$,

$m_{ij} = \begin{cases} 1 & \text{if the } i\text{-th vehicle belongs to the depot from which it departs on the } j\text{-th route} \\ 0 & \text{otherwise} \end{cases}$, $i \in V,\ j \in R$,

t_j - traveling duration on the *j-th* route in minutes, $j \in R$

z - vehicle retention time at the gas station in minutes

tr - maximum allowed retention time of the vehicle on route in minutes

$q_i^{\min}$ - minimum capacity of the *i-th* vehicle, $i \in V$

$q_i^{\max}$ - maximum capacity of the *i-th* vehicle, $i \in V$

Variables:

$$x_{ij} = \begin{cases} 1 & \text{if the } i\text{ - th vehicle is moving on the } j\text{ - th route} \\ 0 & \text{otherwise} \end{cases}, \; i \in V, \; j \in R$$

$$y_{ik} = \begin{cases} 1 & \text{if the } i\text{ - th vehicle supplies the } k\text{ - th gas station} \\ 0 & \text{otherwise} \end{cases}, \; i \in V, \; k \in B$$

Using the introduced notation, the following mathematical model was formulated:

$$(\min) \sum_{i \in V} \sum_{j \in R} s_j \cdot x_{ij} \tag{1}$$

s.t.

$$\sum_{j \in R} x_{ij} \leq 1, \quad i \in V \tag{2}$$

$$\sum_{i \in V} y_{ik} = d_k, \quad k \in B \tag{3}$$

$$\sum_{k \in B} p_k \cdot y_{ik} - q_i^{\min} \cdot \sum_{j \in R} x_{ij} \geq 0, \quad i \in V \tag{4}$$

$$\sum_{k \in B} p_k \cdot y_{ik} \leq q_i^{\max}, \quad i \in V \tag{5}$$

$$\sum_{j \in R} a_{kj} \cdot x_{ij} \cdot m_{ij} - y_{ik} \geq 0, \quad i \in V, k \in B \tag{6}$$

$$\sum_{k \in B} a_{kj} \cdot m_{ij} \cdot y_{ik} \cdot z + t_j - M(1 - x_{ij}) \leq tr, \quad j \in R, i \in V \tag{7}$$

The objective function (1) minimizes the total mileage that all the vehicles used for supplying will cross. The first constraint (2) provides that one vehicle uses at most one route, and the constraint (3) provides that the demand at each gas station be fully met. The constraints (4) and (5) refer to the minimum and maximum vehicle capacity that must be reached and must not be exceeded. The variables x_{ij} and y_{ik} are connected by constraints (6) and (7). Constraint (6) refers to the following: if there is a demand on the *k-th* gas station and if it is met by the *i-th* vehicle (i.e., if $y_{ik} = 1$), then it applies that the *i-th* vehicle needs to go along the *j-th* route (i.e., that $x_{ij} = 1$). The constraint (7) ensures that the total amount of time the vehicle will spend along the route will not be longer than the maximum time allowed, where parameter M is a very large number.

It is important to mention here that the manner in which the variable y_{ik} has been defined, that is, as a binary variable, implies that one gas station could only be supplied by one vehicle. If it is allowed that one gas station is supplied by several vehicles, the mathematical model remains the same while the variable y_{ik} needs to be defined as a continuous variable as follows:

y_{ik} – percentage of the *k-th* gas station demand that is met by the *i-th* vehicle, $0 \leq y_{ik} \leq 1, \; i \in V, \; k \in B$.

4. NUMERICAL RESULTS

The implementation of the mathematical model will be illustrated with a real example of an oil company. The observed problem involves two of the five depots which the company has at its disposal (depot I and the depot II). Depot I has 9 vehicles of different capacity, and depot II has 17 vehicles, also of different capacity. A total of 172 routes to 100 gas stations were predefined, out of which 99 routes start from depot I, and 73 routes from depot II. It is possible to transport fuel to 66 gas stations from depot I, and to 45 from depot II. In addition, it is possible to supply 11 gas stations from both depots.

In accordance with legal regulations, the maximum amount of time which a vehicle can spend on the route is limited to 9 hours. As it was already mentioned, this amount of time consists of the time spent on the road and the retention time. Based on the consultations with company's employees, it has been concluded that the average retention time at the gas station is 45 minutes: 30 minutes for fuel dispensing, and 15 minutes for filling in the documentation.

The other parameters of the problem, such as the names of gas stations, their demand and tank capacities, have not been revealed due to data confidentiality.

The following three scenarios have been analyzed:

Scenario 1: Each gas station must be fully supplied from one tank. The minimum tank capacity is limited to 25%.

Scenario 2: Gas stations must also be supplied from one tank. The minimum tank capacity is limited to 30%, which corresponds better with the real situation in the company.

Scenario 3: It is allowed that the gas station be supplied from multiple tanks, or more precisely, multiple routes. This is achieved once the variable y_{ik} becomes continuous. The minimum tank capacity is limited to 30%.

In all three scenarios there is a demand on 51 of 100 gas stations. The effective capacity was taken as the upper limit of the tank capacity, that is, the percentage of the tank capacity that must remain empty was subtracted from the total capacity.

Table 1 shows the results of all three scenarios. For each scenario the mathematical model has been implemented and solved using GNU Linear Programming Kit (GLPK), a software for solving MIP problems.

Table 1: Results of the optimization

Performances	Scenario 1	Scenario 2	Scenario 3
Total mileage (km)	3239.8	3242.2	3242.2
Number of routes from depot I	9	9	9
Number of routes from depot II	10	10	10
Capacity usage	25-98%	30-100%	30-100%
Total time on the routes	5542	5546	5636

The first row of the table 1 shows total mileage that all vehicles which participate in the supply of gas stations cross. The second and third rows refer to the number of routes, that is, the number of vehicles, from depot I and depot II. In the fourth row the range of capacity utilization of used tanks has been shown. The last row refers to the total time (in minutes) that all vehicles which participate in the supply spend on the routes (on the road and at gas stations).

Based on the total mileage, the number of vehicles (routes) and time spent on routes, scenario 1 is the most profitable one for the observed company. However, this solution can only be applied if the lower limit of the capacity utilization which is 25% is acceptable.

Optimal routes from scenario 2 differ from optimal routes in scenario 1, but the total number of routes is equal and the optimal value of the objective function is slightly inferior: the total mileage is only 2.4 kilometers longer. Total amount of time that vehicles spend on routes is only 4 minutes longer. Based on the obtained results, we can conclude that the company should not risk the loss by allowing that the vehicles be filled less than the safe limit of 30% tank capacity.

The optimal objective function value and the route in Scenario 3 are the same as in Scenario 2. However, by Scenario 3, two gas stations will be supplied by two vehicles. 44.5% of a gas station demand will be met by one vehicle that departs from the depot I and 55.5% by the second vehicle that also departs from depot I. In the case of another gas station, 25.6% of the demand will be met by one and 74.4% of demand by the other vehicle. In this case, both vehicles also depart from the depot I. The consequence of such satisfaction of the demand is that the total retention time on routes prolongs for 90 minutes because it includes two stops at the two gas stations. In further research, the retention time will be seen as a variable value that depends on the amount of fuel to be dispensed at the gas station.

For given input data, Scenario 3 proved to be the most inadequate supplying type. Nevertheless, in the general case, allowing one gas station to be supplied by several vehicles could provide a solution with fewer routes than when this is not enabled. Fewer routes mean hiring a reduced number of vehicles and drivers, hence the lower supply costs.

5. CONCLUSION

The subject of this paper was the vehicle routing problem in the oil industry. In addition to the theoretical focus, this paper provides an overview of current issue in real oil company and the characteristics of vehicle routing problem in the Petroleum Industry of Serbia. On that basis, and in accordance with the information, an original MIP mathematical model was created. Vehicle routing problem was observed as a set covering problem.

The aim of this paper was to present a solution for one part of the complex vehicle routing problem in the real oil company, which would set the basis for the introduction of scientific methods that would allow solving this problem in the company. And as a result of "what -if" analysis, guidelines should be derived that will indirectly lead to cost reductions in the chain of gas stations supply with petroleum products.

REFERENCES

Baldacci, R., Battarra, M., & Vigo, D. (2008). Routing a heterogeneous fleet of vehicles. ,. In, The Vehicle Routing Problem: Latest Advances and New Challenges. New York, US, Springer, 3-27

Clarke, G., & Wright, J. V. (1964). Scheduling of vehicles from a central depot to a number of delivery points. Operations Research, 568-581.

Crevier, B., Cordeau, J.-F., & Laporte, G. (2007). The multi-depot vehicle routing problem with inter-depot routes. European Journal of Operational Research, 176(2), 756-773.

Daneshzand, F. (2011). The Vehicle-Routing Problem. In Z. R. Farahani, S. Rezapour, & L. Kardar, Logistics Operations and Management (pp. 127-153). London: Elsevier.

Dantzig, G. B., & Ramser, J. H. (1959). The Truck Dispatching Problem. Management Science, 80-91.

Giosa, I. D., Tansini, I. L., & Viera, I. O. (2002). New assignment algorithms for the multi-depot. Journal of the Operational Research Society, 977-984.

GLPK http://www.gnu.org/s/glpk/

Kumar, S. N., & Panneerselvam, R. (2012). A Survey on the Vehicle Routing Problem and Its Variants. Intelligent Information Management, 66-74.

Lenstra, J. K., & Rinnooy Kan, A. G. (1981). Complexity of vehicle routing and scheduling problems. Networks, 221-227.

Sear, T. N. (1993). Logistics Planning in the Downstream Oil Industry. The Journal of the Operational Research Society, 9-17.

Toth, P., & Vigo, D. (2002). The Vehicle Routing Problem. Philadelphia: SIAM Monographs on Discrete.

EFFECTIVENESS DETERMINATION OF HIGHER EDUCATION USING LINEAR PROGRAMMING

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Abstract: *Higher education presents main engine of society's overall progress and development. The producers of the knowledge and future progressive force in all sectors of today's living are personified in the Universities. As generators of academic individuals, it is important to achieve high level of educated and qualified students/future employees that will be able to fit in the real sector and contribute to the collective/personal live. To accomplish that, resources investments are necessary to be made by the Universities. The question is how to organize the resources in order of efficient production of high qualified future academic individuals. Moreover, in cases of inefficiency detection, the question is what is necessary to be done for improvement. This paper shows concrete linear programming technique application called DEA (Data Envelopment Analysis), used for measuring the efficiency of the University study program, who through its real implementation represents a basic generator of knowledge.*
Keywords*: Linear Programming, Data Envelopment Analysis, Decision Making Units, Production levels, Composite units*

1. INTRODUCTION

One of the main issues that companies' and institutions' management deals with is permanent optimization and improvement of its main process or production. Given the fact that solving of one problem in many cases can be done in more ways, it is important to find and implement the optimal between them. According to the literature that deals with the system optimization in terms of overall efficiency improvement, especially complex for analysis are service oriented institutions/organizations. Considering the fact that Universities in its basis aim to offer a service called quality education to the consumers personified in students, they can be analyzed precisely in this constellation.

Mathematical programming is special mathematical approach of selecting the best/optimal from the set of possible alternatives towards solving the problem. It assumes that it is possible to represent the problem as a mathematical model that reflects certain production function (more precisely, mathematical function). In this direction, resolution of the problem of optimization converges to determination of the optimal (minimum or maximum, depending on the nature of the model) value of the production function, having in mind all the limitations of the model/environment, represented in the limitation equations. In general, mathematical optimization implies that the production function and the accompanying limitation equations can be linear or nonlinear equations and/or inequalities. If the production function and all limitation equalities are represented in linear form, the mathematical optimization takes form of linear programming modelling and solvation. Nevertheless, some mathematical models have high complexity level and cannot be solved through known mathematical optimization models. Then, not optimal, but "good enough" solution is the subject, using orientation and heuristic models [1].

In context of the previously stated, the starting point for this work is how to build a model that portrays the knowledge and skills delivery very real, taking into account the fact that Universities are the knowledge and skills generators, in order to detect its pros and cons and certain, to propose concrete ways of improvement of this process. For this purpose, DEA (Data Envelopment Analysis) technique is used, starting from the fact that it's nature of application offers very good possibility of model definition approach, as well as its mathematical processing and further discussion. Actually, this technique developed a new approach to the traditional cost / profit analysis and methods for efficiency measurement that enables policy-making through "learning from the best" and inducing theory from practice [2].

1.1. DEA (Data Envelopment Analysis)

There are several phases in LP appliance that have to be conducted:

- Definition of the problem and its mathematical formulation;

- Construction of the mathematical model;
- Finding the optimal solution of the model;
- Analysis of the results and sensitivity of the model, and
- Evaluation of the model and its implementation.

DEA as frontier analysis is designed for organization quality measurement and performance improvement, as main intention of the management. It is nonparametric non-statistical multi-criteria method that allows handling heterogeneous data. Based on LP, it operates with the term technological efficiency, defined as [3]:

$$\theta = \frac{Output}{Input} \tag{1}$$

where input is presented as sum of the resources invested and output is presented as sum of the outcomes of the entity which efficiency is measured. The efficiency is noted as pareto efficiency if allocation of the resources (input and output) is such that better performances are not possible for the entity analyzed. Pareto efficient subject is the subject (entity) with best possible allocation of the resources. Here, it is impossible to improve the output without worsening the input.

DEA declares as effective those entities that produce a certain or more output parameters with fixed inputs or use the same or a smaller quantity of inputs to produce a certain output, compared with the other subjects within the same group being analyzed. The set that is subject of measurement is consisted of entities called DMUs (Decision Making Units) and they have to be homogenous. All DMUs have same inputs and outputs in different quantities. DMU can be institution, bank, human, production line, vehicle, part of vehicle etc. In this work, the subject/course of a concrete University's study program is qualified as DMU.

The mathematical model of DEA, starting from the definition of the efficiency of the k-DMU, in set of n DMUs with m inputs and s outputs given by [4]:

$$\theta_k = \frac{u_1 y_{1k} + u_2 y_{2k} + \cdots + u_s y_{sk}}{v_1 x_{1k} + v_2 x_{2k} + \cdots + v_m x_{mk}} \tag{2}$$

Is defined as:

- Goal:

$$max\left(\theta_k = \frac{u_1 y_{1k} + u_2 y_{2k} + \cdots + u_s y_{sk}}{v_1 x_{1k} + v_2 x_{2k} + \cdots + v_m x_{mk}}\right) \tag{3}$$

- Given:

$$\frac{u_1 y_{11} + u_2 y_{21} + \cdots + u_s y_{s1}}{v_1 x_{11} + v_2 x_{21} + \cdots + v_m x_{m1}} = \frac{\sum_{i=1}^{s} u_i y_{i1}}{\sum_{j=1}^{m} v_j x_{j1}} \leq 1$$

$$\cdots$$

$$\frac{u_1 y_{1k} + u_2 y_{2k} + \cdots + u_s y_{sk}}{v_1 x_{1k} + v_2 x_{2k} + \cdots + v_m x_{mk}} = \frac{\sum_{i=1}^{s} u_i y_{ik}}{\sum_{j=1}^{m} v_j x_{jk}} \leq 1$$

$$\cdots$$

$$\frac{u_1 y_{1n} + u_2 y_{2n} + \cdots + u_s y_{sn}}{v_1 x_{1n} + v_2 x_{2n} + \cdots + v_m x_{mn}} = \frac{\sum_{i=1}^{s} u_i y_{in}}{\sum_{j=1}^{m} v_j x_{jn}} \leq 1 \tag{4}$$

$$v_1, \ldots, v_m \geq 0, u_1, \ldots, u_s \geq 0; \tag{5}$$

$$x_{jk} \geq 0, y_{ij} \geq 0; j = 1, \ldots, m; i = 1, \ldots, s; k = 1, \ldots, n \tag{6}$$

where x_{jk} is j-th input in k-th DMU, y_{ik} is i-th output of the k-th DMU, $v_1, \ldots, v_m$ are weights of the m inputs and $u_1, \ldots, u_s$ are weights of the s outputs, both of the k-th DMU. DEA sets weights in such way – best way, to maximize the efficiency of every single DMU. So, the frontier is consisted of efficient DMUs with efficiency equals to 1. Every other DMU with efficiency below 1 is considered to be inefficient. Often, as in this paper, the dual DEA CCR model is used. It is represented with following equations:

- Find $min\theta$;
- Having limitations:

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{i0}, \qquad i = 1, \ldots, m \tag{7}$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0}, \qquad r = 1, \ldots, s \tag{8}$$

$$\lambda_j \geq 0, \qquad j = 1, \ldots, n \tag{9}$$

where index 0 represents each DMU that equations are solved for (in order to maximize its efficiency – observed DMU), lambdas are weighted coefficients that are used to represent the so-called composite DMU for each real DMU that will be located as inefficient. The composite DMU for each inefficient real DMU is consisted as sum of the ERS (efficiency reference set – efficient DMUs used for interpretation of the

composite DMU for the observed real DMU) multiplied with its lambda coefficients. If A and B are efficient DMUs (m inputs, s outputs) and define the ERS set of observed inefficient C DMU, the composite DMU of C → C' can be interpreted as:

$$\lambda_A \begin{bmatrix} y_{1A} \\ \dots \\ y_{sA} \\ x_{1A} \\ \dots \\ x_{mA} \end{bmatrix} + \lambda_B \begin{bmatrix} y_{1B} \\ \dots \\ y_{sB} \\ x_{1B} \\ \dots \\ x_{mB} \end{bmatrix} = \begin{bmatrix} y_{Composite} \\ \dots \\ y_{Composite} \\ x_{Composite} \\ \dots \\ x_{Composite} \end{bmatrix} = C' \quad (10)$$

2. MATHEMATICAL MODEL

The model built is based on the fact that the delivery of knowledge, skills and competencies of students is conducted through practical implementation of curricula or course components during the study. DEA is particularly applied to service-oriented institutions and requires existence of a basic entity whose efficiency will be measured, with defined constellation of input resources invested and output outcome. Universities can be understood as subjects that deal with knowledge, skills and abilities delivery (basic function). Bearing this in mind, a mathematical model is conducted based on the need of measuring the efficiency level of the financial and other structural resources allocation by the University, with consideration of the achieved results in the process of knowledge, skills and abilities delivery to the students through the courses within a specific academic program. The resources are invested for each course and each course produces knowledge, skills and abilities.

So, course / subject is the entity whose efficiency is measured, i.e. course as decision making unit (DMU):

- All inputs to the DMU are constellated so that their increase can reduce the efficiency of each study course individually. In this manner, all output are considered to represent the outcome of the study program or each course practical implementation so that their increase will influence the increase of the efficiency of each study program individually.
- Inputs of a single DMU are represented with:
  - Expenses and financial structure within each subject consumed on behalf of gross salaries for professors and assistants that were engaged in the study program processing during years. Expenses are calculated in terms of gross salaries / expenses, with consideration of three months length (12 working weeks) of the semester (period of knowledge delivery) and the percentage of load in terms of number of students of the observed course and all students that the concrete person (teacher or assistant) covered during those three months. All increases and salary / expenses fluctuations are considered also. This data is gathered using the finance and human resources modules in ERP platform of the Goce Delcev University in Stip;
  - Expenses and financial structure within each subject consumed on behalf of the equipment and inventory used for the concrete study program. This is done by calculation of the degree of utilization, i.e. the ratio of annual depreciation of computer equipment and inventory used, in accordance with their gross purchase price and the legislation. Percentage of load / utilization in terms of number of students of the observed course and all students that used the same equipment and inventory is considered, and
  - Number of classes held, having in mind that classes load, forming study groups, classes and schedule organization is very important part in the process of overall course organization;
- Outputs of a single DMU are represented with:
  - Index of the level of contribution of each course in skills, competencies and knowledge delivery, prescribed with the accreditation elaborate of the study program (IP-KKV). Massive survey was realized at representative sample of 28 (of total of 88 students graduated at the study program), that generated indexes' values, and
  - Index of the quality of skills, competencies and knowledge delivered (IPKS-KKV) through the study program. This parameter, represented by the average grade of each course is calculated using the reporting module of the student information system of Goce Delcev University, fully automated for students' e-administration.

The model is shown in figure 1:

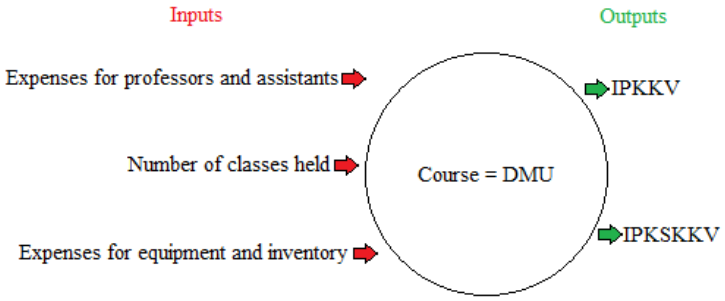

Figure 1. DEA Model: Course as DMU / Input = resources invested / Output = knowledge produced

3. CALCULATION, RESULTS AND DISCUSSION

Considering the above elaborated model and approach, table 1 shows the numerical side of it:

Table 1: Input / Output data

Number of classes held	Expenses for equipment and inventory	Expenses for professors and assistants	DMUs / Courses	IPKKV	IKPSKKV
24	28737,71	83066,86	English language 1	3,571	9,022
168	31190,88	122253,1	Electrical engineering	3,910	7,818
252	28737,71	87609,05	Math 1	3,928	7,170
168	31190,88	105634,6	Programing	4,267	6,852
24	25154,8	79832,87	English language 2	3,571	8,816
252	24766,98	101473,2	Linear algebra	3,875	7,556
252	27093,87	101473,2	Math 2	3,982	7,079
168	27093,87	107276,6	Objective programing	4,267	7
108	31979,06	36434,47	Probability and statistics	3,785	6,943
96	31979,06	78218,35	Digital logic	4,285	7,113
60	218481,7	51455,4	Operational systems	3,875	7,704
96	218481,7	131314	Software processes	3,964	7,295
96	218481,7	117407,6	Data structures and algorithms	4,25	6,954
96	154104,2	187273,8	Computer architecture	3,678	7,147
96	227342,5	62070,34	Data bases	4,321	7,318
72	118954,8	65492	Internet programing	4,339	7,238
72	12381,86	62527,75	Microprocessors	3,571	6,795
72	13413,68	64872,67	Software analysis and modeling	3,928	7,125
48	128867,7	65273,13	Graphics and visualization	4,160	8,170
72	128867,7	95668,31	Multimedia	3,982	7,693
72	87132,91	64428,28	Visual programing	4,339	7,056
72	7203,188	90306,62	Intelligent systems	4,142	7,693
72	7536,731	67004,76	Distant learning systems	3,196	7,602
72	7536,731	57935,99	Software projects management	3,821	7,011

The model has been applied on 24 subjects of the study program of Informatics at the Faculty of Computer Sciences, generation of students 2007/2008. The numerical model is processed in Open Source DEA software application (http://www.opensourcedea.org/index.php?title=Open_Source_DEA). The results of the subjects' efficiency measurement are given in table 2:

Table 2: Courses efficiency

DMU / Subject	Efficiency	DMU / Subject	Efficiency
English language 1	1	Data bases	0,856
English language 2	1 **(ERS=6)**	Digital logic	0,82
Probability and statistics	1 **(ERS=12)**	Multimedia	0,684
Operating systems	1 **(ERS=2)**	Math 1	0,59
Graphics and visualization	1 **(ERS=10)**	Linear algebra	0,566
Intelligent systems	1	Data structures and algorithms	0,558
Distant learning systems	1	Objective programming	0,551
Software projects management	1 **(ERS=16)**	Programming	0,548
Visual programming	0,98	Math 2	0,538
Software analysis and modeling	0,958	Electrical engineering	0,494
Internet programming	0,942	Software processes	0,487
Microprocessors	0,893	Computer architecture	0,375

Courses with efficiency = 1 are noted as relativly efficient courses and are set of representative courses for the courses with efficiency bellow 1, noted as inefficient courses. Most efficient courses are used in most of the cases of composite courses. In general, composite unit (in this case, the course) is the unit that DEA propose for each inefficient unit towards its optimization. Each inefficient unit has its own composite unit, as its example of best input / output allocation. The composite units are generated as the sum of the detected and specific (diferent for each inefficient DMU) ERS units and lambda corresponding coefficients, known as production levels. Courses that are bold in table 2 are noted as entities consisting Efficiency Reference Set – ERS, used in creating composite courses. ERS = X notes the number of times this course is used in creation of composite units for the inefficient detected courses. This defines **Graphics and visualization** and **Probability and statistics** as best efficient subjects, and **Software processes** and **Computer architecture** as subjects with worst resource invested and outcome results constellation.
Table 3 defines all inefficient courses in terms of definition of their composite DMUs (that are "on the frontier" and are what they "should be like").

Table 3. Production levels of inefficient DMUs

COMPOSITES	EFFICIENCY REFERENCE SET				
	English language 2	Probability and statistics	Operating systems	Graphics and visualization	Software processes management
INEFFICIENT COURSES	**LAMBDAS / PRODUCTION LEVELS**				
Electrical engineering	0,086514754	0,230296305	0	0	0,778229001
Math 1	0	0,375590319	0	0	0,655957254
Programming	0	0,325830999	0	0,009357358	0,783848429
Linear algebra	0	0,240252428	0	0	0,839884745
Math 2	0	0,2745388	0	0	0,770090534
Objective programming	0	0,265867267	0	0	0,853439903
Digital Logic	0	0,05593835	0	0,135779195	0,918245408
Software processes	0,080624363	0	0	0,804743829	0,085840258

Data structures and algorithms	0	0,04764483	0	0,93064462	0,051678035
Computer architecture	0,532210613	0	0	0,33862454	0,096534391
Data bases	0	0,308539831	0,813776755	0	0
Internet programming	0	0,273756379	0,010198233	0,784337473	0
Microprocessors	0,105563595	0,04925189	0	0,007417073	0,779054684
Software analysis and modeling	0,097614486	0	0	0,027600157	0,906758254
Multimedia	0,142915191	0	0	0,644193784	0,207101916
Visual programming	0	0,189735113	0	0,598011357	0,296446308

Having this in mind, in order of inefficient DMUs to become efficient, they have to become as their efficient or composite DMUs. For example, most inefficient subject is **Computer architecture**. The composite course can be calculated as:

$$CA_{composite}\begin{bmatrix} ExpensesTeachers \\ ExpensesEquInv \\ NumberOfClasses \\ IPKKV \\ IKPSKKV \end{bmatrix} = 0.5322106 * EJ2\begin{bmatrix} 79832,87 \\ 25154,8 \\ 24 \\ 3,571428572 \\ 8,8160 \end{bmatrix} + 0,33862454 * GV\begin{bmatrix} 65273,13 \\ 128867,7 \\ 48 \\ 4,160714286 \\ 8,1704 \end{bmatrix} + 0,096534391 *$$

$$SPM\begin{bmatrix} 57935,99 \\ 7536,731 \\ 72 \\ 3,821428571 \\ 7,0113 \end{bmatrix} = \begin{bmatrix} 70183,79877 \\ 57752,97057 \\ 35,977508 \\ 3,678571429 \\ 7,1477 \end{bmatrix}$$

$$CA_{real}\begin{bmatrix} 187273,8 \\ 154104,2 \\ 96 \\ 3,678571429 \\ 7,1477 \end{bmatrix} : CA_{composite}\begin{bmatrix} 70183,79877 \\ 57752,97057 \\ 35,977508 \\ 3,678571429 \\ 7,1477 \end{bmatrix} = Deviation\begin{bmatrix} +166,83\% \\ +166,83\% \\ +166,83\% \\ +0\% \\ +0\% \end{bmatrix}$$

Discussion: The cost in terms of the teaching staff in terms of inventory and depreciation of computer equipment are 166.83 % higher than the potentially optimal constellation of parameters. This directly alludes to the fact that equally good results in the output, ie the same level of knowledge of the skills and competencies of the students with the same quality can be achieved mainly by reducing the cost of entry, and that means that the cost for teaching / associate staff and equipment costs . In addition, possible optimization may be required and reducing the number of classes that are realized in practice.

4. CONCLUSION

The purpose of this work is to review the system of delivery of knowledge, skills and abilities in a specific study program through the elaboration of the results achieved, as a result of the resources invested. The specific skills, knowledge and abilities are strictly defined in the official acts for study program accreditation. For its real processing, the University has to make efficient resource allocation (material and non-material), in order to deliver skills, knowledge and abilities at the expected level. Having this in mind, input oriented DEA model is used because it is assumed that the result (level of skills, knowledge and abilities, conducted through complex survey) is invariant and ask what can be done in order to decrease the resources investment for efficiency improvement.

The detection of inefficient courses in terms of inadequate allocation of input resources and / or achieved poor results proposes specific measures to optimize inefficient courses:

- Reduce the cost of engagement and collaboration of the teaching staff
    - Increasing the workload of the teacher
    - Reduction of gross salary

    - Option for freelance engagement of staff with less financial burden
- Reduce the cost of equipment and inventory
    - Purchase of equipment and inventory at a lower purchase price
    - Increasing utilization of the unit (in terms of number of students)
    - Increasing the rate of depreciation
- Reducing the number of realized lectures and tutorials
    - Reduction and convergence of matter in fewer lectures
    - Pipe classes for lectures and tutorials
    - Reducing the number of students' groups
    - Intervention within the study programs / change relevant parameters

For more accurate investigation, it is possible to do an extension of the model by increasing the parameters that are not taken into account in this case, according to the perception of the management of the University. DEA allows that in order of geenration even more appropriate and realistic model.

REFERENCES

Taha, Hamdi A., (2007). Operational research, Introduction. New Jersey: Pearson Education, Inc.

Charnes, A., Cooper, W.W., Lewin, L. A., Seiford, M. L., (1994). Data Envelopment Analysis, Theory, Methodology and Applications. Norwell, Massachusetts: Kluwer Academic Publishers.

Charnes, A., Cooper, W.W., Rhodes, E., (1978). Measuring the Efficiency of Decision Making Units. Amsterdam: North-Holland Publishing Company.

Cooper, W.W., Seiford, M. L., Tone, K., (2007). Data Envelopment Analysis, A Comprehensive Text with Models, Applications, References and DEA-Solver Software, Second Edition. New York: Springer.

Aronson, E. J., Zionts, S., (1998). Operation Research: Methods, Models, and Applications. Westport, Connecticut: Quorum Books.

Breirerova, L., Choudhari, M., (1996). An Introduction to Sensitivity Analysis. Massachusetts :Massachusetts Institute of Technology.

Cooper, W. W., Seiford, M. L., Zhu, J., (2011). Data Envelopment Analysis: History, Models and Interpretations. New York: Springer.

Directorate General – Education and Culture, European Commission, (2009). ECTS Users' Guide. Office for Official Publications of the European Communities.

Yang, Y., Ma, B., Koike, M., (2000). Efficiency – Measuring DEA Model for Production System with k Independent Subsystems. Journal of the Operations Research, Society of Japan, Vol. 43, No. 3,

MULTI-CRITERIA OPTIMIZATION OF THE MOST COMPETITIVE BANK IN MONTENEGRO SELECTION PROCESS

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***Abstract**: Multi-Criteria Decision Making (MCDM) is one of the most prominent branches in decision-making process. It is applied in all those situations where there is a range of often conflicting criteria based on which an optimal decision is to be taken. It is the existence of a number of criteria that is a significant step towards the reality of problems that can be solved by applying MCDM methods. This paper presents a methodology of applying the AHP (Analytic Hierarchy Process) method in selecting the most competitive bank in the Montenegrin market. By reducing a complex decision making problem to comparing pairs of options and through a synthesis of obtained results, the AHP method enables reaching the most favorable decision.*

***Key words**: decision making, multi-criteria decision making, banks, AHP method*

1. INTRODUCTION

A transition process in Montenegro has instigated a reform of the financial sector. The reform has been aimed at providing security and stability of the financial system and boosting efficiency and profitability of the banking system. Reforms have yielded good results. New legislation has been passed, ownership transformation has been implemented, a new concept of bank management has been adopted and a supply of banking products has been increased.

Banks occupy a central position in a country's financial system, due to both the function they perform and the financial potential at their disposal. Contemporary banks are multiservice financial institutions which, in addition to their primary functions, offer a wide range of financial products and services to their customers. The nature of their business is such that banks are market-oriented enterprises operating on principles of liquidity, safety and profitability, aimed at maximizing profit.

The main institution in charge of supervision and oversight of the financial services sector in Montenegro is the Central Bank of Montenegro, founded in March 2001. As an independent institution, the Central Bank is responsible for monetary policy, establishing and maintaining a sound banking system and an efficient payment system. In 2010, a new Law on the Central Bank of Montenegro was passed, based on the new Constitution of Montenegro. Pursuant to that law, the Central Bank has assumed responsibility for providing stability of the financial system, including the promotion and maintenance of a sound banking system and a safe and efficient payment system.

2. BANKING SYSTEM IN MONTENEGRO

Since 2007, the banking sector of Montenegro has comprised 11 commercial banks and six micro-financing institutions that have a license issued by the Central Bank. Within the Central Bank, there is a special department for the control of banks. This department reports on financial indicators of each bank and ensures that each bank maintains a minimum share of capital equity in relation to total assets, as stipulated by law. As part of measures aimed to strengthen the financial system, special attention has been devoted to enhancement and maintenance of banking system stability. In order to achieve that, the Central Bank continuously monitors and analyzes, and if necessary, undertakes corrective measures to strengthen corporate governance and risk management and to ensure further implementation of internationally accepted standards and business principles (BTI 2014, Montenegro country report).

Since the beginning of transition, the banking sector has gone through a substantial change. As the privatization of state-owned banks was one of the main items of banking sector recovery, primarily through foreign capital inflow, a share of foreign capital has increased significantly. The crisis, which hit the world in 2008, affected Montenegro mostly as a lack of trust. Fearful that problems from the 1990s may reemerge, a certain number of people began to withdraw their deposits from the banking system. However, as the crisis spread to the real sector, an increasing number of companies became insolvent and they slowly started to

close and fall into bankruptcy. Since the second half of 2009, the situation has started to improve. Deposits have started to grow which is a sign of recovery and stability of a banking system. Profitability of the banking sector has made significant progress over the last decade. This is primarily due to a comprehensive reform of the banking sector, write-off of bad loans, privatization of state-owned banks, separation of commercial banks from the Central Bank, liberalization of interest rates, introduction of modern banking technology, expansion of loans etc., and opening banking sector to private and foreign units as well. Generally speaking, Montenegrin banking system has experienced a growing trend in profitability .

Stability of the banking system is, among other things, reflected in parameters of liquidity and solvency of banks, and at the end of 2013, these parameters were above the stipulated level. Growth of 4.9%, as compared to the end of the previous year, in total loans and other receivables in the first six months of 2013, is not only the result of an increase in newly approved loans but is also partly fostered by changes in regulations and implementation of IAS as well, and in view of this banks returned a part of written-off loans and other receivables from off-balance sheet items. However, in spite of the efforts banks have undertaken to reduce the level of non-performing loans[1] in the post-crisis period, continuity in growth of these loans has remained the biggest vulnerability of the banking sector and a potential source of risk to financial stability. Despite a moderate success attained by moving non-performing loans to parent banks' balance sheets or by selling and/or restructuring loans, their upward trend has continued. At the end of July this year, non-performing loans and other receivables accounted for 17.8% of total loans and other receivables. A key challenge in 2014, just like in previous years, will be a reduction in volume of non-performing loans. A so called "Podgorički model" for voluntary restructuring of non-performing loans has been developed, and this model has received a full support of the Central Bank, the Ministry of Finance and the World Bank. It is a very complex project whose implementation requires passing *lex specialis* for its enforcement in practice. The project is aimed at improving the performance of solvent legal entities – companies and entrepreneurs – that are dealing with temporary liquidity problems, and by doing that – at providing banks performance boost, since banks are a pillar of stability and support of banking system recovery. The project will, in the long term, prompt positive impulses for triggering economic activities and consolidating real economy.

Also encouraging is the fact that banks deposits grow, which leads to improved credit-to deposit-ratio. At the end of June 2013 the increase in deposits was 1.5%. Lending rates, both in 2012 and during 2013 were extremely high due to the high country risk premium, and thus more expensive fund sources, the upward trends of non-performing assets, risk rating and the general business climate. Due to limited access to resources, banks turned to domestic sources, secured by offering higher deposit rates, which resulted in higher interest margins.

Figure 1 (Source: Financial statements of banks in 2013) shows the proportion of Montenegrin banks in the banking system of Montenegro measured by total assets. The Montenegrin Commercial Bank has the largest share and accounts for 20% (of total assets), followed by the NLB Bank with 17% and the Societe General Bank of Montenegro with 12%. Other banks account for less than 10%.

Figure 2 (Source: Financial statements of banks in 2013) shows the share of banks in the banking sector in relation to the amount of loans given in 2013. The CKB (the Montenegrin Commercial Bank) comes first by this criterion as well with the share of 25%, followed suit by the NLB with 19% while the Societe General Montenegro is in the third place with 16%.

Bank performance has traditionally been measured based on an analysis of financial indicators. The most common way of performing analysis is based on the criteria of liquidity, profitability, capital efficiency and adequacy, whereby different models of multi-criteria analysis can be used. This paper has employed the AHP (Saaty, 1993) model for the ranking of Montenegrin banks.

[1] In compliance with the amended regulation, which came into force on January 1st 2013, a share of non-performing loans and other receivables is calculculated as a percentage of non-performing gross loans and other receivables, without interest and time limits, in total loans and other receivables.

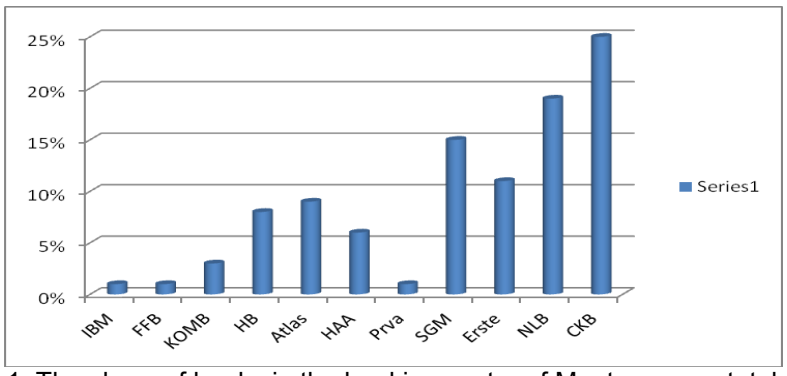

Figure 1. The share of banks in the banking sector of Montenegro – total assets

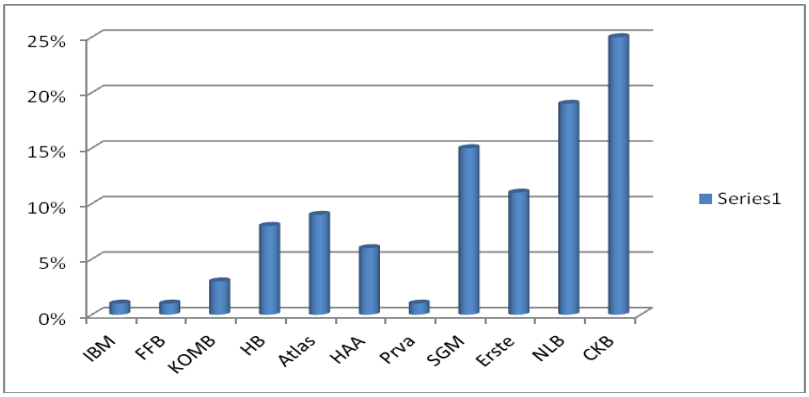

Figure 2.The share of banks in the banking sector of Montenegro – loans

3. AHP MODEL FOR BANK RANKING AND COMPARISON

In order to make an AHP model it is necessary to define the goal, criteria, sub-criteria and alternatives. The goal of this model is ranking of the banks in Montenegro from the best to the worst; the criteria have been divided into two groups – qualitative and quantitative. Quantitative criteria are financial ratios which display characteristics of certain bank performances. When choosing financial ratios in the model, the experience of many different experts in the field has been used (Yeh, 1996). Financial ratios are divided into four groups: liquidity, efficiency, profitability and capital adequacy. Within each group sub-criteria have also been defined. Liquidity sub-criteria are:

1) L1 = money + money equivalents + investments/total deposits;
2) L2 = total approved loans/total deposits;
3) L3 = Liquid assets/total assets

Efficiency sub-criteria are:

1) E1 = operational expenditures/operational income;
2) E2 = provision costs/net interest rate income;
3) E3 = operational income/total number of employees.

Profitability sub-criteria are:

1) P1 = Profit before tax/equity;
2) P2 = Profit before tax/total assets;
3) P3 = Profit before tax/operational income.

And for the last group – capital adequacy, the sub-criteria are:

1) C1 = total obligations/equity;
2) C2 = equity/total loans;
3) C3 = total deposits/equity.

Qualitative factors are owners' support, the importance of a bank in the financial system of Montenegro (significance), management and the bank maturity. These criteria could not be described by any of qualitative methods, so we use verbal descriptions. Alternatives are represented by 7 Montenegrin banks.

In order to use this model for bank ranking, we need to determine the weights of the main criteria and sub-criteria, and then for each criteria at the bottom level of the hierarchy structure to define the intensities for the evaluation of the relevant bank performances. The weights of criteria and sub-criteria are calculated by the

help of Super Decision software on the basis of the pairwise comparison of relative criteria and sub-criteria importance. For quantity criteria, the intensities are defined on the basis of the five-level scale of intensities (excellent, very good, good, satisfied, bad), which have been derived on the basis of the range in which their values have fluctuated.

As for the qualitative criteria, we have used the same evaluation as in CAMELS method, so the intensity scale for each category has been generated. For example, the scale for owners support is defined as: excellent, very good, good, satisfied and bad; the importance of the bank as: excellent, very good, good, satisfied and small; the management: excellent, very strong, strong, average, weak and, finally, the maturity of the bank is assessed as: more than 10 years, from 5 to 10 years, and less than 10 years. CAMELS method has 5 levels for each criteria, but due to the deficiency of precise and quality information, it has not been possible to recognize some subtler levels, as can be performed by the examiners for the bank monitoring who are entitled to have access to all the necessary information. Structure of the AHP model for bank ranking and comparison is presented in Figure 3.

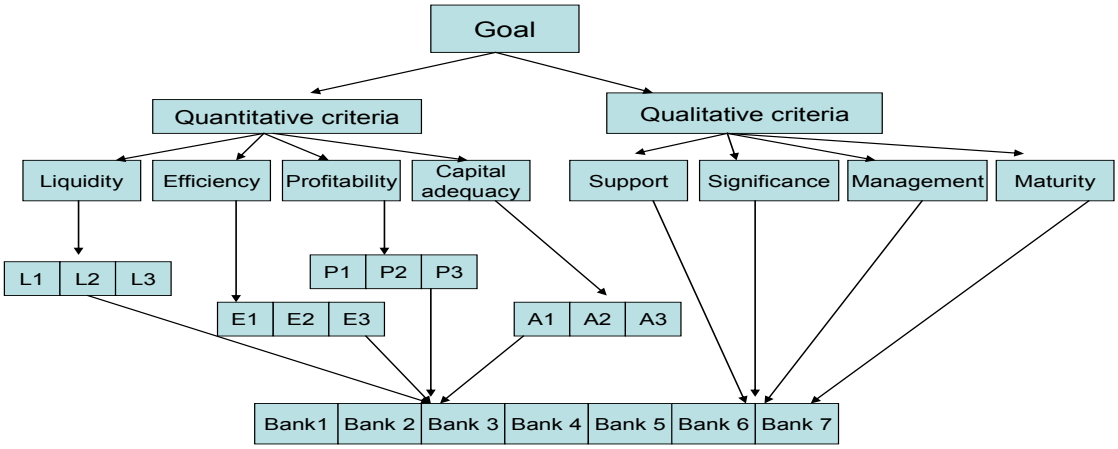

Figure 3. Structure of the AHP model for bank ranking and comparison

4. APPLICATION OF THE AHP METHOD FOR RANKING BANKS IN MONTENEGRO

The banking sector in Montenegro consists of 11 banks. For the purposes of this study, seven banks[2] with the largest market share have been analyzed. The data on the banks' financial indicators date from 2013 and have been obtained from the annual financial statements. The values of financial indicators are presented in Table 2 while the values of the intensity of the quantitative criteria are shown in Table 3. The weights of criteria and sub-criteria are calculated by the help of Super Decision software on the basis of the pairwise comparison of relative criteria and sub-criteria importance. For quantity criteria, the intensities are defined on the basis of the five-level scale of intensities (excellent, very good, good, satisfied, bad), which have been derived on the basis of the range in which their values have fluctuated (Table 3). For the qualitative criteria, we have used the same evaluation as in CAMELS method, so the intensity scale for each category has been generated.

Based on the data for the seven banks that were analyzed using the AHP model, a ranking list of banks has been obtained. A graphic illustration of the ranking list of banks is shown in Table 1 while Figure 4 shows the weights of certain quantitative and qualitative criteria.

Table 1. Graphical illustration of ranks

[2] Names of banks known to authors

Graphic	Ratings Alternatives	Total	Ideal	Normal	Ranking
	Banka1	0.6150	1.0000	0.1971	1
	Banka2	0.4148	0.6745	0.1329	4
	Banka3	0.5544	0.9015	0.1777	2
	Banka4	0.5317	0.8645	0.1704	3
	Banka5	0.3312	0.5386	0.1062	6
	Banka6	0.3259	0.5299	0.1045	7
	Banka7	0.3471	0.5643	0.1112	5

Figure 4. Weights for quantitative and qualitative criteria

Liquidity		0.41667
Efficiency		0.25000
Profitability		0.12500
Capital adequacy		0.20833
Owners' support		0.1601
Importance		0.2008
Management		0.0160
Maturity		0.1000

From Table 1 it can be seen which rank is taken by each selected bank all the given criteria taken into account. In fact, in the overall ranking the best bank in Montenegro is Bank 1, Bank 3 is the runner-up, followed by Bank 4 and Bank 7. The last and the second last place are taken by Bank 5 and Bank 6, respectively.

Bank ranks according to individual criteria (liquidity, efficiency, profitability, capital adequacy and qualitative criteria) have been calculated in a similar manner if the purpose of the analysis is to find the best bank in terms of a single criterion. The banks can be ranked separately on quantitative and qualitative criteria.

When taking into account only quantitative criteria, the analysis can be carried out separately according to individual quantitative criteria, such as the liquidity criterion (Table 4), the efficiency criterion (Table 5), the profitability criterion (Table 6) and the capital adequacy criterion (Table 7).These tables show that Bank 1, which is ranked best in the overall rating, according to these criteria usually occupies the sixth position (according to the criteria of liquidity and efficiency), i.e., the fourth according to the criterion of profitability and the second according to the criterion of capital adequacy. When you look at the table that shows the ranking of the banks according to qualitative criteria (Table 8), we can note that the leading bank is Bank 1. Thanks to qualitative criteria, as well as a good position according to capital adequacy criterion, the bank is the first in the overall ranking. This information may be of interest for those making decisions on the selection of the most competitive bank.

Table 2. Values of financial ratios

	Criterion											
Alternative	L1	L2	L3	E1	E2	E3	P1	P2	P3	C1	C2	C3
Bank 1	1.16	1.00	0.13	0.42	0.06	82.26	0.08	0.010	0.17	6.59	9.49	6.16
Bank 2	1.31	0.88	0.32	0.48	0.00	94.74	-0.32	-0.030	-0.52	9.38	1.12	7.75
Bank 3	1.28	1.07	0.15	0.36	0.00	84.19	0.14	0.016	0.23	7.81	0.83	6.49
Bank 4	1.53	1.29	0.15	0.35	0.00	106.87	0.15	0.017	0.22	7.85	0.58	5.55
Bank 5	2.08	1.76	0.14	0.46	0.00	70.56	-0.07	-0.013	-0.23	4.07	0.58	2.28
Bank 6	0.99	0.85	0.11	0.55	0.05	59.64	0.01	0.002	0.03	7.09	13.06	6.60
Bank 7	1.28	1.07	0.15	0.36	0.00	77.90	0.09	0.012	0.20	6.76	1.13	5.67
Criterion	Max	max	max	min	min	max	max	max	max	min	max	min
Best value	2.08	1.76	0.32	0.35	0.00	106.87	0.15	0.017	0.23	4.07	13.06	2.28
Worst value	0.99	0.85	0.11	0.55	0.06	59.64	-0.32	-0.030	-0.52	9.38	0.58	7.75

Table 3. Values of intensities

Criterion	L1	L2	L3	E1	E2	E3	P1	P2	P3	C1	C2	C3
Type	max	Max	max	min	min	max	max	max	max	min	max	min
Excellent	(1.81 - 2.1)	(1.51 - 1.8)	(0.31-0.5)	(0.3-0.36)	(0.0-0.009)	(98-107)	(0.15-0.18)	(0.015-0.018)	(0.21-0.25)	(3 -4.5)	(11.1-13)	(0.0 - 2.5)
Very good	(1.51-1.8)	(1.31-1.5)	(0.26-0.3)	(0.37-0.39)	(0.01-0.019)	(92-97)	(0.11-0.14)	(0.011-0.014)	(0.17-0.20)	(4.51 - 6.5)	(8.1-11)	(2.51 -3.5)
Good	(1.21-1.5)	(1.11-1.3)	(0.21-0.25)	(0.4-0.42)	(0.02-0.03)	(84-91)	(0.07-0.10)	(0.007-0.010)	(0.11-0.16)	(6.51 - 7.5)	(5.1-8)	(3.51 -5)
Satisfied	(1.1-1.2)	(0.91-1.1)	(0.16-0.2)	(0.43-0.46)	(0.04-0.05)	(76-83)	(0.03-0.06)	(0.003-0.006)	(0.06-0.10)	(7.51 - 9)	(2.1-5)	(5.01 - 6.5)
Bad	(0.61-1)	(0.71-0.9)	(0.1-0.15)	(0.47-0.56)	(0.06-0.07)	(58-75)	(0.0-0.02)	(0.0-0.002)	(0.0-0.05)	(9.01-10)	(0-2)	(6.51 -8)

Table 4. Liquidity criteria

Weights	0.11067	0.04611	0.06148		
	L1	L2	L3	Total	Ranking
Bank 1	0.5588	0.5706	0.3943	0.1124	6
Bank 2	0.6321	0.5004	1.0000	0.1545	2
Bank 3	0.6143	0.6098	0.4637	0.1246	5
Bank 4	0.7360	0.7353	0.4571	0.1435	3
Bank 5	1.0000	1.0000	0.4435	0.1840	**1**
Bank 6	0.4752	0.4846	0.3401	0.0958	7
Bank 7	0.6142	0.6060	0.4746	0.1251	4

Table 5. Efficiency criteria

Weights	0.0520	0.0404	0.0385		
	E1	E2	E3	Total	Ranking
Bank 1	0.8411	0.0000	0.7697	0.0734	6
Bank 2	0.7320	1.0000	0.8866	0.1127	3
Bank 3	0.9900	1.0000	0.7878	0.1223	**1**
Bank 4	1.0000	0.0002	1.0000	0.0905	5
Bank 5	0.7657	1.0000	0.6603	0.1057	4
Bank 6	0.6383	0.0000	0.5581	0.0547	7
Bank 7	0.9793	1.0000	0.7290	0.1194	2

Table 6. Profitability criteria

Weights	0.0356	0.0119	0.0180		
	P1	P2	P3	Total	Ranking
Bank 1	0.5157	0.6013	0.7417	0.0388	4
Bank 2	-2.1179	-1.7654	-2.2362	-0.1366	7
Bank 3	0.9100	0.9147	1.0000	0.0613	2
Bank 4	1.0000	1.0000	0.9657	0.0649	**1**
Bank 5	-0.4504	-0.7867	-0.9728	-0.0429	6
Bank 6	0.0965	0.1057	0.1359	0.0071	5
Bank 7	0.6018	0.6863	0.8726	0.0453	3

Table 7.Capital adequacy criteria

Weights	0.0290	0.0499	0.0302		
	C1	C2	C3	Total	Ranking
Bank 1	0.6170	0.7269	0.3703	0.0654	2
Bank 2	0.4338	0.0857	0.2942	0.0258	7
Bank 3	0.5212	0.0638	0.3516	0.0289	6
Bank 4	0.5180	0.0441	0.4111	0.0297	5
Bank 5	1.0000	0.0446	1.0000	0.0615	3
Bank 6	0.5741	1.0000	0.3455	0.0770	**1**
Bank 7	0.6016	0.0868	0.4023	0.0339	4

Table 8. Qualitative criteria

Weights	0.1601	0.2008	0.0160	0.1000		
	Owners' support	Importance	Management	Maturity	Total	Ranking
Bank 1	1	1	1	0.77	0.4539	**1**
Bank 2	0.55	0.77	0.77	0.55	0.3100	5
Bank 3	1	1	1	0.55	0.4319	2
Bank 4	1	0.77	1	0.55	0.3857	3
Bank 5	0.77	0.33	0.33	0.33	0.2278	7
Bank 6	0.55	0.55	0.55	0.55	0.2623	6
Bank 7	0.55	0.77	0.77	1	0.3550	4

5. CONCLUSION

One of the options for finding a model to measure bank performance is the control of the banks performed by the Central Bank. The control is a common interest of the Central Bank, capital owners and users of banking services. The Central Bank, as the institution in charge of monetary policy, performs control over the banks in order to be able to promptly react to potential problems and protect the interests of citizens and the entire economic system. The owners of capital in banks are more and more interested in establishing an efficient and effective system of internal control in order to ensure better competitiveness through identifying the causes of their inefficiency and taking preventive action to avoid them. From the perspective of consumers – users of banking services, supervision over banks is important to avoid the risk of doing business with high-risk banks.

In the modern-day business world, in order to make optimal decisions, it is necessary to analyze the problem in terms of multiple criteria. In such cases, it is possible to use methods of multiple criteria decision-making. The choice of method depends on a particular case and the aim of the decision-maker. Some of the known methods are: ELECTRA, PROMETHEE, DEA, CAMELS, VIKOR and AHP. In this paper we employed the AHP method, in order to rank the banks in Montenegro, based on defined criteria. The advantages of the AHP method are in the possibility of inclusion of qualitative criteria and in the fact that apart from overall ranking, the alternatives can be ranked according to individual criteria and sub-criteria, which is an advantage that is often critical when decision-makers decide to use the AHP method. Montenegrin banks have been ranked applying the AHP method on the basis of quantitative and qualitative criteria, and with the help of a software package Super Decision. Banks have been ranked according to the criteria of liquidity, efficiency, profitability, capital adequacy, equity support, the importance for the financial market in Montenegro, management and maturity. In the overall ranking the best bank in Montenegro in 2013 is Bank 1. This practical example, accompanied by data from the financial statements, has shown the benefits of the AHP method, and helped in determining the most

competitive bank in Montenegro on the basis of several criteria relevant to the study, as well as in ranking the other banks.

REFERENCES

BTI (2014). Montenegro country report

Caterino, N., Iervolino, I., Manfredi, G., Cosenza, E. (2009). Comparative analysis of multi-criteria decision making methods for seismic structural retrofitting, Computer –Aided Civil and Infrastructure Engineering, 24.

Centralna Banka Crne Gore (2014). Preporuke vladi Crne Gore za ekonomsku politiku 2014.

Dragašević, Z., (2010). Modeli višekriterijumske analize za rangiranje banaka, Doktorska disertacija, Ekonomski fakultet Podgorica

European Investment bank (2013). Banking in Central and Eastern Europe and Turkey Challenges and Opportunities

Fabris, N., Mitrović, M.(2012). Central Bank of Montenegro, Critical overview of Montenegro's growth model, East-West journal of economics and business, vol. xv – 2012, no 1 & 2

Feng, Y., Lu, H., Bi, K. (2004). An AHP/DEA Method for measurement of the Efficiency of the R&D Management Activities in Universities", International Transactions in Operational Research, 11.

Hunjak, T., Jakovčević, D., (2003). Multi-criteria Models for Bank ranking and Comparison, Almanac of the faculty of Zagreb, I, number 1.

International Monetary Fund (2013). Montenegro 2013 article IV consultation, IMF Country Report No. 13/271,

Kubiszewska, K., Development of banking sectors in Kosovo and Montenegro in the years 2000-2010, Gdansk University of Technology

Macharis, C., Springael, J., De Brucker and Verbeke, A. (2004), PROMETHEE and AHP: The design of operational synergies in multicriteria analysis. Strengthening PROMETHEE with idea of AHP", European Journal of Operational Research, Vol. 153.

Martić, lj. (1978). Višekriterijalno programiranje, Informator, Zagreb.

Montenegro Beyond the Peak: Growth Policies and Fiscal Constraints, Public Expenditure and Institutional Review (Volume II)

Rakočević, S., Dragašević, Z. (2009). Analisis of banks Efficiency in Montenegro Evaluated bx AHP Method, 10th International Simposium on the Analitic Hierarch/Network Process, Multi-Criteria Decesion Marking, Pittsburgh, USA

Saaty, T.L. (1993). Fundamentals of Decision making and Priority Theory with The Analytic Hierarchy Process, RWS Publications, Pittsburgh, USA

Saaty, T.L.(2001). The Analytic Network Process, RWS Publications, Pittsburgh, USA

World Bank Group Montenegro Partnership Country Program Snapshot October 2013

Yeh, Q.J: (1996) The application of data envelopment analysis in conjunction with financial ratios for bank performance evaluation, Journal of the Operational Research Society, Vol. 47.

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.409.3124&rep=rep1&type=pdf

http://www.dii.unisi.it/~mocenni/Note_AHP.pdf

www.cbcg.me

www.superdecision.com

RISK MANAGEMENT IN THE OPERATIONAL PLANNING PROCESS AT THE OPERATIONAL AND TACTICAL LEVELS

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Abstract: *This paper describes a risk management and it's evaluation procedures, in the operational planning process at the operational and tactical levels. Operational planning represents coordinated staff procedure in the work of the headquarters. Its purpose is to determine the best way to perform assigned missions and tasks, or to plan potential future tasks that might appear through the use of forces in the operations. The importance of risk management in the operational planning process has direct implications for the success of all types of operations performed by the Serbian Armed Forces. Emphasis is given to the management and risk assessment in all dimensions of the operational environment.*

Keywords*: operational planning, operational environment, risk management, SymOrg2014*

1. INTRODUCTION

Military operations are carried out within the framework of the complex factors of the area where the shape and nature have a significant impact on the effects of operations. It requires a broad understanding of the strategic and operational environment that is relevant to the completion of the mission.

Operational planning is a starting point of performing any operations, and also the element of the projection of future activities by which the operation is carried out, namely how is the complex mission carried out. Headquarter is conducting an assessment at the beginning of operational planning, in order to determine the best way to accomplish the mission. The assessment is carried out on the basis of established elements that comprise the factors of the operating environment. This assessment is a continuous process that includes the mission, enemy, time and land, its own strengths and total time available.

Observing the operating environment as a challenging environment for executing different operations, from combat to non-combat, military units must be capable and adaptable to successfully carry out the mission, no matter the conditions, particularly bearing in mind the different temperature, different land, fear, insecurity, confusion, fatigue and so on. All this combined with the human and physical dimensions takes the complexity that needs to be taken into account in operational planning. Operational environments are complex conditions, circumstances and influences that require from holders of operational planning to make the right decision. Operational planning refers to the executions of operations precisely in difficult conditions and with varying degrees of risk, which is manifested in certain trends of instability and lasting state of persistent conflict.

Risk management in the process of operational planning gets the central stage and it represents a complex approach, especially if one takes into account the operational environment that will remain dirty, the frightening, physically and emotionally exhausting ambient of environmental conditions in which the operation is performed .

2. THE OPERATIONAL ENVIROMENT

Military operations are conducted in a different range of environments characterized by complexity, uncertainty and constant change. The operational environment includes the physical components (air, land , maritime and cosmic space) and cyberspace. It also includes information to shape the conditions in these areas, including the enemy, friendly forces and neutral forces, relevant to the conduction of operations. Basic characteristics of the operating environment are complexity, variability and uncertainty.

The complexity and variability are the categories of operating environments that are constantly changing, and they manifest themselves in the complexity of the process and the situation that is made from a multitude of elements or components and their interactive relationship. Two operational environments that

are the same can not exist, especially bearing in mind that the operating environment is not static but it is constantly evolving. This evolution comes as a result from actions of a man who learns and is able to adapt. Therefore, the man influences the operating environment, and thus it changes. Some changes are expected, while others are not. Some changes are obvious and immediate, others are complex and hidden. The complexity and variability of the permanent nature of the operating environment makes the determination of the relationship between cause and effect very complex and contributes to the uncertainty of military operations, respectively contributing to the operations being exposed to certain risks. Uncertainty is what is unknown about a given situation or lack of understanding how the situation may evolve. In the process of operational planning, the commander accepts the implementation of operations in operating environments that are inherently uncertain. Within such situations, operational planning achieves a dimension of planning operations in the full range of influential factors.

3. OPERATIONAL PLANING

Operational planning is aligned staff process in the work of Command / HQ, whose purpose is to determine the best way to perform assigned missions and tasks or planning potential future tasks in the course of deployment of forces in operations (Instruction for operational planning and operation commands in the Serbian Armed Forces (SAM), 2014). At the same time, the system of operational planning enables the development of plans, which should be timely to respond to situations in which the SAM can be used. It is based on the development of goals and relationships with subordinate and superior levels, with clear and well defined responsibilities of individual organs of Command / HQ. (Instruction for operational planning and operation commands in SAM, 2014).

In the process of operational planning an essential prerequisite for the success of the operational plan and the success of the operation is an understanding of the operating environment" ... establishing an understanding of the conditions under which the power of the SAM is used. Armed forces are used in the operational environment governed by the certain conditions and they are changing during the course of the mission. By having full understanding of the operational environment, possible ways of solving problems are identified and the potential results of using own forces, enemy forces, and neutral participants are predicted." (Instruction for operational planning and operation commands in SAM, 2014).

According to the mentioned Instruction, operational planning at operational and tactical levels is implemented through seven stages : 1) initiation (receiving the task), 2) orientation (the study and understanding of the task) , 3) the development of variants of use (courses of action) , 4) analysis of variants use (course of action) , 5) comparison of variants of use (course of action) , 6) approval the use of variants (course of action) and the decision to perform the operation and 7) production of orders. For the operational planning process at the operational and tactical levels, the second phase is interesting - orientation, in which is risk assessments carried out and in a complex way goes on risk management as a whole. The second phase is characterized by seventeen steps, among which the seventh step is risk assessment.

Making reasonable estimates and conscious acceptance of risk is a fundamental issue for the performance of operational planning and execution of operations. Careful determination of risk, analysing and minimizing danger to an acceptable level and the executing the plan that provides that desired level, contributes to the success of the execution of the operation.

4. RISK MANAGEMENT

Risk management primarily refers to the process of identifying risks, its assessment and treatment. At the same time , risk management is a standard that defines risk as a combination of the probability of an event and its consequences. The way in which the risk is being managed depends on the likelihood that the risk will occur and what influence does its achievement has (Paul M. Collier, 2009) .

In the process of operational planning, HQ identifies potential hazards and begins doing initial assessments of the level of risk for each hazard. The commander, based on the assessment decides where, what type and how much risk can he accept for the realization of certain variants of use (course of action).

4.1. Definitions of risk

The term risk can be defined in a different ways. In most cases, the " risk " has one of the three meanings: 1) The possibility of loss or injury. This is the most commonly recognized concept which clearly states that

something is lost or can be lost through accident or other forms; 2) The potential for negative influence. This is a generic definition. Something could go wrong. The negative impact may be unclear and unknown, but it would also result in a negative outcome, and 3) Probability of adverse events. This moves us into the world of statistics and quantitative analysis. We see the risks on the horizon. What is the probability that it will achieve? What will be the impact if it does occur? Can you quantify the damage? What will be our best or worst case, if it happens? (John J. Hampton, 2009).

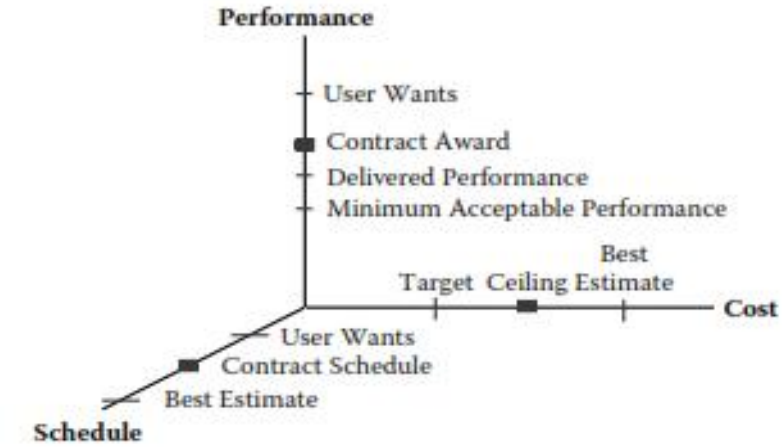
A broader definition is becoming the norm for the organization, namely becoming an imperative for operational planning process in a complex operating environment. Therefore, the risk is an occurrence which, if it occurs, adversely affects the ability of the project to achieve its objectives outcomes. (Paul R. Garvey, 2009). Hence, the risk of event has two aspects. The first is its probability of occurrence, and the other is its impact (or consequence) on the project.

Generally, this expression is given by the equation:

Risk = f (Probability, Impact) (1)
(1)

Uncertainty is the vagueness of the outcome of the situation. Uncertainty is analyzed to measure risk. Bearing in mind that the risk is potential event, the probability is used to express the chance that the event will occur. Often, the nature of such events is such that the analysis used to measure subjective probabilities instead of objectively derived measures.

Risk is present in every activity and is expressed in specific dimensions and to a large extent " pushes " what is technically or economically feasible. Managing risk exists within and across all these dimensions, as shown in Figure 1:



Scheme 1. Dimensions of risk management *(Paul R. Garvey, 2009)*

Risk management is a management method that focuses on the identification and control of events that have the potential to cause unwanted changes ... it is neither more nor less than an informed management." (TV Caver, 1985.). The objectives of risk management are early and continuous hazard identification and distribution of information on the results of risk. They should be such that the system fulfills its function within defined cost and meets customer needs.

Why is risk management in the operational planning important? It is important because risk management seeks to provide risk information relevant for the decision, namely a decision that will provide also the planning of forces in operation, in order to achieve the objective with respect to defined criteria.

In general, the risk management process consists of the steps that are shown in figure 2:

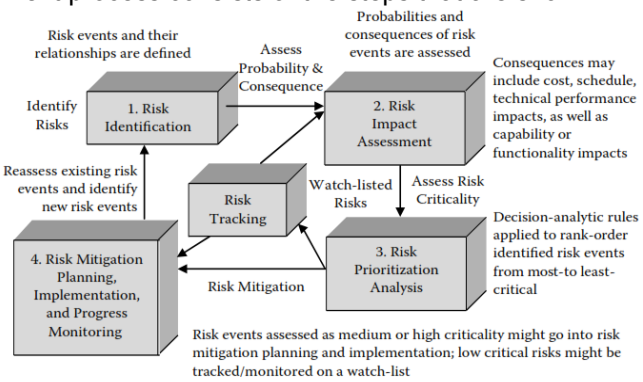


Figure 2: Steps common to a risk management process *(Garvey, P. R., 2009.)*

According to the Instruction for operational planning and operation commands in the Serbian Armed Forces, risk management involves identifying and controlling hazards to protect the forces and increase the chances for task execution. It applies to every task and operating environment and it is implemented through five steps: a) identification of the risk of adverse events specific situations; b) danger assessment; c) defining the measures to control the risk (decision on application); e) an estimate of the remaining (residual) risk; f) implementation and monitoring of the measures.

4.2. Identification of danger

Identifying dangers is a critical step in the risk management process . His goal is to timely and continuously identify dangers within the operational planning process, to list known risks and, thus ,identify risks that must be present for the commander and HQ in process of plan development. As a process, risk identification is a continuous activity that is regularly carried out in the operational planning of phase of orientation.

Danger represents such a condition that has the potential to cause a variety of injuries, illness or death of soldiers, damage or loss of equipment or property, or to prevent the execution of the mission. It may be a situation or event which may reduce the ability to perform the mission, or its failure .

Regardless of the used methods, the identification of risk requires a comprehensive understanding of the operational environment and the specific economic, legal and regulatory factors that are affecting the execution of the operation. Looking at the operational environment as a complex system where there are no clearly defined boundaries within its dimensions, require that during the operational planning, one should find solutions and successfully implement the operations with respect to balancede risk. (Paul R. Garvey , 2009).

In the process of identifying dangers, participation of certain specialists who are in command during the operational planning process, is necessary. All members of HQ can participate, especially if they have experience in planning operations.

Data for the process of identifying risks are coming from many different sources. Some sources are particularly relevant. Content in these sources and materials often provide the basis for risk and justifies why is a potential problem important for operational planning.

The risks can be identified and validated through systematic analysis of the operations, such as modeling and simulations, and through implementation of observation and experience. Risk identification includes efforts to analyse written materials and perform interviews with experts in specific areas of operation .

4.3. Assessment of danger

Assessment of danger includes events that may affect the success of the operation. Impacts are not limited to the above criteria only. Additional criteria such as political or economic consequences may also require consideration. Through assessment, it is necessary to include the probability of occurrence of each risk. This often involves the use of techniques of subjective probability estimates, especially when circumstances preclude a direct evaluation by objective methods (eg, modeling, simulation).

Subjective assessments of probability is mostly used in the process of operational planning. This allows access to information that can decide a course of action, or the alternatives, or need to assess the opportunities in the operational planning process.

An ordinal risk matrix is most commonly used in a method for analyzing risks in processes of operational planning at the operational and tactical level in terms of prioritization of risk and subjective assessment of probability of ranking.

Ordinal risk matrix is widely used for the determination of the risk event. Figure 3 is a classical 5 × 5 matrix of ordinal risk. Inline scale defines a matrix. These are measures of probability. Level along the vertical side of the matrix represents the probability level, while the level along the horizontal side of the matrix effect (consequences). (Paul R. Garvey, 2009).

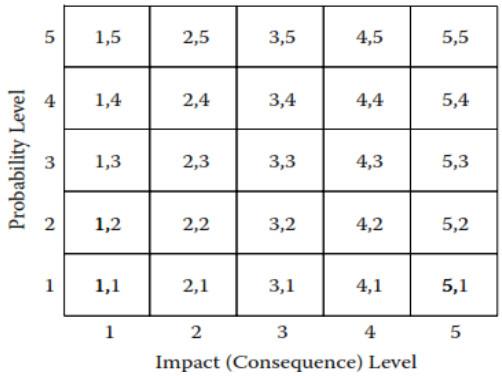


Figure 3. A traditional 5 × 5 ordinal risk matrix
(*Paul R. Garvey, 2009.)*

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In the operation planning process, the matrix that is used to determine the level of risk is formed in the same way. It was created as a result of the practice and it was accepted in the American Army Manual (Headquarters Department of the Army, Washington, 2006). The final result of this analysis is the initial risk assessment for each identified danger, and it is expressed as very high, high, moderate or low. These categories were determined by using a standardized risk assessment matrix (Figure 4).

RISK ASSESSMENT MATRIX						
		Probability				
Severity		Frequent A	Likely B	Occasional C	Seldom D	Unlikely E
Catastrophic	I	E	E	H	H	M
Critical	II	E	H	H	M	L
Marginal	III	H	M	M	L	L
Negligible	IV	M	L	L	L	L
E – Extremely High		H – High		M – Moderate		L – Low

Figure 4: Risk Assessment Matrix

In this step, there are three sub-steps that are carried out, namely:

• Assessment of the probability of the event or occurrence,
• Assessment of the expected result of an event or occurrence and
• Determining the level of risk for a given probability and severity.

4.3.1. Assessing the probability of an event or occurrence

This is the first estimate based on known information, or information based on previous experiences. Probability is estimated based on the frequency of similar event. For the purposes of risk management in operational planning, according to the American Manual, FM 5-19 (Headquarters, Department of the Army, Washington, 2006), there are four levels of probability: often, probable, occasionall and rare. The meaning of the above probabilities is shown in table 2:

Levels	Definition/description
Often	Known as a regular occurrence. Expected to happen to someone for sure. Often examples are thermal injuries, collision of vehicles and similar.
Probable	Happens several times. Occurs habitually and will happen in a certain moment. Examples may include unintentional dropping weapons, unintentional firing a shot and similar.
Occasional	Happens sporadically but is not unusual. Examples may include unexploded agents elements or warfare against friendly units and similar.
Rare	Is supposed not to happen but is not impossible. Examples may include ammunition explosion during transport.

Table 2: Probability meanings

4.3.2. Assessment of expected event or occurrence result

The sensitivity of an assessment is expressed in the level of the the incident that will affect the operational capability or the success in accomplishing mission. The level of sensitivity is evaluated for every danger based on knowing the results of similar events that occurred, and they are graded as: catastrophic; critical; marginal and negligible.

Mark	Definition / description
Catastrophic	- the mission on the whole is endangered and cannot be accomplished, - death and permanent invalidity, - the loss of critical equipment for accomplishing mission, - dangerous environmental pollution, - security jeopardized mission and - unacceptable collateral damage.
Critical	- units' operational capability is seriously violated and so is the mission, , - permanent or partial invalidity or temporary incapability up to three months, - massive weapon and equipment damage - property and environment significant damage, - security failure and - significant collateral damage.
Marginal	- reduction of units operational capabilities or mission accomplishment, - minor damages of equipment, property or environment and - days lost due to injury or illness up to three months.
Negligible	- little or no negative influence on the units' operational capabilities and accomplishing mission, - first aid or minor medical treatment, - minor technique damage, but in function and reapaired and - minor or none environment damage.

Table 3: Level of sensitivity

4.3.3. Determining the level of risk

Using a standard risk assessment matrix (Figure 4) , the probability and severity of each identified danger is converted into a certain level of risk. Figure 4 is a classical 5 × 5 matrix of ordinal risk . Along the vertical side of the matrix the level of probability and impact is shown (consequences) along the horizontal side of the matrix.If the probability is higher, then the probability of the occurrence of risk events is higher, too. If the level of probability is lower, also is the lower of probability of risk events . A similar relationship stands for the consequences. A higher level of impact - the greater is the risk of the consequences of events on the operation or mission. The lower level of impact - less risk caused by events on the operation or mission. This matrix provides an assessment of the probability and severity expressed in terms of the standard risk level. Assessment is not absolute and can only be indicators but does not necessarily need to be, of the relative risk of a given work , activity or event. Levels of risk are listed in the lower left corner of the matrix. All accepted residual risks of the matrix must be approved at the appropriate level of command. Certain levels of risk and their implications in relation to the mission are shown in ordinal table 4:

Ordinal Scale Level (Score)	Definition/Context: Occurrence Probability
Extremely High Risk **(E)**	Loss of ability to accomplish the mission if hazards occur during mission. A frequent or likely probability of catastrophic loss (IA or IB) or frequent probability of critical loss (IIA) exists. This implies that the risk associated with this mission, activity, or event may have severe consequences beyond those as sociated with this specific operation or event. The decision to continue must be weighed carefully against the potential gain to be achieved by continuing this course of action (COA)
High **(H)**	Significant degradation of mission capabilities in terms of the required mission standard, inability to accomplish all parts of the mission, or inability to complete the mission to standard if hazards occur during the mission. Occasional to seldom probability of catastrophic loss (IC or ID) exists. A likely to occasional probability exists of a critical loss (IIB or IIC) occurring. Frequent probability of marginal losses (IIIA) exists. This implies that if a hazardous event occurs, serious consequences will occur. The decision to continue must be weighed carefully against the potential gain to be achieved by continuing this course of action (COA).
Moderate **(M)**	Expected degraded mission capabilities in terms of the required mission standard and will result in reduced mission capability if hazards occur during mission. An unlikely probability of catastrophic loss (IE) exists. The probability of a critical loss is seldom (IID). Marginal losses occur with a likely or occasional probability (IIIB or IIIC). A frequent probability of negligible (IVA) losses exists.
Low **(L)**	Expected losses have little or no impact on accomplishing the mission. The probability of critical loss is unlikely (IIE), while that of marginal loss is seldom (IIID) or unlikely (IIIE). The probability of a negligible loss is likely or less (IVB through (IVE). Expected losses have little or no impact on accomplishing the mission. Injury, damage, or illness are not expected, or may be minor and have no long term impact or effect.

Table 4: An Ordinal Scale for Occurrence Probability
(*Headquarters Department of the Army Washington (2006) FM 5-19 (p.1-3)*

4.4. Development of versions of use (courses of action)

In this step, a set of identified risk events, their assessment of the impact and probability of their occurrence are "treated" to get from the most to the least - critical rank - order the identified risks. The main objective of risk prioritising is to form the basis for the allocation of critical resources. These resources include the allocation of additional forces (if necessary), in order to focus on addressing the risks that are most critical in the process of operational planning.

Once when risks are identified, it is necessary to determine risk management instruments. It primarily depends on the type of risk, that needs to be solved to an acceptable level. For example, because of their nature, certain risks are usually managed by appropriate response measures.

4.5 . Defining measures to control risk (decision about application)

This step includes developing plans to mitigate risks, elimination or reduction of the risk and bringing it to an acceptable level. When the plan is implemented, it is the continuous monitoring and evaluation of specific solutions and re-correction of the courses of action if it is determined by the estimated level of risk. Making decisions is based on an estimate of residual risk and the process of the control development and review of risk control continues until an acceptable level of risk is achieved. Risks need to be reduced to a level that their activity is below potential benefits. This process is carried out in steps of development of courses of action, analysis of courses of action, comparing courses of action and their approval process defined in standard operating procedures of operational planning (Manual for operative planning and work of commands in the Serbian Armed Forces, 2014).

After assessing all dangers, commander exercise control that eliminates or reduces the risk (its probability). The primary function of control is manifested through: *training* (qualifications) *of the units*, *physical control and warning (avoidance)*. Control of training include elements that are typical for the process of training, and whether they achieved the performance standards defined in the training process. Segment of physical control is implemented through the physical security of certain places or placing certain warning signs. Finally, avoiding relates to the elimination of physical contact with the identified dangers.

According to the American manual for risk assessment (Headquarters, Department of the Army, Washington, 2006), for control to be effective, it must meet the following criteria: it is suitable , feasible and acceptable. The convenience of control is manifested through the removal or mitigation of risk of danger to an acceptable level. The feasibility of the control for a unit is that it can carry out control property, while the acceptability of control is expressed in subjective justification of the costs of time and resources through acquired use.

4.6. Evaluation of the remaining (residual) risk

A very important thing to keep in mind is that so-called residual, which remains after control also. The controls can not completely eliminate or reduce risks of certain danger. Total residual risk will be greater than or equal to the widest remainder of the identified risk. However, given the complexity of the remaining controls and potential synergy effects of all dangers, the commander can determine if the residual risk is high in the mission.

Decision making by itself is determination of what is an acceptable level of risk. The risk or potential loss should be adjusted according to the expected gains. It should be emphasized that all decisions, at every level of command, should be based on an adequate assessment of risk. (Karović , S. Radončić, H., Komazec N. , 2012.).

4.7 . Implementation and monitoring the measures

Taking into account the dynamics and complexity of the operational environment, in operational planning process we must expect different sources and levels of risk. Some risks can become more significant than others. Operational planning process is exposed to various sources of risk and it is necessary to consider all available parameters in order to be able to implement planned strategies for reduction or elimination of risks.

Supervision should be understood as a form of control measures and it is an integral part of risk management in the operational planning process. Supervision provides subordinates to understand how, when and where are controls implemented. This ensures prevention of unauthorized deviation from standards or violations of policy and risks control, that could jeopardize the mission. Evaluation (assessment) is done during all phases of operation, and also after the execution of an operation or its particular stage. The evaluation should: identify all the risks that were not identified as part of the initial assessment, to identify new danger that have appeared during the operation, or other activities, and to assess effectiveness in supporting operational goals and objectives.

These are the most important elements relating to the monitoring and evaluation of risk assessments. However, it is important to stress, in order to maintain continuity with the requirements of the mission and tasks, to implement process of complex risk management in a standardized way. Risk management can be adapted to use various tools to display information for the complex risk management. The paper is not about specific tools in the form of specific patterns that are used for specific assessment and this would represent a new paper that would include specific questions for the analysis and evaluation of certain danger. (Karović, S. Radončić, H. , Komazec , N. , 2012.) .

5. CONCLUSION

In the process of operational planning at operational and tactical levels for use of SAF, there are some clearly defined procedures and steps. A key segment in it is the operational environment and its assessment in all dimensions that characterize it. As a part of operational planning, an important part is risk management as an indispensable category that is crucial for making a decision on use of SAF in different types of operations.

The essence of risk management in the operational planning process is based on its identification as part of the operational environment, its ranking and bringing to an acceptable level, respectively taking measures to reduce its impact. Identifying risks in such circumstances is based on the experience of HQs that perform operational planning and it is oriented toward specific mission and the specific operational environment. Operational planning process is always carried out in conditions of uncertainty and limited time, which requires that risk assessment and methods that are used, must be very practical and adaptable to ambient of operational environment.

It may be noted that the previously presented method of risk management, presents the basis function in the operational planning at operational and tactical levels in consideration of the use of SAF in the operational environment. At the same time, it presents a very efficient method of determining the probability and level of risk, that is practically applicable. The implementation is very simple and provides efficient indicators that are essentially the best way to fast and effective action for the operational planning process and operational commands according to established procedures, particularly bearing in mind that most of the risk is based on the experience and records of various types of dangers in the operational environment.

REFERENCES

Caver, T. V., (1985, April). Risk Management as a Means of Direction and Control, ”Fact Sheet, Program Managers Notebook, Defense Systems Management College (DSMC), Defense Acquisition University (DAU), No. 6.1.

Garvey, Paul R., (2009.) Analytical methods for risk management: a systems engineering perspective. Taylor & Francis Group. Chapman & Hall/CRC is an imprint of Taylor & Francis Group, an Informal business. (2009). New York.

General Staff of the Serbian Army, Manual for operative planning and work of commands in the Serbian Army (2014), Belgrade

Headquarters Department of the Army Washington, DC. (2006.) Field Manual No. 5-19. (2006). Washington, DC, July 2006.

Paul M. Collier, (2009). Fundamentals of RiskManagement for Accountants and Managers. Butterworth-Heinemann is an imprint of Elsevier Linacre House, Jordan Hill, Oxford OX2 8DP, UK 30 Corporate Drive, Suite 400, Burlington, MA 01803, USA.

John J. (2009.) Fundamentals of enterprise risk management: how top companies assess risk, manage exposure, and seize opportunity. (2009). AMACOM, a division of American Management Association, 1601 Broadway, New York, NY 10019.

Karovic, S., Radoncic, H., Komazec, N., (2012). Risk management in the military decision-making process. Paper presented at the SYMORG 2012 Conference.

A NEW CONSTRUCTIVE HEURISTICS FOR SOLVING THE MINIMUM FEEDBACK VERTEX SET PROBLEM

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Abstract: *In the present paper, we address the feedback vertex set problem, and propose a new heuristics to solve it. Our heuristics is a greedy constructive one, and is based on the vertices labeling. We tested our heuristics on random generated instances of various densities and number of vertices. We report the computational results as percentage of deviations of the approximate solutions obtained by our heuristics from the exact solutions of the instances or from the upper bounds, when we were not able to find the exact solution in a reasonable time by an exact algorithm.*

Keywords*: feedback vertex set, de-cycling, heuristics, un-oriented arcs, un-weighted vertices*

1. INTRODUCTION

The problem of finding a minimum feedback vertex set (FVS) in a graph is one of the classical *NP*-complete problems mentioned by Karp (1972) when he was researching the reducibility among combinatorial problems. A wide survey of the feedback set problems can be found in Festa *et. al* (2000), were it is emphasized that solving feedback vertex set problems is useful in combinatorial circuit design; deadlock prevention in operating systems; constraint satisfaction and Bayesian inference in artificial intelligence; and graph theory.

Festa *et al.* (2000) examined the relationship between the feedback vertex set (FVS) and the feedback arc set problems, described the applications of feedback vertex set problems, and showed new directions in feedback vertex set problem research. Moreover, the feedback vertex set problem has applications in VLSI chip design (see for instance the survey article published by Silberschatz *et. al* (2008)).

Different versions of the FVS problems exist. Xiao & Nagamochi (2013) defined four FVS problems, as there are oriented/un-oriented arcs/edges in the graph, and there are vertices or arcs/edges to be deleted in order to remove the cycles: Directed Feedback Vertex Set (DFVS), Undirected Feedback Vertex Set (UFVS), Directed Feedback Arc Set (DFAS), and Undirected Feedback Edge Set (DFES). UFES problem is equivalent to finding a maximum spanning tree in a graph, therefore, it can be solved in polynomial time. The other three problems are *NP*-hard, and UFVS and DFAS problems were included in Karp's (1972) list of *NP*-complete problems. Xiao & Nagamochi (2013) proposed an $1.7356^n n^{O(1)}$-time exact algorithm to solve UFVS, thus improving all previous published results.

Another version of FVS is obtained, when graph's vertices have associated weights and the feedback vertex set with minimum sum of weights is desired.

Chen *et. al* (2008) presented improved parameterized algorithms for the FVS problem on both un-weighted and weighted graphs. Their algorithms constructed a feedback vertex set of size at most *k* in a given graph *G* of *n* vertices, or report that no such feedback vertex set exists in *G*. In the weighted case, they determined the set of minimum weight among the feedback vertex sets of size at most *k*.

Fomin et. al (2008) presented a time $O\left(1.7548^n\right)$ algorithm for finding a minimum feedback vertex set in an undirected graph on *n* vertices. They also proved that a graph with *n* vertices can contain at most 1.8638^n minimal feedback vertex sets and that there exists an infinite family of graphs having 1.5926^n minimal feedback vertex sets.

Chen *et. al* (2012) showed that for every planar graph the minimum cardinality of a feedback vertex set is at most three times the maximum number of vertex disjoint cycles in the graph. Gasper & Mnich (2013) discussed some combinatorial and algorithmic questions around minimal feedback vertex sets in tournament graphs. Jiang *et. al* (2013) investigated the minimum weight FVS problem on tree convex bipartite graphs, which are generalizations to convex bipartite graphs and chordal bipartite graphs.

The rest of the paper is organized as follows: in Section 2, we explain the notation and terminology; Section 3 presents the mathematical models of a FVS problem and classic algorithms for solving FVS problems. In Section 4, we present our new heuristics. We report our computational results in Section 5. Section 6 contains some concluding remarks and ideas for future work.

2. NOTATION AND TERMINOLOGY

A feedback vertex set in an undirected graph $G=(V,E)$ is a set of vertices F, $F \subseteq V$ such that every cycle in graph G contains at least one vertex from F. A graph that contains no cycles is called forest. A forest that is connected is called tree, hence, a forest can be also defined as a collection of disjoint trees. In other words, a set F of vertices from G is a feedback vertex set of G if and only if $V \setminus F$ is a forest. The size of the feedback vertex set F is the number of vertices in F.

In the literature, three equivalent problems related to the feedback vertex set can be found under different names: minimum feedback vertex set, de-cycling (or minimum cut-set), and maximal forest. We insert below the definitions of those three problems.

Definition 1. Given a directed/undirected graph $G=(V,E)$, to solve the minimum **feedback vertex set** problem means to find a set $F \subset V$ with minimal cardinality such that each cycle from G contains at least one vertex from *F*.

Definition 2. Given a directed/undirected graph $G=(V,E)$, to solve the **de-cycling (minimum cut-set)** problem means to find a set $F \subset V$ with minimal cardinality such that the graph induced by $V \setminus F$ is acyclic.

Definition 3. Given an undirected graph $G=(V,E)$, to solve the **maximal forest** problem means to find a set $T \subset V$ with maximal cardinality such that induced graph $H=(T,E')$ of G is a forest.

Note that $F = V \setminus T$, where *F* is the minimum set found by solving the minimum feedback vertex set problem or the minimum cut-set problem and T is the maximum set found by solving the maximal forest problem.

One generalization of the FVS problem is the following: given a directed/undirected graph $G=(V,E)$, $V = A \cup B$ ($A \neq \phi$ - allowed, B - blackout), find a minimum set $F \subset A$ such that each cycle from G contains at least one vertex from F.

In this paper, we have considered un-weighted feedback vertex set problem on undirected graphs without blackout vertices (UFVS).

3. MATHEMATICAL MODELS AND CLASSIC SOLVING PROCEDURES FOR FVS PROBLEMS

Given an undirected graph $G=(V,E)$, Models (1)-(3) and (4)-(6) describe two possible mathematical formulations of the UFVS problem. Let C be the set of sets of vertices of all induced cycles of G. Model (1)-(3) refers to the vertices of the graph's induced cycles. In the final solution, the variable x_j is equal to 1 if the vertex v_j belongs to the feedback vertex set (or, in other words, it does not belong to the maximal forest), otherwise, it is equal to 0.

$$(\min) \quad \sum_{j \in V} x_j \tag{1}$$

$$\sum_{j \in c} x_j \geq 1 \quad \forall c \in C \tag{2}$$

$$x \in \{0,1\}^{|V|} \tag{3}$$

Let T be the set of sets of vertices of all induced trees of G. Model (4)-(6) refers to the vertices of the graph's induced trees. In the final solution, the variable y_t is equal to 1 if the tree t belongs to the maximal forest, otherwise y_t is equal to 0.

$$(\max) \quad \sum_{t \in T} |t| \, y_t \tag{4}$$

$$\sum_{t \in T : t \cap \{i,j\} \neq \phi} y_t \leq 1 \quad \forall (i,j) \in E \tag{5}$$

$$y \in \{0,1\}^{|T|} \tag{6}$$

The approaches for solving UFVS problems are split in exact algorithms and heuristics. The exact algorithms are sometimes polynomial, i.e. for the special cases defined by certain reducibility properties of the graph (e.g. majority of program flowcharts). In what follows, we present a simple Prim's algorithm like constructive heuristics, for solving the UFVS problem. This algorithm illustrates completely the nature of the problem we address.

- Input: $G = (V, E)$
- Set $T \leftarrow \phi$ and $F \leftarrow \phi$.
- Do
  Select an arbitrary vertex $i \in (V \setminus T) \setminus F$.
  If the sub-graph of G induced by the set $T \cup \{i\}$ is cycle free then $T \leftarrow T \cup \{i\}$
  else $F \leftarrow F \cup \{i\}$.
  While $(V \setminus T) \setminus F \neq \phi$.
- Output: the maximal forest induced by T, and the minimal feedback vertex set F.

We also implemented an exact algorithm that solves UFVS in order to find the optimal solutions to the randomly generated instances needed in our experiments. The algorithm is an iterative branch and bound which uses a relaxation of Model (1)-(3) in each step. It systematically adds constraints of type (2) until the solution does not contain any cycle. The main steps are presented below.

- Include in Model (1)-(3) only those constraints that correspond to the cycles of size 3.
- Solve to optimality the relaxed Model (1)-(3).
- While *Cycle_Found*
  Add new constraints to Model (1)-(3), those that correspond to the identified cycles.
  Solve to optimality the updated Model (1)-(3).

The number of iterations, needed to find the optimal solution, and the number of constraints, added to the relaxed Model (1)-(3) in any iteration, are inverse proportional. We implemented two versions of this exact algorithm: one with moderate constraints generation, and one with extensive constraints generation.

4. THE NEW CONSTRUCTIVE HEURISTICS

In this section, we propose a greedy constructive heuristics to solve the undirected feedback vertex set problem. The basic steps are inserted below.

- Input: $G = (V, E)$.
- Set $G^0 \leftarrow G$, $E^0 \leftarrow E$, $V^0 \leftarrow V$ and $k \leftarrow 0$.
- Do
  $v \leftarrow DetectCycle(G^k)$.
  If *Cycle_Found* then
  remove vertex v from V^k and all edges incident to v from E^k forming G^{k+1}.

$k \leftarrow k+1$.

While *Cycle_Found*.

- Output: the maximal forest $G^k = (V^k, E^k)$, and the minimal feedback vertex set $F = V \setminus V^k$.

The function $DetectCycle(G)$ detects a cycle in G, and returns the vertex from the cycle with the largest degree. The same function sets the global variable *Cycle-Found* to 'TRUE' if the graph G contains at least one cycle, or otherwise, to 'FALSE'. Removing the vertex with the largest degree favors breaking more cycles at once, but also makes the heuristics greedy.

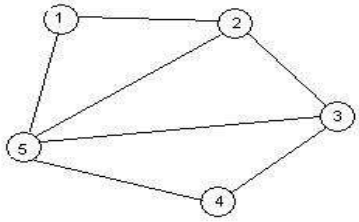

Figure 1: The graph used to describe how the procedure *DetectCycle()* works

A simple example of a graph and its minimal feedback vertex set is shown in Figure 1. Starting from the graph $G^0 = (V^0, E^0)$ where $V^0 = \{1,2,3,4,5\}$ and $E^0 = \{\{1,2\},\{1,5\},\{2,3\},\{2,5\},\{3,4\},\{3,5\},\{4,5\}\}$, the first detected cycle is 1-2-5. Further, the vertex 5, the vertex with the largest degree in the cycle, is returned by the function *DetectCycle()*. Then, vertex 5 is removed from the set of vertices together with all edges adjacent to it, i.e. $\{\{1,5\},\{2,5\},\{3,5\},\{4,5\}\}$. Thus, the graph $G^1 = (V^1, E^1)$ is defined, where $V^1 = \{1,2,3,4\}$ and $E^1 = \{\{1,2\},\{2,3\},\{3,4\}\}$. This graph is cycle free, hence the maximal forest is $G^1 = (V^1, E^1)$, and the minimum feedback vertex set is $F = \{5\}$.

The computational complexity of the cycle detection step is $O(|V^2|)$.

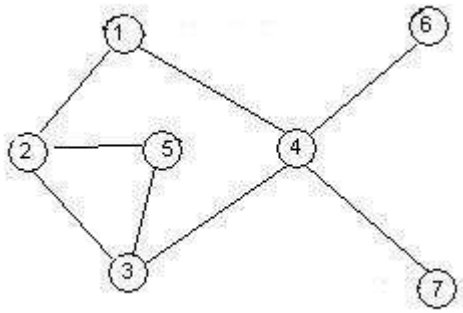

Figure 2: The graph used to show a situation when the new heuristic misses to find the exact solution

Running our heuristics for finding the minimum FVS of the graph presented in Figure 2, the following unfortunate situation appears: the detected cycle is 1-2-3-4; the vertex with the largest degree in the cycle is 4; the graph remains with cycles after eliminating 4 and its edges; the new graph after this step is $G^1 = (\{1,2,3,5,6,7\},\{\{1,2\},\{2,3\},\{2,5\},\{3,5\}\})$. The next detected cycle is 2-3-5; vertex 2 and its edges are eliminated; and the final FVS is $F = \{2,4\}$ and the final forest is $G^2 = (\{1,3,5,6,7\},\{\{3,5\}\})$. In fact, the minimum FVS contains one vertex and can be obtained in the first step, by removing the vertex 3 from the cycle 1-2-3-4.

5. COMPUTATIONAL RESULTS

For our experiments, we implemented the exact algorithm and the new heuristics that solve UFVS problems. We generated randomly 250 instances, and grouped them according to the number of vertices *v* (20, 30, 40, 50, and 60) and density *d* (10, 30, 50, 70, and 90).

Table 1: The results obtained by running the exact algorithm

Density	# vertices	# instances solved exactly	Average time (for instances solved exactly)	% Dev of LB from UB (for instances not solved exactly)
10	20	10	0	N/A
	30	10	0	N/A
	40	10	0.32	N/A
	50	10	75.07	N/A
	60	6	1934.50	3.27%
30	20	10	0.09	N/A
	30	10	22.89	N/A
	40	10	1433.96	N/A
	50	0	N/A	8.21%
	60	0	N/A	20.78%
50	20	10	0.97	N/A
	30	10	135.84	N/A
	40	3	6862.80	9.64%
	50	0	N/A	9.92%
	60	0	N/A	20.00%
70	20	10	2.05	N/A
	30	10	442.01	N/A
	40	8	4184.96	12.50%
	50	1	5888.30	13.58%
	60	0	N/A	17.65%
90	20	10	3.44	N/A
	30	10	173.19	N/A
	40	10	1605.88	N/A
	50	7	2934.14	16.67%
	60	4	2602.50	16.67%

For each pair of values *(v, d)* we generated 10 instances as follows: we arranged the edges into an array of size $\frac{v^2 - v}{2}$; following the uniform distribution, we randomly generated, *d* times, an index that refers to a component of the array. The first index was generated between 1 and v^2, the second index was generated between the first index and v^2, and so on; when we reached the component v^2, we started from the beginning.

Table 1 summarizes the computational results obtained by running the exact algorithm. For each group of instances, we reported how many instances out of 10 we solved exactly in less than 7200 seconds; the average time needed for exactly solved instances; and the average deviation of the lower bound from the upper bound in the case of instances that we did not solved exactly.

The computational results showed that the exact algorithm best performs when the density of the graph is either very small ($d = 10$) or very large ($d = 90$). In addition, for middle values of the density ($d = 30$, $d = 50$, and $d = 70$), the algorithm has a significant low performance when the number of vertices in the graph increases from 50 to 60.

In order to describe the performance of the new heuristics, we summarized our computational results in Table 2. For each group of instances, we reported the average percentage of the deviations of the size of the obtained forest from the size of the optimal forest (or, from the upper bound found for the size of the optimal forest, when we were not able to solve the instance exactly in less than 7200 seconds). In Table 2, d represents the density of the graphs that, together with the number of vertices, characterizes the groups of instances.

Table 2: The results obtained by running the heuristics (the percent of the deviation of the obtained forest size from the optimal solution or from the upper bound when the instance was not solved exactly in 7200s)

# vertices	$d = 10$	$d = 30$	$d = 50$	$d = 70$	$d = 90$
20	1.62%	3.36%	3.41%	6.15%	9.09%
30	2.39%	6.00%	4.90%	5.63%	10.00%
40	1.64%	5.81%	10.17%	5.00%	3.92%
50	3.43%	12.31%	14.50%	20.00%	8.77%
60	4.38%	21.65%	20.67%	19.61%	10.00%

Similar to the case of the exact algorithm, the experimental results showed a good performance of the new heuristics when the density of the graph was either very small or very large. Also, relatively good performance was noticed for the graphs with middle values of the density and number of vertices up to 50.

6. CONCLUSION AND FUTURE WORK

In this paper, we addressed the feedback vertex set problem, and proposed a new constructive heuristics to solve it. We tested our heuristics on random generated instances of various densities and number of vertices. We described the performance of our exact algorithm by counting the number of instances solved to optimality in a certain time, and the average difference between the lower and upper bounds, when the exact solution was not reached. Further, we reported the computational results as percentage of deviations of the approximate solutions from the exact solutions of the instances or from the upper bound, when we were not able to find the exact solution in reasonable time by the exact algorithm.

Our intention is to perform additional experiments in order to compare our heuristics to other constructive heuristics found in literature. Including some randomization steps, we can extend this heuristics to a GRASP procedure and/or a set-covering approach, thus improve its performance. Our intention is also to develop a meta-heuristics based on VNS to solve the FVS problems.

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REFERENCES

Bar-Yehuda, R., Geiger, D., Naor, J. & Roth, R. M. (1994). Approximation algorithms for vertex feedback set problem with applications to constraint satisfaction and Bayesian inference, Proceedings of the Fifth Annual ACM-SIAM Symposium on Discrete Algorithms, Arlington, Virginia, pp. 344-354.

Chen, J., Fomin, F. V., Liu, Y., Lu, S. & Villanger, Y. (2008). Improved algorithms for feedback vertex set problems. Journal of Computer and System Sciences, 74,1188-1198. doi:10.1016/j.jcss.2008.05.002

Chen, H. B., Fu, H. L. & Shih, C. H. (2012) Feedback vertex set on planar graphs. Taiwanese Journal of Mathematics, 16(6) 2077-2082.

Festa, P., Pardalos, P. M. & Resende, M. G. C. (2000). Feedback set problems. In Du, D.-Z. & Pardalos, P. M. (Eds.). Handbook of Combinatorial Optimization, Supplement vol. A, Kluwer Academic Publishers, pp. 209–259.

Fomin, F. V., Gaspers, S., Pyatkin, A. & Razgon, I. (2008) On the minimum feedback vertex set problem: exact and enumeration algorithms. Algorithmica, 52(2) 293–307. doi:10.1007/s00453-007-9152-0

Gaspers, S. & Mnich, M. (2013). Feedback Vertex Sets in Tournaments. Journal of Graph Theory. 72(1) 72-89. doi:10.1002/jgt.21631

Jiang, W., Liu, T. Wang, C. & Xu, K. (2013). Feedback vertex sets on restricted bipartite graphs. Theoretical Computer Science, 507, 41-51. doi:10.1016/j.tcs.2012.12.021

Karp, R. M. (1972). Reducibility among combinatorial problems. In: Complexity of computer computations, Plenum Press, New York, pp. 85-103.

Silberschatz, A., Galvin, P. B. & Gagne, G. (2008). Operating System Concepts (8th ed.), John Wiley & Sons. Inc.

Xiao , M. & Nagamochi , H. (2013). An Improved Exact Algorithm for Undirected Feedback Vertex Set. In: Combinatorial Optimization and Applications, Lecture Notes in Computer Science. 8287, Springer International Publishing, pp 153-164. doi: 10.1007/978-3-319-03780-6_14

OPERATIONS MANAGEMENT

MATERIAL REQUIREMENT PLANNING FOR COMPLEX ASSEMBLY SYSTEMS UNDER ENVIRONMENTAL UNCERTAINTY

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Abstract: *This paper presents basic settings of an original framework for optimizing the supply planning under environmental uncertainty in the assembly systems. A new dynamic inventory model with stochastic demand and stochastic lead times is formulated and incorporated within the framework. This notably strengthens the framework and makes it able to operate with real shortage costs of the final products within the optimization process and with more realistic assumptions about product demand. The use of the proposed framework is considered for single-level multi-product, multi-component assembly systems and, it is believed, that it can be generalized to a multi-level systems as well. The advantages of the proposed framework are confirmed through the experimental results, and the case in which multiple finished products share a common component bank is presented.*

Keywords: *shortage costs, backlogging, service level, component bank, BOM, dynamic programming*

1. INTRODUCTION

Effective management of inventory levels under environmental uncertainty is a complex and essential problem in production and operations management. The selection of no adequate replenishment policy leads to expensive inventories or increased penalty costs. The commonly accepted approach for replenishment planning in major companies is the Material Requirements Planning (MRP) under environmental uncertainties (Louly et al., 2008). Uncertainty in demand and supply creates the need for the optimizations procedures and almost all of them can be formulated as a trade-off between overstocking and stock out while minimizing the total cost. The inventory management is especially important for assembly systems, because for them a lack or excess of a component leads to increased holding and shortage costs related to the corresponding final product and components that assemble that final product. Therefore, the inventory level of a component depends on the stock levels of other components. Stock out for a component stops the assembly process, and so the stocks of other components and the corresponding holding costs increase.

In the available literature, there is a lack of works that can be effectively applied in practice in the cases of complex component's and final product's interdependencies in assembly systems. Traditional approaches should typically result in a large model that is difficult to solve and maintain. The assumptions made in known models tend to be restrictive for this kind of a problem, so the range of possible applications is significantly restricted. A serious drawback is that the obtained MRP is rather unrealistic, because it cannot take into account the real state of the production environment. Hence, the system cannot follow the large number of significant production events to make real-time decisions and it does not provide support to the manager to revise the unrealistic plans.

The assumption that, without a doubt, produces useless solutions for considered applications is that the shortage cost for an assembly component is known in advance. In assembly systems, shortage costs are related to a finished product, but the objective in a significant number of optimization procedures is to minimize the sum of average backlogging and holding component costs. As the stock out for a component can increase the holding costs for other components, it is clear that the holding costs also depend of the distribution of missing components. NP-hard character of this problem makes finding the proper solution to this problem very difficult. This is the main reason why researchers circumvented this problem, either by introducing backorders or by assuming that shortage component costs are known.

Another fact that further complicates the problem is that the demands for products are correlated in practice. This leads to a correlation between the demands for components, so incorporation of this into a model makes that model, due to its extreme complexity, practically unsolvable. However, as a holding cost, shortage cost and demand distribution are the three most important parameters on which optimization is performed, avoiding the real modeling leads to a completely useless solutions.

The paper deals with the management of inventory levels in a single-level multi-product, multi-component assembly system in a MRP environment under uncertainties. It presents basic settings of an original framework for optimizing the supply planning under environmental uncertainty in the complex assembly systems. A new dynamic inventory model with stochastic demand and stochastic lead times is formulated and incorporated within the framework. This contributes to determination of real costs and demand distributions in the considered environment. This is a significant improvement over the existing procedures, which, in real applications, due to the arbitrary and inaccurate defined input parameters, cannot give usable results, even for the simplest instances of the problem.

The remainder of the paper is organized as follows. The next section presents related works. The problem formulation is given in Section 3. Section 4 presents the basic settings of proposed framework, while Section 5 presents a detailed approach for the incorporation of total costs, incurred due to the lack of components into a known simple model for MRP under environmental uncertainty. The comparison of the proposed approach with the best known procedure (Proth et al. (1997)) is given in Section 6. Concluding remarks and directions of future research are given at the end of the paper.

2. LITERATURE REVIEW

The problem of supply planning in assembly systems in which multiple finished products share a common component bank, in its original form, has been given limited attention in literature. The extreme complexity of this problem can be one of the reasons for the lack of related works. The only paper that considers the incorporation of real shortage costs into the optimization procedure is the paper by Proth et al. (1997). This paper proposes an approximate assessment of components based on the arrangement of the final products. The production-volume policy states that it will be good to assemble as many type-1 products as possible, then as many type-2 products as possible, etc. Other published mathematical models of component inventory control for assembly systems cannot be directly applied when multiple finished products share a common component bank. Best replacement for the unit backlogging cost was with introduction of the service level or special control policies, and this does not solve the problem in a significant number of applications. The clear conclusion can be derived according to Louly and Dolgui (2008): “the obtained models show that the increased number of component types increases the optimal value of planned lead time”.

On the other side, the literature is rich in papers that consider optimization problems of MRP parameters, which is of great importance for the formulation of the problem. There are various approaches that optimize MRP parameters, like safety stocks, lot-sizing, planning horizons, planned lead times and other. Also, there are a number of exceptional works dealing with MRP parameterization under uncertainties and the comprehensive reviews of these models are given in Yeung et al. (1998), Dolgui et al. (2005) and Mula et al. (2006). It can be concluded that the analytical modeling approach was the most frequently encountered (Molinder (1997), de Kok and Visschers (1999), Yeung et al. (1999), Louly and Dolgui (2002), Gupta and Maranas (2003), Axsäter (2005, 2011), Arda and Hennet (2006), Dolgui and Prodhon (2007), Louly et al. (2008)). The dynamic programming models were mainly theoretical and they addressed only one type of uncertainty and assumed a simple structure of the problem. For problems with many different final products and more than one type of uncertainty, the analytical approach is replaced by procedures based on artificial intelligence (Hojati (2004), Samanta and Al-Araimi (2001), Petrovic (2001), Fox et al. (2000)) and simulation (Kadipasaoglu and Sridharan (1997), Xie et al. (2003)).

3. PROBLEM FORMULATION

Planning of multi-component supply for interrelated assembly systems with random lead times and random demands is impossible if the costs, which result from the lack of a certain amount of components, are not known. In defining the model on the basis of which the cost for an assembly system under environmental uncertainty is optimized, first task is to introduce variables that quantitatively determine the costs incurred if insufficient, or more than necessary components are available for assembling the finished product. In case of insufficient quantity, unified size is the shortage cost, while for the case where the amount is greater than the required, holding cost is considered.

In inventory management, holding costs include rent for the required space, labor to operate the inventory, interest on money invested in the inventory, cost for damaged and lost goods and other direct expenses. All of these factors can be introduced, on the basis of historical data and business analysis, into the aggregate holding cost of a certain component. How well the aggregate value reflects the real situation so the results of the optimization based on the applied model are more or less usable.

Cost, due to insufficient amounts of the components is, in the real world, far more complex than the holding cost. The shortage or penalty cost is the total of all costs per unit of not satisfying the order on its due date. It can be paid directly or it can be a chance of profit missed, which is called the opportunity cost. In assembly systems, first problem is that these costs are still tied for the finished product, but the optimization is always performed with regard to the components, because release of orders is always made for components, not for final products. In these systems, component shortages create additional cost in the form of holding cost for the other components which can't be assembled to the finished product. An additional complexity is the possibility that the same components can be used to assemble various finished products having different penalty costs. Most papers in the literature introduce the assumption which not only narrow the range of practical application, but in general provide useless solutions. The most common approximation in these papers is defining these parameters as deterministic constants related directly to the component, without any feedback to the other parameters of the model. As the holding cost and the shortage cost are an integral part of each of models and represents basic values of any optimization, application of this simplified model in practice usually gives inapplicable results. On the other hand, if these variables are presented in the model by real interdependence with other variables, obtained models, because of its enormous size would be also inapplicable in practice.

Problem can be formulated as an optimal assessment of unfinished final products according to the specific lack of components in a single-level assembly line. Once, the optimal assessment is determined, shortage cost for that assessment is uniquely defined. A procedure for solving described problem can be applied in two ways in the further optimization processes: it can be incorporated into a procedure for optimizing release orders and it can be used as a separate tool for the optimal assessment of unfinished final products.

In this paper we consider a multi-period planning horizon T having *n* periods of a cyclic assembly system for multiple finished products sharing a common component bank. Let index *i* denote the type of the finished product, $i = 1,...,ni$, where *ni* is the number of product types, index *k* denote the type of the component, $k = 1,...,nk$, where *nk* is the number of component types and $q_{i,k}$ denote quantity of component *k* needed to assemble the finished product *i*. Thus we can define the BOM matrix ***Q***,

$$Q = \begin{Vmatrix} q_{1,1} & \cdot & \cdot & \cdot & q_{1,nk} \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ q_{ni,1} & \cdot & \cdot & \cdot & q_{ni,nk} \end{Vmatrix}$$

which uniquely represents a BOM of a considered assembly system.

Following notations are used to describe the proposed model (upper script *j* denotes the period):

- h_k, the unit holding cost for component *k*;
- p_i, penalty cost charged for each finished product *i* short;
- p_k^*, *penalty cost charged for each component k being short.*
- L_k, the lead time for component *k*;
- d_i, demand for the final product *i*;
- dc_k^j, demand for component *k* in period *j*, $dc_k^j = \sum_{i=1}^{ni} q_{i,k} d_i$;
- $f_i^j(d) = P\{d_i^j = d\}$, probability mass function giving the demand for period *j* for finished product *i*;
- $fc_k^j(d) = P\{dc_k^j = d\}$, probability mass function giving the demand for period *j* for component *k*;
- x_k^j, $x_k^j = y_k^j - d_k^j$, random variable representing ending inventory for period *j* for component *k*;
- o_k, unit order cost for component *k*.
- y_k^j, available quantity of component *k* in period *j*;
- $\boldsymbol{X}^j[nk] = (x_1^j,...,x_k^j,...,x_{nk}^j)$, vector whose *k*-th element is x_k^j;

At the start of the *j*-th assembly cycle two decisions have to be made: how many type-*i* products to assemble in that cycle and how many components *k* to order in the same cycle. Ordering too many components results in excessive inventory costs and too few, in excessive costs related to product backlogging.

4. PROPOSED FRAMEWORK

The framework for optimizing the supply planning under environmental uncertainty in the assembly systems (SPF) enables incorporation of real costs into optimization procedures. SPF consists of four modules (Database, knowledge-based component - KBC, module OAMC and an arbitrary optimization procedure). In the Database, historical data about stochastic variables is stored. Also, dynamic data, produced in other modules is incorporated into database. The main task of KBC is to evaluate the probability distribution of stochastic variables and helps in optimizing the trade-off between the quality and efficiency of the optimization process. The module OAMC is used for optimal assessments of missing components.

In general case, the problem of optimal assessments of missing components is NP-hard. Danilovic and Vasiljevic (2014) have proven that OAMC could be reduced in linear time to the well known cutting stock problem which is known to be NP-hard. The advantage of the SPF is that OAMC can be mostly solved in preprocessing, so that the dynamic part of the procedure can be extremely efficient. The composition of the missing components (MC) determines the complexity of the optimization process, i.e., whether the procedure for solving OAMC should be hard or simple. Denote by *MCh*, a subset of *MC* with *"hard*" reductions and by *MCs*, a complement of *MCh* regarding to *MC*. As the cardinality of *MC* is limited in real applications, all *MCh* optimizations could be done in preprocessing and the resulting *OAMC*(*MCh*) could be stored in a database. In that way, the module that calculates the total costs of the current optimization state actually calculates the *optimized total costs* (OTC) for the current state of the missing components.

The SPF achieves a simple link to the KBC. The relational structure of the problem enables the use of relational programming for its implementation. This approach simplifies and speeds up the execution significantly and provides a simple and interactive processing. In practical applications, it is important to have all necessary calculations as close as possible to the database, obtaining a direct connection between the KBC and the decision system.

The outlook of the framework can be easily adapted for any arbitrary optimization approach. Figure 1 presents a framework that is used for a simple dynamic programming optimization. A well known stochastic dynamic programming procedure for identifying optimal decisions (Christou 2012) is used. The optimal decision at the start of any period depends on the inventory at the end of the previous period. Thus, using backwards recursion, the first step is to optimize the decision made in the final period, which minimizes the total future cost of that decision. This is a simple single-period problem to find the value of $\boldsymbol{Y^n}$ that minimizes the expected value of the cost function.

At the beginning of the optimization procedure, the *n*-th time period is considered. In each iteration, a required inventory level at the beginning of the current period is obtained. The optimization procedure has the bidirectional connection to the database (SQL Server database in Fig. 1) through the SQL procedures. Stochastic data (demand and lead times for the current time period) is obtained from KBC in the form of the correlated probability values. KBC interactively control OAMC through SQL procedures in order to optimize the trade-off between the quality of the solution and the efficiency of the calculations. For the current inventory level, module OAMC supply optimization procedure with the optimal assessment of missing components, so exact cost values can be calculated. Using calculated costs, optimization procedure defines best supply strategy for the first previous time period.

Optimization process is iterated recursively through the time periods, until the first period for which the inventory levels are known values. When *j* = 0, stored evaluation data from the database are used to release orders for components.

In the next Section, the detailed explanation of this example of dynamic MRP optimization is presented and in Section 6 the advantages of this approach are outlined through the experimental comparison with the best known results.

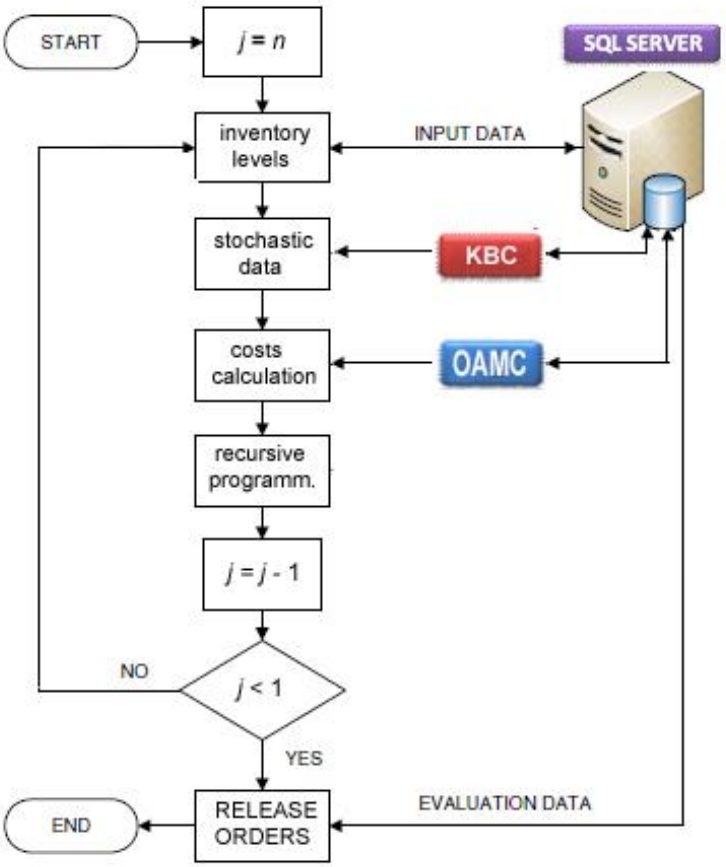

Figure 1: SPF for dynamic programming optimization

5. STOCHASTIC DYNAMIC MODEL

The stochastic inventory model involves the derivation of replenishment decisions over a discrete planning horizon consisting of a finite number of periods under stochastic demand and stochastic lead times. The demands and lead times for each period are usually sequences of random variables having arbitrary distributions. The objective is to determine the ordering quantities from period t = 1 to period $t = j - L$ so as to minimize the total expected ordering, holding and shortage costs. It is assumed in this example that order releases are at the end of the period and that the ordered inventory arrives immediately and is available at the beginning of the next period.

The stochastic process $\{x_k^0, \ldots, x_k^n\}$ is a Markov chain, so the first step is to optimize the decision made in the final period, that is, $\hat{\boldsymbol{Y}}^{\boldsymbol{n}}$, which minimizes total future cost, $W^n(\boldsymbol{X}^{\boldsymbol{n-1}})$ of that decision. The expected value of the cost function is

$$E[C(\boldsymbol{X}^{\boldsymbol{j-1}}, \boldsymbol{Y}^{\boldsymbol{j}})] = \sum_{k=1}^{nk} E[C(x_k^{j-1}, y_k^j)] = \sum_{k=1}^{nk} A + \sum_{k=1}^{nk} B,$$

where A is the expected value of the order component cost and B is the expected value of the sum of holding and shortage component costs:

$$A = o_k(y_k^j - x_k^{j-1}) \quad , y_k^j > x_k^{j-1};$$

$$B = E[C(y_k^j)] = \sum_{d=0}^{y_k^j - 1} h_k(y_k^j - d)\, fc_k^j(d) + \sum_{d=y_k^j+1}^{\infty} p_k^*(d - y_k^j)\, fc_k^j(d)$$

The major critique of this approach lies in it's inapplicability for the assembly systems where multiple finished products share a common component bank due to incorrectly defined variables p_k^* and $fc_k^j(d)$. The p_k^* is an abstract value which doesn't exists in the real environment. Only the value p_i for the finished product is known, and the estimation of p_k^* from p_i is impossible. On the other hand, the value $fc_k^j(d)$ must be calculated from expected demand of final products.

The following suggested approach more precisely defines this problem with the introduction of probability mass function of *nk* variables:

$$ff^j = f^j(d_1, d_2, ..., d_{nk}) = P\{dc_1^j = d_1 \wedge dc_2^j = d_2 \wedge ... \wedge dc_{nk}^j = d_{nk}\}.$$

The use of $ff^j(d_1, d_2, ..., d_{nk})$ enables efficient and simple inclusion of real costs into the model. The list of arguments $(d_1, d_2, ..., d_{nk})$ represents a specific sequence of component demand values. Therefore, KBC sets, for the *j*-th period, a set of sequences $\{\boldsymbol{\sigma}_r^j\}$, $r = 1, ..., rr$, where *rr* is the cardinality of the set and $\boldsymbol{\sigma}_r^j$ denotes the *r*-th sequence from a set. Denote by $\boldsymbol{\sigma}_r^j(k) = d_k^j$, the *k*-th element of the sequence $\boldsymbol{\sigma}_r^j$. Expected value of the cost function is then:

$$E[C(\boldsymbol{X}^{j-1}, \boldsymbol{Y}^j)] = \sum_{k=1}^{nk} A + \sum_{r=1}^{rr} \left[OTC(\boldsymbol{Y}^j, \boldsymbol{\sigma}_r^j) \cdot ff^j(r) \right],$$

noting that $OTC(\boldsymbol{Y}^j, \boldsymbol{\sigma}_r^j)$ is the optimal total cost for the current component quantities, obtained from the OAMC module. The data for $ff^j(r)$ can be stored as a data table in the database, and can be dynamically updated by KBC.

Using dynamic programming, value for $\hat{\boldsymbol{Y}}^n$ is obtained minimizing $E[C(\boldsymbol{X}^{n-1}, \boldsymbol{Y}^n)]$, so the total future cost is:

$$W^n(\boldsymbol{X}^{n-1}) = \min(E[C(\boldsymbol{X}^{n-1}, \boldsymbol{Y}^n)]).$$

Now, dynamic programming recursive function can be applied:

$$W^{n-1}(\boldsymbol{X}^{n-2}) = \min(E[C(\boldsymbol{X}^{n-2}, \boldsymbol{Y}^{n-1})] + E[W^n(\boldsymbol{X}^{n-1})]),$$

and the procedure can be proceeded until the first period, for which, the state of the inventory is a known value.

6. EXPERIMENTAL RESULTS

The aim of the experimental study is to outline the necessity for exact calculations of total costs for assembly systems, where final products share common component bank. In the literature, due to the complexity of the problem, no optimal assessments of missed components are considered. The only exception is the paper of Proth et al. (1997), which is an extended version of some previous works. Hereinafter their policy is denoted as PROTH. We will compare PROTH results with the results obtained with the proposed framework.

The PROTH policy introduces the sorting of product types in descending order according to their cost values, $p_i + \sum_{k=1}^{nk} q_{i,k} h_k$. Assembling of products is then performed according to this sorted list: we assemble as many products which type is the first element in the list, then products which type is the second element in the list, etc.

The example is described by the matrix *Q*, the vector ***p*** of product penalty costs and the vector ***h*** of component holding costs:

$$Q = \begin{Vmatrix} 3 & 1 & 2 & 3 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2 & 1 & 3 & 0 & 0 & 0 \\ 0 & 0 & 0 & 3 & 1 & 4 & 2 & 0 & 0 \\ 0 & 0 & 0 & 2 & 0 & 3 & 5 & 4 & 2 \end{Vmatrix}$$

$$\boldsymbol{h} = (2,3,1,3,2,5,3,5,2)\,,\quad \boldsymbol{p} = (200,150,200,150).$$

The demand for each product is d = 3 and the available quantity y_k of each component has value in (10, 12, 14). Proth's sorted order of products is (3,1,4,2). Table 1 presents randomly selected data from 19683 combinations of y_k values. Column O*i* presents the number of assembled *i*-type products when OTC is calculated and column P*i* presents the number of assembled *i*-type products when PROTH is applied. Column Δ holds absolute deviations in costs values for OTC and Proth, while column % shows relative deviations of the corresponding values.

Table 1: Comparison with PROTH assessment policy

y1	y2	y3	y4	y5	y6	y7	y8	y9	O1	O2	O3	O4	OTC	P1	P2	P3	P4	PROTH	Δ	%
10	10	10	14	10	12	10	10	10	2	2	0	2	1176	1	0	3	0	1451	275	23.38
10	10	10	14	10	10	10	10	10	3	0	1	1	1265	2	0	2	0	1458	193	15.26
10	10	12	12	10	10	10	10	10	2	1	0	2	1335	2	0	2	0	1454	119	8.91
14	14	12	14	14	10	14	14	14	3	0	1	1	1335	2	0	2	0	1528	193	14.46
12	10	10	12	10	14	12	10	10	1	1	1	2	1346	1	0	3	0	1465	119	8.84
12	12	14	12	10	10	10	10	10	2	1	0	2	1347	2	0	2	0	1466	119	8.83
12	10	12	12	10	14	12	10	10	1	1	1	2	1348	1	0	3	0	1467	119	8.83
10	12	12	12	14	12	10	10	10	2	1	0	2	1359	1	0	3	0	1461	102	7.51
14	14	12	10	12	12	12	10	14	1	0	1	2	1533	0	0	3	0	1699	166	10.83
10	12	12	10	14	14	10	14	14	2	0	0	2	1564	0	0	3	0	1713	149	9.53
14	14	12	10	14	14	14	14	14	0	0	2	2	1556	0	0	3	0	1739	183	11.76

From Table 1 it can be observed that, even for this simple example with only four final products, OTC and PROTH strategies result in entire different decisions about the assembling priority. The selected data in Table 1 represents the conclusions which are valid for the entire set of results. Costs, obtained by PROTH are always greater than OTC. For this particular example the relative deviation varies from 7% to more than 23%.

The proposed decisions for a certain planning period are now iterated through the dynamic recursion, so wrong decisions are multiplied through the iterations. The unambiguous conclusion is that algorithms with no optimal assessment policy cannot be applied to solve the MRP problem when multiple final products share common component bank.

7. CONCLUDING REMARKS

This paper presents an original framework that contains modules which are aimed at optimizing of supply planning under environmental uncertainty for complex assembly systems. As a detailed description of these modules is beyond the scope of a single paper, only the basic system settings are exposed here.

In cases where the cost, due to the lack of components, depends on the lack distribution, a multi-dimensional character of the problem causes exponential expansion of a feasible solution set. In the literature, the problem is avoided by introducing a service level, but this does not solve the problem in a significant number of applications. Additionally, correlated demand makes the problem even more complex.

The proposed framework has modules that serve for obtaining optimal assessments of missing components, for calculations of the optimal costs and incorporation of these costs into a known model. For the instances

having complex BOM structures, KBC and OAMC serve to reduce these structures to the level which is appropriate for the proposed procedures. The conclusion, which is common for all tested instances, is that it was always possible to reduce, even most complex BOM structures, to the structures that could efficiently be processed by the proposed procedures. The results, obtained on reduced networks, accurately reflected the real input variables of the problem. Experimental results at the end of this paper confirm the significant advantage of our proposed framework in comparison with the policy presented in Proth et al. (1997).

Limitations of the proposed approach are related to the depth of a corresponding network reduction, so future work on this problem has two possible directions: first, development of new modules for network reduction which would increase the number of instances that can be efficiently processed; next, determination of the most suitable stochastic procedures to treat multidimensional input variables.

REFERENCES

Arda, Y. and Hennet, J. C. (2006). Inventory control in a multi-supplier system. Int. J. Prod. Econ., **104**(2), 249–259.

Axsäter, S. (2005). Planning order release for an assembly system with random operations times. OR Spectrum, **27**, 459–470.

Axsäter, S. (2011). Inventory Control when the Lead-time Changes. Prod. Oper. Man., **20**(1), 72–80.

Banda, M. G. and Stuckey P. J. (2007). Dynamic Programming to Minimize the Maximum Number of Open Stacks. INFORMS J. Com., **19**(4), 607-617.

Christou, I. T. (2012). Quantitative Methods in Supply Management; Models and Algorithms. Springer London, isbn 978-0-85729-765-5.

Danilovic, M. and Vasiljevic, D. (2014). A Novel Relational Approach for Assembly System Supply Planning Under Environmental Uncertainty. Int. J. Prod. Res., doi: 10.1080/00207543.2014.916429.

de Kok, T. G. and Visschers, J. W. C. H. (1999). Analysis of assembly systems with service level constraints. Int. J. Prod. Econ., **59**, 313–326.

Dolgui, A., Louly, M.-A. and Prodhon, C. (2005). A survey on supply planning under uncertainties in MRP environments. In Selected Plenaries, Milestones and Surveys. 16th IFAC World Congress, edited by P. Horacek, M. Simandl and P. Zitek. Prague, Czech Republic.

Dolgui, A. and Prodhon, C. (2007). Supply planning under uncertainties in MRP environments: A state of the art. Annual Reviews in Control, **31**(2), 269–279.

Fox, M.S., Barbuceanu, M. and Teigen, R. (2000). Agent-oriented supply chain management. Int. J. Flex. Man. Sys., **12**, 165–188.

Gupta, A. and Maranas, C.D. (2003). Managing demand uncertainty in supply chain planning. Comp. Chem. Eng., **27**, 1216–1227.

Hojati, M. (2004). Bridging the gap between probabilistic and fuzzy-parameter EOQ models. Int. J. Prod. Econ., **91**, 215–221.

Kadipasaoglu, S.N. and Sridharan, V. (1997). Measurement of instability in multi-level MRP systems. Int. J. Prod. Res., **35**, 713–737.

Louly, M. A. and Dolgui, A. (2002). Newsboy model for supply planning of assembly systems. Int. J. Prod. Res., **40**, 4401–4414.

Louly, M. A., Dolgui, A. and Hnaien, F. (2008). Optimal supply planning in MRP environments for assembly systems with random component procurement times. Int. J. Prod. Res., **46**(19), 5441–5467.

Molinder, A. (1997). Joint optimisation of lot-sizes, safety stocks and safety lead times in an MRP system. Int. J. Prod. Res., **35**, 983–994.

Mula, J., Poler, R., Garcıa-Sabater, J. P. and Lario, F. C. (2006). Models for production planning under uncertainty: A review. Int. J. Prod. Econ., **103**, 271–285.

Petrovic, D. (2001). Simulation of supply chain behaviour and performance in an uncertain environment. Int. J. Prod. Econ., **71**, 429–438.

Proth, J.M., Mauroy, G., Wardi, Y., Chu, C. (1997). Supply management for cost minimization in assembly systems with random component yield times., J. Intell Manuf., **8**, 385–403.

Samanta, B., Al-Araimi, S.A. (2001). An inventory control model using fuzzy logic. Int. J. Prod. Econ., **73**, 217–226.

Xie, J., Zhao, X. and Lee, T.S. (2003). Freezing the master production schedule under single resource constraint and demand uncertainty. Int. J. Prod. Econ., **83**, 65–84.

Yeung, J. H. Y., Wong, W. C. K. and Ma, L. (1998). Parameters affecting the effectiveness of MRP systems: A review. Int. J. Prod. Res., **36**, 313–331.

Yeung, J. H. Y., Wong, W. C. K., Ma, L. and Law, J. S. (1999). MPS with multiple freeze fences in multi-product multi-level MRP systems. Int. J. Prod. Res., **37**, 2977–2996.

SPREADSHEET APPLICATION IN OPERATIONS MANAGEMENT EDUCATION

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Abstract: *This paper describes good practice of spreadsheet application in education. It enables operations management (OM) students to learn the logic behind software packages, to gain experience using a spreadsheet to model and solve real problems, to have a more clear view of the dynamics of business systems. We present modelling of operations management problems as discrete controlled object in spreadsheets. This concept allows clear separation between a discrete object (a low of behaviour and the control domain), a performance criterion, and a method used to find an optimal solution. Also, paper includes forecastig methods, developed in spreadsheets, as part of OM education. Benefit of approach, described in the paper, is in the easier understanding and solving of operations management problems for students. Approach is applied and tested in the education of operations managers at Faculty of Organizational Sciences, University of Belgrade. Primary purpose of paper is contribution to the development of spreadsheet models and spreadsheet applications in operations management education.*

Keywords*: operations management, education, spreadsheets, spreadsheet modeling, spreadsheet applications*

1. INTRODUCTION

In today business world, that is very competitive, spreadsheets play an important role as a business modelling, analysis, and decision support tool. Undergraduates from business, accountancy, information systems, economics, and social sciences schools, that doing internships in all business functional areas consider that Excel skills are invaluable and that corporate recruiters demand spreadsheet skills when hiring fresh graduates, as it is stated in Leong and Cheong (2008). It is therefore meaningful to examine how well spreadsheets are incorporated into management and engineering education and in what ways it can be improved. Most undergraduate programs on universities teach foundational courses in statistics, calculus, and computer programming. Their main purpose is to equip undergraduates with the ability to analyze and solve problems. Many students find learning such technical material dry and demanding and usually do not continue to apply those skills meaningfully beyond university course work. In order to facilitate acquiring of analytical skills for students, more professors that teaching these courses, and also teaching management science, have embraced spreadsheets as their primary computing and teaching tool, as it is stated in Liberatore and Nydick (1999),Winston (1996) and Winston (2004).

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Research on spreadsheets in engineering education in the last few decades has placed great challenges on educators and other stakeholders to apply this computational tool both theoretically and practically towards improving the teaching process. These challenges have forced institutions of higher education to adapt spreadsheets for instructional purposes, with its enhancement tools as a means to improve the quality of engineering education, as it can be seen in Oke (2004). The need for high quality, learning-centred education has therefore made the application of spreadsheets important.

Spreadsheets are in accordance with active learning. Active learning allows students to discuss about problems, supports teamwork and problem solving activities. As it is described in Prince (2004) active learning is widely accepted as a far more effective mode of instruction than lecture alone.

This paper analyses spreadsheet models and application in education of operations managers. We organize paper as follows. In the introduction and second chapter, we briefly explained the need for spreadsheet application in education. Specifically, we base our review on operations management (OM) education. Chapter three describes concept of modelling business dynamics in spreadsheet as discrete controlled object. This chapter presents a low of behaviour, the control domain, a performance criterion, and a method used to find an optimal solution of operations management problems, modelled as discrete controlled object

in spreadsheets. Section four is dedicated to forecasting in a spreadsheet, as another example of learning the logic of operations management problems. Finally, we made general remarks and present future directions.

2. THE APPLICATION OF SPREADSHEETS IN OM EDUCATION

In the field of education, spreadsheets can be utilized in many different ways. Spreadsheets reduce the need for tedious calculations allowing greater attention to be focused on the subject itself. This feature of spreadsheets can be used in many disciplines across the curriculum. The distinction should be made between "content of the curriculum" which includes terms, facts, symbols, formulas, principles etc. and "process skills" which cover observing, measuring, inferring, communicating and experimenting. On the basis of this distinction, students should be given the opportunity to design and develop their own templates in each content area, and also to use the devices to solve problems and make decisions on the basis of quantified evidence. Spreadsheets are very useful for achievement of these objectives, since they are capable of solving different problems involving numbers or formulas, and are especially powerful if data are used repetitively and changing over time.

Using spreadsheet software in operations management courses can add relevance by enabling students to work on problems and data sets that are larger than textbook examples and similar in size to those they encounter in the real world, as it is presented in Gardner (2008). Having students build their own operations management software in a spreadsheet, takes students beyond the learning experience of using special purpose software by enabling them:

- to learn the logic behind software packages,
- to gain experience using a spreadsheet to solve real problems,
- to have a more transparent view of business systems dynamics, and
- to learn to organize and manage their work.

Lecturer can focus on the process logic, organizing the spreadsheet according to the logic while demonstrating the dynamics of business systems and processes, rather than teach spreadsheet mechanics. Spreadsheet projects are particularly good tools to use with hands-on learners and the charting capabilities make them effective with visual learners.

3. BUSINESS DYNAMICS IN SPREADSHEETS

Spreadsheet simulation is very appropriate for business dynamics understanding and modelling. One of convenient approaches for representing model of real operation management problems in spreadsheets is provided by discrete controlled object concept. This concept allows clear separation between a discrete object (a low of behaviour and the control domain), a performance criterion, and a method used to find an optimal solution. Spreadsheet structure, consisted of rows and columns, is appropriate for presenting different value of variables in time periods, as it is described in Kostic (2001). For example, dynamic discrete EOQ problem to find optimal number of replenishments in the fixed-order quantity system as a basic problem of optimal control can be modelled as discrete controlled object in spreadsheets, as it is showed in Kostic (2009). The decision environment is deterministic and the time horizon is finite. A discrete system consists of the law of dynamics, control domain and performance criterion. It is primarily a simulation model of business dynamics, but the performance criterion enables various order strategies to be compared. Model of discrete system control is both a simulation model of business dynamics and an optimization model which can give optimal control according to the defined performance criterion. This approach is appropriate for modelling and solving various types of operations management problems as:

- Minimizing costs of raw materials procurement;
- Production costs minimization;
- Route optimization;
- Production dynamics optimization;
- Business management financial aspects;
- Investment funds allocation;
- Transport cost minimization, etc.

The process that we follow in order to make students understand business dynamics and build their own model of discrete controlled object in a spreadsheet is:

1. Problem presenting and verbal description;
2. Problem analyzing:
    a. Time horizon and time intervals defining;
    b. System flows identification (actions and accumulations);
    c. Factors of influence identification (circumstances and control);

   d. Flow regulator relations development;
   e. Control domain constraints:
      - flow non negativity constraints;
      - available capacity constraints;
      - storage space constraints;
      - other constraints;
   f. Performance criterion formulation;
   g. Combined flows block diagram;
3. Optimal control problem:
   a. Transformation to basic problem form;
   b. Discrete object optimal control problem defining;
4. Spreadsheet simulation:
   a. Transformation of mathematical relations to spreadsheet formulas and functions;
   b. Tables, menus, reports and graphs organization;
   c. One admissible solution determination;
   d. Better solution determination;
5. Spreadsheet optimization (control domain searching);
6. Findings;

Students repeat described process for every new problem that is presented on the lectures. At the beginning of each class professor presents the underlying logic of problem for practice, using one or more examples in a lecture. Each student constructs spreadsheet model or application in a computer lab under the supervision of the instructor who may do a step-by-step demonstration. Over the course of the semester, as students gain experience with spreadsheet models, the detail level of instructions diminishes. This forces students to rely more and more on what they have learned from previous problems. At the end of course students have to model and solve assigned problems by themselves, with little or no help from the instructor because the goal is to teach students to work independently.

In the following of paper we will present simple example of transportation costs minimization problem, translated to discrete controlled object problem developed in spreadsheet, Kostić (2012). Problem is presented in order to describe learning process, which is created for better understanding and modeling of system dynamics.

Company has an obligation to deliver product X over next four periods in the dynamics defined in Table 1. There are three types of vehicles: P1, P2 and P3 that are available for transport. Capacity of vehicle represents number of containers in one period of time, and it is given in Table 2. Containers dimensions depend from vehicle type. Numbers of product X units that can be placed in containers are given in Table 3.

Table 1: Product delivery dynamics

Period	1	2	3	4
Quantity	290	215	200	390

Table 2: Capacity of vehicle

Vehicle	P1	P2	P3
Capacity	4	6	3

Table 3: No. of X units/cont.

Vehicle	P1	P2	P3
Capacity	50	45	65

Transportation cost is different for every type of vehicle, and also depends from time period, as it is shown in Table 4.

Table 4: Transportation cost/cont.

Vehicle	1	2	3	4
P1	3	2	3	2
P2	2	4	4	3
P3	4	3	2	4

Students have to define transportation plan that will satisfy given product delivery dynamic and to minimize total transportation costs.
In order to model problem in the spreadsheet, students have to identify flows of system. In this case, there are three material flows, where subject is product X, transported with particular type of vehicle. Phases of flows are:

vehicle 1 transport type
vehicle 2 transport type
vehicle 3 transport type
Yi
action

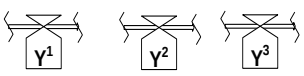


Figure 1: One phase flows

Phases of flow can be presented as it is shown in Figure 1, where Y_t^i represents transport of product X with transport vehicle i (i=1,2,3) in time period t.

Next step is influence factors identification. Influence factors are recognized in verbal description of problem.

p_t^1 - product X transport dynamics

p_t^{i+1} - available containers for transportation vehicle i (i=1,2,3)

p_t^{i+4} - container i capacity (i=1,2,3)

p_t^{i+7} - transportation cost for container i (i=1,2,3)

u_t^i - quantity of product X transported with vehicle i (i=1,2,3)

After problem flows and influence factors identification, students are familiar with problem. Now, they can start with mathematical modeling. In described problem, flow regulators equation development considers that for all vehicles transport is discrete, with stages on the beginning of time periods. Total of all previous delays of function rebound, when discrete quantity is created, is equal zero. Because of that, delay factors K_i (i=1,2,3) are also zero, and whole discrete quantity of flow $c_i = u_i$ (i=1,2,3) is realized in the same time period as its realization started.

$$Y_t^i = u_t^i \ , \ i = 1,2,3; \ t = 1,2,3,4 \tag{1}$$

Relations for constraints of available containers capacity, that has to be engaged for transport of u_i product X units, are following:

$$S_t^i = INT[\frac{u_t^i}{p_t^{i+4}}] + \delta_t^i \tag{2}$$

$$\delta_t^i = \begin{matrix} 1 \ za \ \frac{u_t^i}{p_t^{i+4}} - INT[\frac{u_t^i}{p_t^{i+4}}] > 0 \\ 0 \ za \ \frac{u_t^i}{p_t^{i+4}} - INT[\frac{u_t^i}{p_t^{i+4}}] = 0 \end{matrix} , \ i = 1,2,3; \ t = 1,2,3,4 \tag{3}$$

That number can't be greater than number of available containers for transport vehicle i.

$$S_t^i \le p_t^{i+1} \quad i = 1,2,3; \ t = 1,2,3,4$$

Realization of transportation plan, which will satisfy given product delivery dynamic, has to be included in control space relations.

$$p_t^1 = \sum_{i=1}^{3} u_t^i, \quad t = 1,2,3,4 \tag{4}$$

Goal function represents minimization of total transportation costs.

$$\min\{J = \sum_{t=1}^{4} \sum_{i=1}^{3} S_t^i \cdot p_t^{i+7}\} \tag{5}$$

Now, discrete control object is defined through the low of behavior

$$Y_t^i = u_t^i \ , \ i = 1,2,3; \ t = 1,2,3,4 \tag{6}$$

and control domain

$$0 \le p_t^{i+1} - S_t^i$$
$$0 = p_t^1 - \sum_{i=1}^{3} u_t^i, \quad i = 1,2,3;\ t = 1,2,3,4 \tag{7}$$

where

$$\delta_t^i = \begin{matrix} 1\ za\ \frac{u_t^i}{p_t^{i+4}} - INT[\frac{u_t^i}{p_t^{i+4}}] > 0 \\ 0\ za\ \frac{u_t^i}{p_t^{i+4}} - INT[\frac{u_t^i}{p_t^{i+4}}] = 0 \end{matrix}, \quad i = 1,2,3;\ t = 1,2,3,4 \tag{8}$$

$$S_t^i = INT[\frac{u_t^i}{p_t^{i+4}}] + \delta_t^i$$

Initial state is known $X_0^i = 0$ (i=1,2,3).

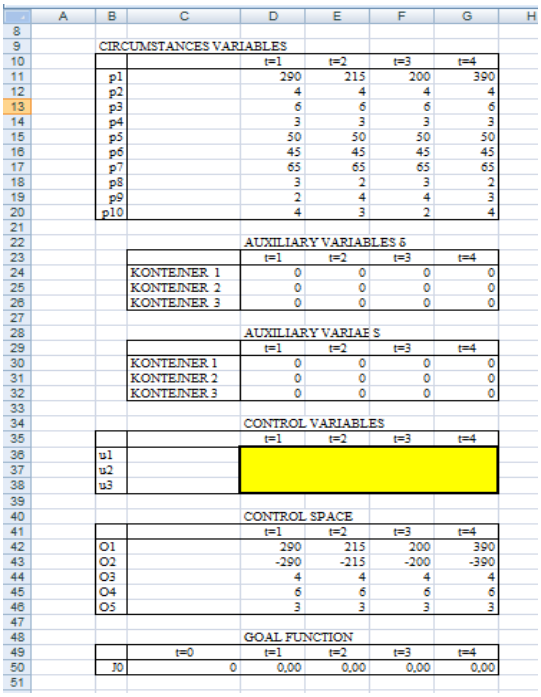
For defined object, admissible control should be chosen in accordance with circumstances dynamic p^s_t (s=1,2,...,10; t=1,2,3,4) for time periods T=4, in the way that will guide discrete object from known initial state X_0^i to the set of final phase states $X_4^i \in M_4$. For every t=1,2,3,4 control space constrains have to be satisfied and goal function J has to be minimized.

When mathematical model is created, students translate relations to spreadsheet model. Tables in worksheet are arranged in defined areas, for example:

- values for circumstances variables p are arranged in area D11:G20
- formulas for auxiliary variables δ are arranged in area D24:G26
- formulas for auxiliary variables S are arranged in area D30:G32
- control variables should be written in area D36:G38
- formulas for control space O are arranged in area D42:G46
- formulas for goal function are arranged in area D50:G50

Simulation model in spreadsheet is obtained when mathematical relations for discrete control object are translated in appropriate spreadsheet formulas and functions. Next paragraph presents spreadsheet formulas for time period t=1, in column D. These formulas should be copied in next three columns.

AUXILIARY VARIABLES δ
D24 =IF(D36/D15-TRUNC(D36/D15)>0;1;0)
D25 =IF(D37/D16-TRUNC(D37/D16)>0;1;0)
D26 =IF(D38/D17-TRUNC(D38/D17)>0;1;0)
AUXILIARY VARIABLES S
D30 =TRUNC(D36/D15)+D24
D31 =TRUNC(D37/D16)+D25
D32 =TRUNC(D38/D17)+D26
CONTROL SPACE O
D42 =D11-SUM(D36:D38)
D43 =SUM(D36:D38)-D11
D44 =D12-D30
D45 =D13-D31
D46 =D14-D32
GOAL FUNCTION J
D50 =C50+D30*D18+D31*D19+D32*D20



CIRCUMSTANCES VARIABLES

	t=1	t=2	t=3	t=4
p1	290	215	200	390
p2	4	4	4	4
p3	6	6	6	6
p4	3	3	3	3
p5	50	50	50	50
p6	45	45	45	45
p7	65	65	65	65
p8	3	2	3	2
p9	2	4	4	3
p10	4	3	2	4

AUXILIARY VARIABLES δ

	t=1	t=2	t=3	t=4
KONTEJNER 1	0	0	0	0
KONTEJNER 2	0	0	0	0
KONTEJNER 3	0	0	0	0

AUXILIARY VARIAE S

	t=1	t=2	t=3	t=4
KONTEJNER 1	0	0	0	0
KONTEJNER 2	0	0	0	0
KONTEJNER 3	0	0	0	0

CONTROL VARIABLES

	t=1	t=2	t=3	t=4
u1				
u2				
u3				

CONTROL SPACE

	t=1	t=2	t=3	t=4
O1	290	215	200	390
O2	-290	-215	-200	-390
O3	4	4	4	4
O4	6	6	6	6
O5	3	3	3	3

GOAL FUNCTION

	t=0	t=1	t=2	t=3	t=4
J0	0	0,00	0,00	0,00	0,00

Figure 2: Spreadsheet model of the problem

Careful selection of control variables values leads to admissible solution. Admissible solution provides non negativity of control space, arranged in area D42:G46. Negative values in control space are guide for admissible solution finding. Better solution is one that gives smaller value to goal function. When all described steps are realized, spreadsheet model for transportation costs minimization problem translated in discrete control object problem is created. This model is presented in the Figure 2.

4. FORECASTING IN SPREADSHEETS

Forecasting is another topic where students need to understand the underlying technique, but where textbook examples, that are small enough for hand computation, are too small to be realistic. As it is demonstrated in Gardner (2008) spreadsheets allow students:

- to understand mathematical concepts and techniques by enabling them to see the computation, without having to do the computation and get lost in the mechanics,
- to see the effects of changing parameters for various forecasting models,
- to learn to adapt forecasting models to special situations,
- to see the effects of data issues on forecasts,
- to use critical thinking skills to evaluate forecasting models, and
- to learn to organize their work.

Charting capabilities enhance the effectiveness of spreadsheets as a learning tool by providing visual images that enable students to observe the properties and limitations of the various forecasting techniques. This works particularly well for students who are visual learners.

Moving averages and exponential smoothing concepts (Holt and Winters forecasting methods) are much easier for understanding through copying formulas down a column in a spreadsheet, using data generated in the previous row. Data and formulas for the Holt forecasting procedure in spreadsheet are presented in the Figure 3.

	A	B	C	D	E	F	G	H	I	J
1	No.	Year	Actual demand X_t	Level L_t	Trend T_t	Forecast F_t	Mean squared error			
2	0	1999	3500	3200	1000			α=	1	
3	1	2000	4200	4200	1000	4200	0	β=	0	
4	2	2001	4800	4800	1000	5200	160000			
5	3	2002	5300	5300	1000	5800	250000			
6	4	2003	6700	6700	1000	6300	160000			
7	5	2004	8000	8000	1000	7700	90000			
8	6	2005	9200	9200	1000	9000	40000			
9	7	2006				10200				
10	8	2007				11200				
11	9	2008				12200				
12	10	2009				13200	116666,7	=MSE		
13	11	2010				14200				

=α*Xt+(1-α)*(Lt-1+Tt-1)

=β*(L_t-L_{t-1})+(1-β)*T_{t-1}

=L_t+T_t

=(X_t-F_t)^2

=L_t+n*T_t

Figure 3: The Holt forecasting procedure in spreadsheet

As it is presented in the Figure 3, students enter formulas for the first period and known initial values, and then copy them. For example, formulas needed to be entered in presented model are following:

LEVEL Lt
D3 =$I$2*C3+(1-$I$2)*(D2+E2)
TREND Tt
E3 =$I$3*(D3-D2)+(1-$I$3)*E2
FORECAST FOR ONE FUTURE PERIOD
F3 =D2+E2
FORECAST FOR n FUTURE PERIODS
F9 =$C$8+(A9-$A$8)*$E$8
MEAN SQUARED ERROR
G3 =(C3-F3)^2

The effect of changing parameters can be taught very effectively with a spreadsheet. In the case of exponential smoothing, smoothing constants can be maintained in cells that are referenced from the formulas so the constants can be easily changed and the formulas and charts updated automatically. By constructing the spreadsheet to accommodate multiple forecasts, the lagging and smoothing effects of different smoothing constants can be illustrated in a chart as in the Figure 4. This again allows the student to mentally connect the concepts of the parameter, the formula, and the visual image of the chart.

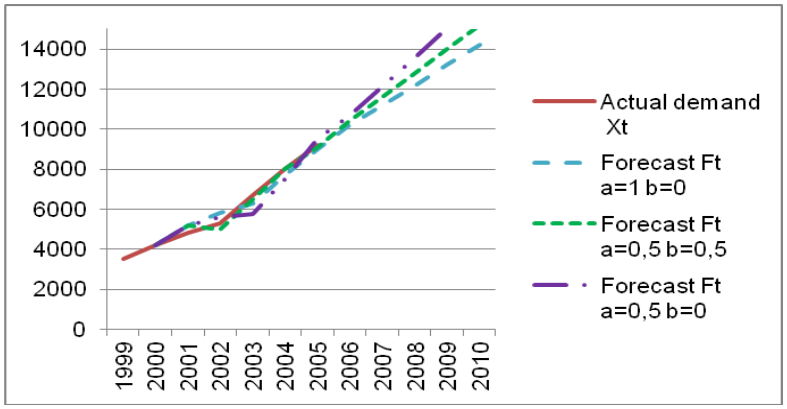


Figure 4: Comparison of Exponential Smoothing Parameters

5. CONCLUSION

Approach described in this paper is applied and tested in the education of operations managers at Faculty of Organizational Sciences, University of Belgrade, Serbia. This approach is used in education process, for students of the third and fourth year of undergraduate studies. As a result of this curriculum implementation in the classroom, we came to the conclusions that are given in the further of paper.

The final benefit of learning through spreadsheet approach is that students must learn to recognize problems in real world, describe noticed problems, translate them to mathematical and spreadsheet model, and try to find some satisfactory solution. Whole process teaches students to plan, organize, and assure quality in their work. In this way, students overcome usual fact that forecasting packages, ERP systems and other software packages appear to be black boxes that take data inputs and spit out answers without giving them any insight into the solution process. Students are learned to understand how the process behind the software works, to understand limitations and to recognize when data are missing or inappropriate for the application. Also, as employees, they are capable to model problem or create application by their own.

Most textbooks have spreadsheet models to accompany them, but that is not the case when some of the real projects should be implemented. Some texts, such as Barlow (2005) are actually spreadsheet-based. As it is proven in Gardner (2008), having students build their own operations management software in a spreadsheet enables improves and learning by allowing the instructor to tailor the software and the instructions for developing it:

- to the students' level of knowledge and ability,
- to any textbook, and
- to the instructor's teaching style and real-world experience.

Being able to adapt, rather than adopt, teaching materials can provide a more satisfying teaching and learning experience for both instructors and students.

As it is presented in the paper, dynamic discrete models are very appropriate for developing in spreadsheets because of the approach that takes as principal variable a discrete time t and separation of the law of dynamics, control domain, performance criterion and a method used to find an optimal solution. Spreadsheet structure of rows and columns is appropriate for developing this kind of model. Model set in spreadsheet in this way provide quality base for simulation, which is very useful for laboratory experiments in educational purposes. In this way students can understand the problem, develop mathematical model, translate it to spreadsheet model and run simulation.

One of directions for further elaboration of using spreadsheets in operations management education can be based on the integration of spreadsheet models and heuristic methods in order to solve different operations management problems modelled as discrete control systems. That approach could lead to the development of software applications, which would allow students to introduce and use searching methods, in order to achieve higher level of applied knowledge, which can be used for OM problems solving. Another possible application of spreadsheet in OM education is combination of Visual Basic for Application and spreadsheets, as very appropriate tool in problem solving. Usage of Visual Basic for Application and spreadsheets allow student to create own information system or software adjusted to exact problem. Even better, this kind of software is very quick to create, thanks to Visual Basic and spreadsheets characteristics. Also, any changes that should be implemented in model and application are easy to make.

REFERENCES

Barlow, J. (2005). Excel Models for Business and Operations Management, 2nd ed. John Wiley & Sons, Inc

Gardner, L. (2008). Using a spreadsheet for active learning projects in operations management. INFORMS Trans. Ed. 8(2) 75-88

Kostic K. (2001). Izrada i koriscenje poslovnih modela, Fakultet organizacionih nauka, Beograd

Kostic, K. (2009). Inventory control as a discrete system control for the fixed-order quantity system. Applied Mathematical Modelling

Kostić K. (2012). Simulacija biznis situacija, FON, Beograd

Leong, T.Y., Cheong, M. L. F. (2008). Teaching Business Modeling Using Spreadsheets.INFORMS Trans. Ed. 9(1), pp. 20-34.

Liberatore, M. J., R. L. Nydick. (1999). Breaking the mold—A new approach to teaching the first MBA course in management science. Interfaces 29(4) 99–116.

Oke, S. A. (2004). Spreadsheet applications in engineering education: A review. Int J Eng Educ 20, pp. 893–901.

Prince, M. (2004). Does active learning work? A review of the research. J. Engrg. Ed. 93(3) 223–231

Winston, W. L. (1996). Management science with spreadsheets for MBAs at Indiana University. Interfaces 26(2) 105–111.

Winston, W. L. (2004). Microsoft Excel: Data Analysis and Business Modeling. Microsoft Press, Redmond, WA.

IMPROVEMENT OF PLANNING SYSTEM IN SUPPLY CHAINS AND SOFTWARE SUPPORT

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Abstract: ***The topic*** *of this paper was born out of the* ***pratical need for improving collaboration also within planning,*** *and it deals with synchronising a) constant improvement of Planning Systems (principles, concepts, processes, structure, software sulutions etc.) of the Supply Chain members (SCPS) and b) limited ability of the SC members (especially if they are of the small and medium enterprise type – SMEs) to maintain the required software solutions needed to support such a dynamic planning system in SC. Bearing in mind: a) the different types of SC and their members (big business and/or SME), b) the complexity of planning per se, c) the different ways of organising for planning in LS and d) the difficulty in applying software changes within SCPS (stress, waiting, cost etc.),* ***the problem*** *is how to ensure adequate, but not overly expensive software support (new or improved) in a timely fashion for the new SCPS concept. The initial* ***hypothesis*** *is that there is at least one way in which it is possible to develop SCPS and, at the same time maintain the adequacy of the software solution supporting it. The paper is* ***intended*** *for those who design and construct SCPS, as well as all users of it, with the intention to increase awareness of the necessity for constant development of that particular system and about the need for its flexibility, as well as the awareness of the significance and possibilities of planning system engineering. At the same time it is also intended for those who create SCPS software – so that they bear in mind that their software should be functional even if significant changes within SCPS occur. In this paper we have shown a SC model followed by the relevant problem areas (and related works): planning in SC, with the need for SCPS improvement, and the standard software solutions in SC planning/management. In the section about research and results, we have defined seven research questions; we have then* ***pointed out*** *the significant elements of participant collaboration complexity within SC, as well as the possibility for maintaining the adequacy (relevancy) of the software solutions whilst constantly imporving SCPS.*

Keywords: System Planning, Supply Chain (SC), Collaboration in SC, Software Solutions adequacy, SC Planning System Improvement

1. INTRODUCTION

Management of organizational systems, both individual and those associated in supply chains (SC), begins with planning. Planning is the process of defining goals and their decomposition to the level of operational objectives, defining the necessary operations for transforming objects of work and defining the associated resource requirements, as well as determining the total demand for resources and ensuring their availability (Omerbegovic-Bijelovic, 2010). This large task becomes even more complicated when connecting companies in SC (Fig. 1), because the planning for one company becomes the planning for a number of companies - related by management (including planning), but also by business, technological, economic, and formal - legal issues.

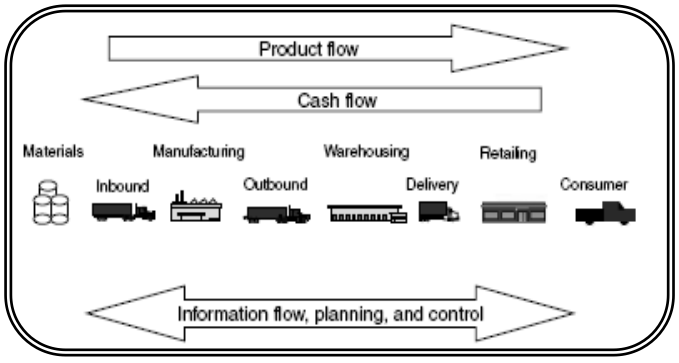

Figure 1: A classic view of the supply chain
Source: Schutt, 2004, p. 6.

Supply/value chain can be composed of two (buyer and seller, or resource supplier and manufacturers, or alike) or more consecutively positioned participants in the process of transformation of objects of work. Their predecessors and successors in the process (e.g. from those engaged in extracting ores, to those engaged in retail business of mixer bars) may also be members of SC. Carriers and others who provide various services to the other members (and thereby add value to the work of SC) are also SC participants/members, but are often omitted from consideration due to the simplicity of the model.

SC can be serial or divergent (Dominguez, 2014). As each participant in a SC may have more "input partners" and more "output partners," it is possible to generate more SCs (Fig. 2), and to plan for one or, more rarely, for more SCs, over the same set of partners.

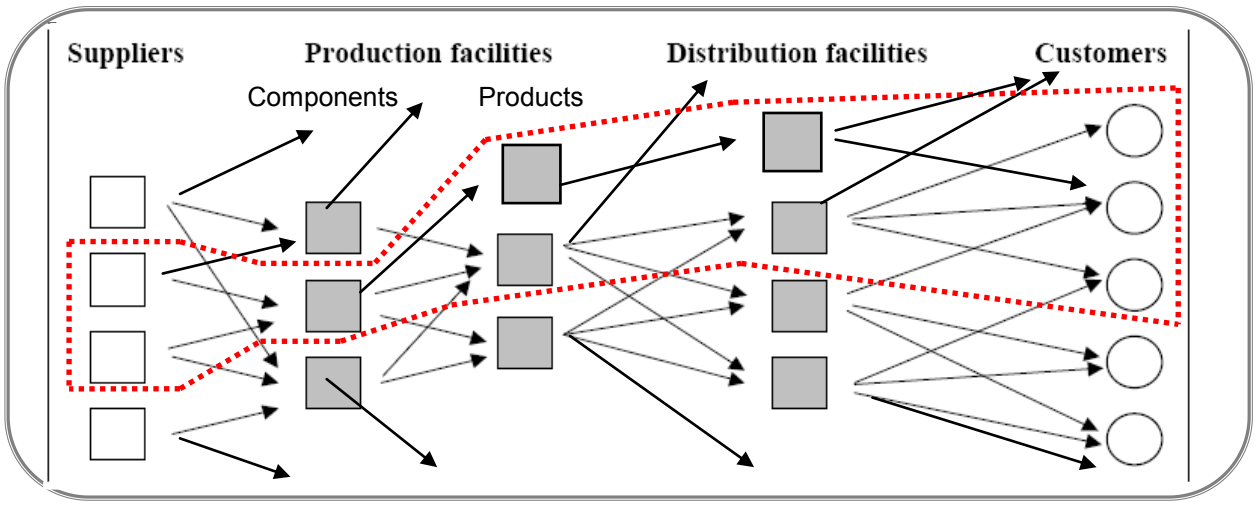

Figure 2. One possible supply chain in planning system network structure
Source: with adaptation from Dudek (2009), p. 26.

Planning in SC (as a system, SCPS) implies a shift from "individual" planning (successive and segregate) to collaborative planning in SC, wherein the collaborative planning approaches can be:
a) *Hierarchical planning approach* - with centralized guidance in planning in SC, with the inevitable use of modern software solutions, including using APS (*Advanced Planning and Scheduling*), models and methods of operations research and others.
b) *Non-hierarchical approach to planning* - essentially collaborative planning based on coordination between the selected areas of business planning ("*planning domain*") of participants in SC (Fig. 3). Thus it is possible to arrange that a supplier/manufacturer plans to supply a customer independently (VMI - *Vendor Managed Inventory*), to cooperate in the supply planning (CMI, Co-Managed Inventory) or to work together on planning, forecasting and supply (CPFR, Collaborative Planning, Forecasting and Replenishment).

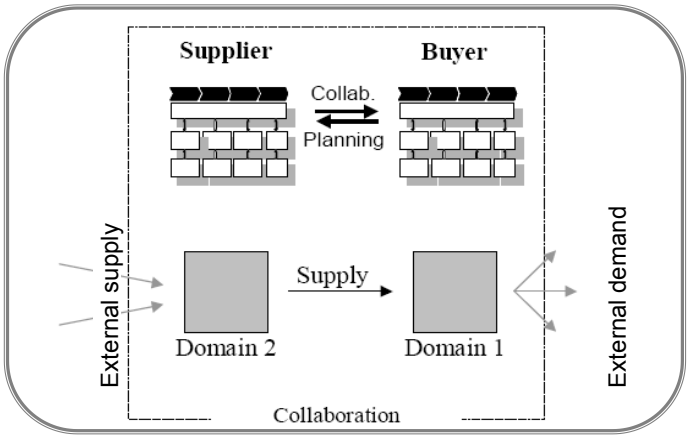

Figure 3: Two party collaborative planning
Source: Dudek, 2009, p. 58.

Due to the possibility of different interpretations of the term "collaborative planning", here it refers to: planning operations in SC, through the planning of operations of selected, contracted "*planning domain*". SC is planned according to time horizon (*far shorter than before*), and within a longer time horizon (in the corresponding number of iterations) it is planned for shorter periods. A long-term, medium-term and short-term plans still exist, and companies make "major" (master) plans for 12 (and/or 18) months - on a "rolling planning" principle. The principle implies also that plans relating to the shorter period give more reliable data. Typically, a master plan does not leave out the most important data (Table 1).

Table 1: Basic decisions of master planning, Source: Rohde / Wagner (2005), p.159.

N°	Decision type	Description
1	Procurement	Quantities of input materials purchased from external suppliers
2	Production / Material handling	Production and handling quantities, or output levels of other relevant operational processes
3	Inventories	Inventory levels at the end of planning periods
4	Customer shipments	Quantities supplied to customers and their origins
5	Transports	Transport quantities on all transport links considered

Besides on negotiation and contracts, the collaboration between members of a SC is based on the fulfillment of the contracted issues and on building the trust among SC participants. Therefore, collaboration is

established in multiple phases (Kilger and Reuter, 2005, p. 271): Domain planning, Data exchange, Negotiation&Exception handling, Execution, Performance measurement.

When it comes to the realization of the planning process, it is done by a pull principle: first the outputs from SC are determined, then predecessors' operations, upstream. At each stage (for each participant in SC) firstly the type and quantity of its output are determined, and then - based on consumption norms - the necessary amount of resources (which should be obtained from the predecessor in SC). The neighbours in SC cooperate on the level of "planning domain" (Fig. 4).

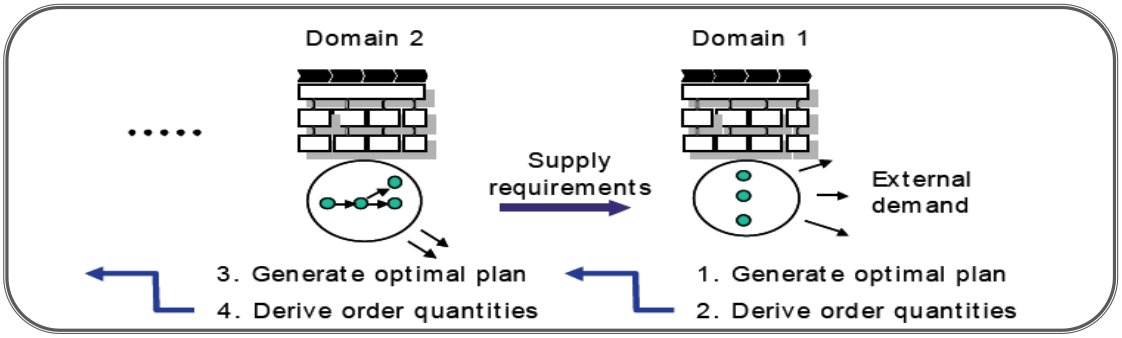

Figure 4: Upstream planning scheme
Source: Dudek (2009), p. 47.

The above suggests the complexity of the problems of planning systems in SC (SCPS). The complexity increases when we take into consideration the development of SCPS. As the system implies a process (processes) and structure, here the "organization to plan," as well as appropriate meta-managerial tools (Omerbegovic - Bijelovic, 1998) such as concepts / models, methods, technical means and organizational tools (including software), their development even more/ further multiplies the complexity of SCPS.
This paper is written based on the following structure: Section 2 explains the conceptual framework and gives the problem description; in Section 3 survey results are presented, and Section 4 summarizes some concluding remarks and suggestions for further studies.

2. PROBLEM DESCRIPTION AND LITERATURE REVIEW

Working within SC demands serious activities and resources for synchronising the varied interests and operations of its members. Synchronising the SC functioning starts with planning (SCPS), which, in time, changes (as a rule: improves). Planning in SC has, for decades, been impossible without software support. That support needs to change together with the changes within SCPS. SC members, not only within the SME category – which have “evidently of limited capacity” (Sitompul, 2012), and can therefore seem like a serious if not insurpountable problem – especially if the changes are very frequent. This is why some members of SC, unable to follow developments, decide on ceasing to be in SC altogether or find other solutions for keeping the relevancy of their software planning solutions.

2.1. Planning in supply chains

Schut (2004, p. 219) states that planning (including SC) covers the following areas: Sales Forecasting, Quantitative support for Sales & Operations Planning, Integrated Supply Chain Tactical Planning, Production requirements calculation from distribution network requirements, Master Scheduling of production, Detailed scheduling of production, Inventory deployment planning in a distribution network and Short-range transportation planning and load building. By Zamarripa et al. (2012), “the typical scope of the **SC planning problem** is to determine the optimal production levels, inventories and product distribution in an organized network of production sites, distribution centers, consumers, etc., taking care of the constraints associated to products and raw materials availability, storage limits, etc. in such network nodes.”

All of these areas (and others relevant to SCPS) are based on mathematical modelling and programming, which is an argument in favour of claims that there is no modern planning without software support. (*Of course, sometimes, in special circumstances and only for the limited scope of issues / narrow fields, even today it is possible to obtain an acceptable solution without software support.*) But the business system is so complex that it is impossible (and certainly not profitable) to operate without adequate software support in the conditions of contemporary competition.

2.1.1. Planning of one participant in a supply chain

Participants in SC can retain a tendency to "individualistic" or "disconnected" planning in SC (DSC), reffering to planning without involving other parties and without "spreading" the scope of the information based on which the planning is done. Moreover, within a single company so called "Functional silos" may appear

where there is a lack of cooperation between different functions within a company. In the same way we can define the ”planners' silos” in SC, where the planning is done without taking into consideration the attitudes/knowledge of other participants in SC who are also involved in the planning (planning "within the closed box"). This planning approach implies that a company plans only internal activities (procurement, production, sales) that are directly related to the supply/demand of the first predecessor/successor in SC. Companies that aim to integrate the entire supply chain tend to eliminate "functional-" and "planning silos" and create inter-functional processes.

2.1.2. Cooperation between neighbouring participants in SC in production and inventory planning

Cooperation between neighbouring participants in SC in the area of production and inventory planning in different participants in SC has been studied by many authors. Prominent authors in this area (Lee, Padmanabhan and Whang, 1997; Barratt and Oliveira, 2001) agree that the presentation of sales data from retail outlets is useful information for manufacturing companies that are planning the production in line with demand forecasts. Raghunathan (1999) claims that a manufacturer reduces its costs to a different extent, depending on the number (percentage share) of retailers who share their sales forecasts with a manufacturer, as well as that the cooperation in forecasting helps to reduce the cost of the retail chain which shares its forecasts with a manufacturer.
Paiva et al. (2014) suggest that supply planning and trust-based relationship within buyers and suppliers are positively related and both influence supply integration and operational performance. They claim that “integration with suppliers is the means by which companies work with suppliers seeking mutual objectives, sharing ideas, information, knowledge, risks, rewards and solutions to common problems”.

2.1.3. The cooperation of the entire supply chain in production and inventory planning

It is assumed that some of the members of SC (e.g. retail) have limited interest in participating in the exchange of information and cooperation in SCPS . The key reason for cooperation can be identified by the fact that SCPS is a prerequisite for the efficient supply of all the members of SC.
Cao and Zhang (2011) consider collaborative relationships and find that they “can help firms share risks, access complementary resources, reduce transaction costs and enhance productivity, and enhance profit performance and competitive advantage over time”. Collaboration concerns with the alignment of decisions and actions amongst SC members - in their planning and inventory management. This alignment is enabled by the exchange of information in the SC (Stadtler 2009).

The availability of relevant information provides a manufacturer with better production planning, especially for products with a high variation in demand. As production plans are developed under the direct influence of identified demand, this means the possibility of creating a detailed and reliable delivery and supply schedule, using simulations in defining future orders, for example. A manufacturer is enabled to create its own delivery plan that is probably different from that of the customer's orders, with the adjustment of production plans to the real market needs. Considering research studies, according to Småros (2007), it is possible to draw a general conclusion that the availability of sales data from customers' facilities to the end user is a very significant potential for improving business of manufacturing enterprises. Studies show that by a combination of reports on orders of retail outlets and reports on the flow of goods in distribution centers of retail chains (which are governed by the concept of VMI), a production company can benefit even when only a handful of the total number of customers and retailers is involved in the collaboration system. The greater part (%) of its sales is "covered" by including into the VMI system, the better for all participants in SC.

2.2. Application software in supply chain planning

The general trend of the software manufacturers is the integration of supply chain components into existing software packages (ERP) in order to offer customers a complete solution designed for the overall needs of companies in SC. According to (Yen, Chou and Chang, 2002), in most cases, softwares for SC management (SCM software) are software solutions specifically developed for the needs of companies of a certain type (production, storage, distribution, trade). Some of the major software vendors have tried to combine different and specific software solutions for SC in a single software solution. According to (Yen, Chou and Chang, 2002), the best solution for the success of SC is the development of SCM software in two ways: a) The solutions that support the planning of participants in SC (Supply Chain Planning Software), and b) Software solutions that support the operational functioning of SC (Supply Chain Execution Software). *Softwares used for planning in SCs* are based on mathematical algorithms whose implementation optimize the flow of information and goods, enhance the efficiency of the SCs and optimize inventories. These software solutions are completely dependent on the available information and its reliability (precision). Software for planning in SC provides the support for these most important functions of SC; the greatest contribution is realized in the demand planning, which is the initial plan for all other activities in the chain - based on which further plans are created. *Software intended to support the operational functioning of SC* is designed for automation of SC

specific needs (e.g. vehicle route optimization in distribution or automatic ordering in accordance with predefined signal inventories/re-order point).

2.2.1. Software packages for production and inventory planning of one participant in SC

Software used for planning in SC allows SC members to manage inventory in line with sales and demand forecasts. As part of the SCM in general, a software solution for SC planning (S&OP - Sales and Operations Planning) plays an important role in reducing costs and improving the profitability of a company. Using software for SC planning (such as Modules for demand planning or S&OP modules), based on historical data and along with the expected activities to improve sales, companies can simulate the potential demand and, in line with expectations, harmonize inventories of finished goods and raw materials.

In some cases the software components required to manage SC represent solutions that are fully integrated into the standard ERP, while in the others they represent separate modules or fully independent software solutions for the management of SC. According to (Kumar, 2001), software solutions for the SCM have a very large impact on the performance of the entire company, which has been recognized by leading software manufacturers. Major producers of software (SAP and Oracle) are dedicated to the further development of software for SCSP; this resulted in the creation of advanced software modules aimed at "complex" planning in SC (Chang and Makatsoris, 2001).

Current software solutions for planning in SC enable cooperation between a manufacturer and buyer through the exchange of information on the available stock and realized sales, in order to perform mutual optimization of inventories. According to the recommendation made by Software AdviceTM (www.softwaradvice.com), in accordance with the cost of software, the number of implementation and success in optimizing inventory, the following software packages are recommended: JD Edwards, WISERoyal, SCP 4.0, SAP-SCM, PackManagerNulogy's, iTracker Hosted 3PL, MachSix, IBS Enterprise Manufacturers, POOL4TOOL and Quintiq's Supply Chain Planning & Optimization.

SC aims to integrate all the key business processes. In practice, it happens that the key processes in SC individually do not have uniformed adequacy of software support, which implies a reduction of compatibility and causes missed business results.

Standard business softwares (ERP) are primarily focused on providing software support to internal operations (production planning, inventory records of raw materials and finished goods, material and financial records - accounting, etc.). In contrast to standard ERP solutions, software solutions designed for SC are focused both on internal business activities and on external processes among participants in SC. According to (Buxmann, von Ahsen, Díaz and Wolf, 2004), the largest number of Supply Chain Management Software packages support SCPS (all SC members who cooperate in planning), while standard ERP solutions provide automation and support in the implementation of operational plans.

The most common system of advanced planning, APS, provides immediate response to customer requirements providing timely and reliable information from the business system of a production company. APS system is a concept on which the software for SCM is based. The basic structure of APS concept ensures the creation of software that consists of the following planning modules and sub-modules: Strategic Network Planning, Demand Fulfilment & ATP, Production Planning and Scheduling, Transportation Planning and Distribution Planning.

2.2.2. Software support to production and inventory planning with the cooperation of neighboring participants in SC

From the perspective of the cooperation in the SC planning, one of the most important goals is to achieve harmonized interpretation of: 1) the problems that exist in all participants, 2) the functioning system of observed supply chain, and 3) the approach to decision making. The key to success is the adoption of comprehensive optimal decisions based on the collective knowledge of participants in SCPS.

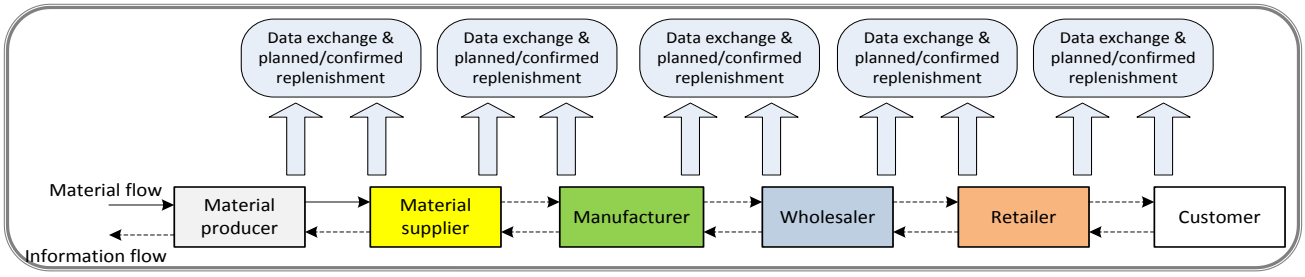

Figure 5. Model of cooperation of neighbouring participants in SC planning

The model of cooperation of neighboring participants in planning in SC is shown in Figure 5. Software tools that provide cooperation in planning in supply chains should be clear and "user friendly" for all members of

SC, transparent (and to show valid and accurate information), provide monitoring of performance indicators of all participants in the SC planning, as well as enable compatibility with different software (ERP solutions) used by participants in the SC.

In their studies (Stadler and Kilger, 2005) presented (by APS matrix) the list of software manufacturers that base their software solutions on the APS. The survey by the SCM Competence & Transfer, published in (Laakmann et al., 2003) included 23 APS software solutions. Stadler and Kilger (2005) summarized the results of the survey and presented the complemented results by APS matrix (**Table 2**). Some of the most important comprehensive software solutions for SCM, based on the APS, are i2 Technologies, PeopleSoft and SAP (with *Advanced Planner and Optimizer* (APO)). In these comprehensive solutions it is possible to use only a specific module, in case of limited need.

i2 Technologies offers the solution from i2 software modules, mostly directly connected with the planning in SC: SC Strategist, Demand Manager, Supply Chain Planner, Factory Planner, Production Scheduler, Demand Fulfilment, Enterprise Project Planner and Transportation Modeler, Optimizer and Manager.

	Strategic Network Planning	Demand Planning	Master Planning	Demand Fulfillment / ATP	Production Planning & Scheduling	Distribution & Transport Planning	Collaborative Planning	Alert Management
Adexa	●	●	●	●	●		●	●
Agilisys	●	●	●	●	●	o	●	●
Aspen Tech	●	●	●	●	●	●	●	●
Axxom	●	●	●	●	●	●	●	●
Baan	●	●	●	●	●	●	●	●
DynaSys		●	●	o	●	o		
Flexis			●	●	●			●
GEAC		o	o	o	●			●
i2 Technologies	●	●	●	●	●	●	●	●
ICON		●	●	●	●	o	●	●
Intentia	●	o	●	●	●	o	●	o
Manunistics	●	●	●	●	●	●	●	●
Mapics	●	●	●	●	●	●	●	●
Oracle		●	●	●	●		●	●
Peoplesoft	●	●	●	●	●	●	●	●
SAP	o	●	●	●	●	●	●	●
TXT e-solutions		●	●	●	●	o		●
Viewlocity	●		o	●	●	●	●	●
Wassermann	o	o	●	●	●		●	o

Table 2. The planning process in SC and APS

PeopleSoft as part of Oracle's Advanced Supply Chain Planning (ASCP) provides companies with the ability to plan in the entire supply chain through a "holistic planning, scheduling and optimization". ASCP is a simultaneous approach to planning for all members of the SC - suppliers, manufacturers and distribution centres, both in short and in long terms. The concept of APS in this software is implemented through the following modules: Strategic Network Optimization, Production & Distribution Planning (PDP) and Vehicle Loading, Demand Management (Demand Forecasting and Demand Consensus, Production Scheduling Process (PSP), Production Scheduling and Discrete Order Promising.

SAP AG offers the SAP APO (based on APS). APO is a fully integrated APS solution, which is accessed through the application of Supply Chain Cockpit. It contains the modules: Demand Planning, Supply Network Planning, Global ATP, Production Planning and Detailed Scheduling, Deployment and Transport Load Builder, Transportation Plan-ning and Vehicle Scheduling, Purchasing, Workbench.

2.2.3. Software support to production and inventory planning with the cooperation of all participants in SC

Software solutions for cooperation in planning in supply chains are a combination of ERP solutions, software for project management and software on whose concept different social networks are functioning. The main advantage of this software is that it allows decentralization of control and responsibility in the planning of activities in the whole SC. All participants in the SCPS have access to the software in accordance with the position in which they work and the relevant responsibilities. The concept of the functioning of the software is based on the regular exchange of information between participants, so it is imperative that all stakeholders are aware of the responsibilities of regular updates of progress and change in the status of the activities for which they are responsible. Unlike the traditional software designed for planning in SC which optimize plans and simplify the planning process, these software solutions allow "discussion" i.e. the exchange of information between participants on a particular topic.

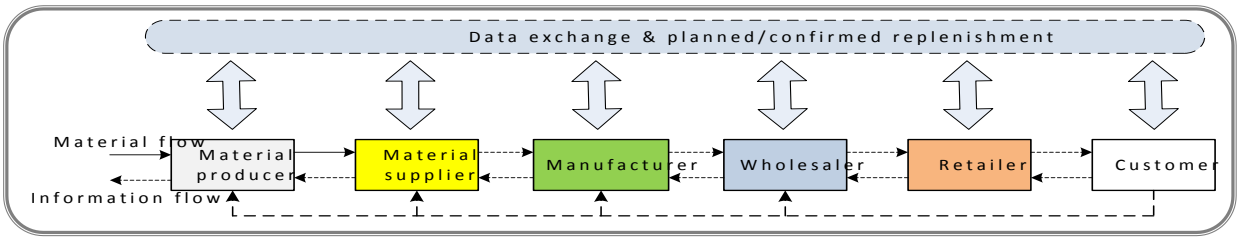

Figure 6. Model of a full cooperation in planning in SC

The cooperation of the participants in planning in SC can be full or limited. Full co-operation (Fig. 6) is achieved if all participants in SC cooperate fully (transparent) and use the appropriate software for collaboration in planning in SC. The basic concept of cooperation is presented in Lecic-Cvetkovic et al. (2012).

Limited co-operation (Fig. 7) is a modification of the full cooperation model; it occurs when the cooperation of the participants in SC is limited, where each participant cooperates with the first predecessor and successor in the SC, whilst concurrently cooperating with the final buyer. It is believed that the cooperation with the buyer is most easily attainable, because the buyer i.e. retail store, aims to ensure the availability of products to consumers and thus "retain" them, while the other SC members have the opportunity to find alternative channels of product placement.

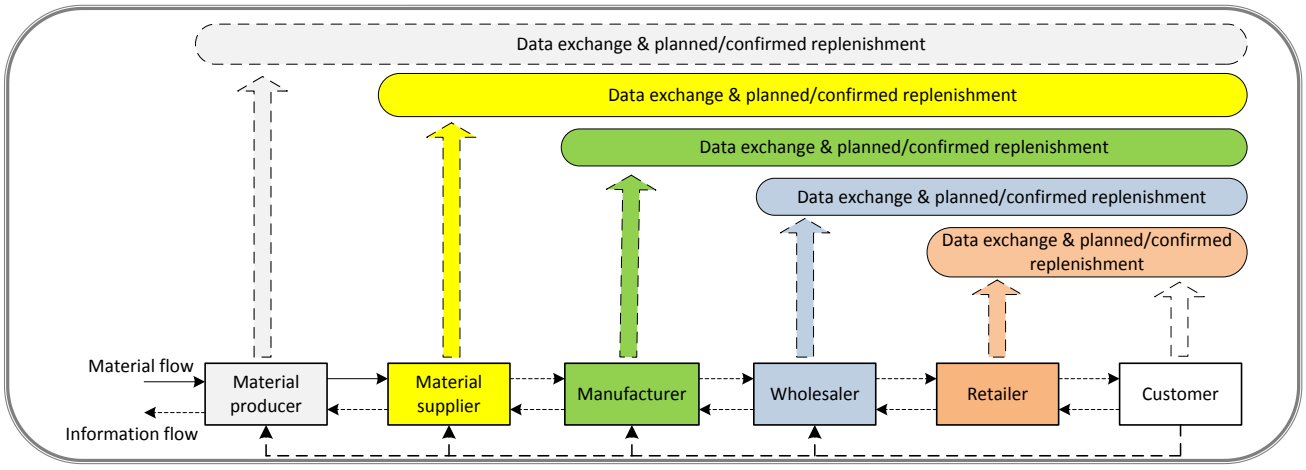

Figure 7. Model of limited cooperation between the participants in SC planning

Collaborative planning, forecasting and replenishment (CPFR) software from „Demand Solutions“ which is "cloud-based" concept, provides reliable information on the demand and the need for replenishment of the stock through the coordination of material and informational flow between multiple participants in the SC, between different locations and different companies. *Demand Solution software* allows defining priorities in meeting the demand (through *Demand Solutions Dashboards*), as well as different levels of aggregate considerations of demand and the available stock. Cooperation is achieved through the following additional features: Exchange calendar event (production, delivery, receipt), Support for XML and EDI in order to facilitate the exchange of information, full access to the entire SC from the perspective of each member. Cooperation in planning in SC is also provided by software „Voyager Collaborate“, whose main advantage is Module Logility Voyager Collaborate with providing effective communication in decision-making, contributes to the identification of potential problems and preventive action. JDA CPFR, created by JDA Software Group, is a direct upgrade by creators of VICS CPFR ® standard, through the module that allows planning by the application "alerts" and the work with flexible planning horizon. NeoGrid CPFR is a software solution for collaboration in planning in SC which is derived from the solutions intended for aligning inventory levels between the SC members, i.e. between multiple storage positions.

3. RESEARCH AND RESULTS

By Paiva et al. (2014), “Some studies about supply chain planning have focussed on mathematical models to reduce losses due to mismatches, while other studies have focussed on antecedents that lead to improvements in supply chain planning, for example, the use of electronic marketplaces, advanced planning systems, information technologies use and supply chain flexibility. Here we draw attention to the improvement of planning in LS and the need to maintain the software support for such, new planning.

Contemporary SC cannot operate without adequate software support (which effectively and efficiently serve SCPS, i.e. which can be applied, and, at the same time, provides the benefit for SCPS), and the adequacy of software support reduces with the accumulation of changes in the concept of SCPS (because every change of SCPS requires appropriate, new or updated software). Hence the need to replace the software with a new, more adequate one. But the downsides of the replacement are: replacement costs, changing time, and stress (training for new software for planning in SC, adjustments of experts in planning in SC etc.).

Hence SCPS must be improved, and the adequacy of its software support must be maintained, i.e. must not be reduced. Therefore, this paper seeks answers to questions (RQ1-RQ7):
RQ1: What is the "chosen problem" in SCPS?
RQ2: Why is it necessary to have a software support for SCPS?

RQ3: What changes with the improvement of SCPS?
RQ4: What is happening with the SC planning software with the improvement of SCPS?
RQ5: Is it possible to "keep" the adequacy of the software for SCPS?
RQ6: Who can "keep" the adequacy of the software for SCPS?
RQ7: How to "keep" the adequacy of the software for SCPS?

"Selected problem" (RQ1) refers to maintaining the adequacy (or at least the usability and usefulness) of not too expensive, new or improved, software solutions to support the SC planning system (SCPS), in circumstances when SCPS maintains its topicality, i.e. it improves in accordance with the progress of the environment. "*The adequacy of software support for SCPS*" (Software Support Adequacy for Supply Chain Planning System, SSA4SCPS) as one of the key performance indicators of "quality software solutions for SCPS", means that software solutions suit all the needs of SCPS, that this support is effective and efficient, is on the same "level of modernity" as the SCPS, is usable (accomplishes its goals well enough) and is useful. Indicator SSA4SCPS, similarly to other quality indicators of any product/service, must be measurable/comparable, its functional dependence on certain variables should be described, standards for measures of their changes should be defined for the measurement system and the maintenance of the desired values, etc. The question is what happens when the SCPS software support loses its function, i.e. is it possible to do business without this support? Examples from the past show that it is (was) possible, but the contemporary practice says that it is not possible. Modern business involves a significant level of availability and reliability of data, accessibility, and the use of software tools for decision making, quick decision making, and dislocation of the participants in the decision-making system and in the complete management, etc. The cooperation of the participants in SC without software support for SCPS is now virtually impossible. Therefore, it is necessary to maintain the highest possible (or at least acceptable) indicator levels of SSA4SCPS.

When considering the SC planning system, it is interesting to investigate what is the function of software support (RQ2), i.e. which business activities in SC cannot be planned if there is no adequate software support. It is already said (Tab. 1) what "basic decisions of master planning" are. But that is only part of the function of a complex planning system in general as well as in SC. Practically, there is no area or object of planning where the software support does not facilitate obtaining a solution of a higher quality (more reliable, more accurate, faster, etc.).

When asked why the SCPS is complex, the best response is to remember at least some of the dimensions of the business system (Omerbegović-Bijelović, 2005): processes, resources, organizational components/parts, inputs and outputs, the relationship between inputs and outputs, changes, property, environment, expectations and goals, constraints, and so on. When this is viewed as an object of development in SC, exponential growth in a number of potential problems can be identified. For managers (owners and managers), this complexity would be insurmountable without a software support - for planning and for all other managerial activities.

Enhancement/improvement of the SC planning system (RQ3) can be symbolic and "painless", but a radical change (concepts, principles, data supply and software support, together with function and location of parts of the planning system in the SC organizational structure) is an important, complex, and unavoidable task. The cause of these changes is the need to maintain the competitiveness of SC and its members while the motives may be different - depending on the perceived problems and the capacity to address them, but always with setting a certain priority/objective: maximizing the satisfaction of customer requirements (Lecic - Cvetkovic et al., 2010). Often the Bullwhip Effect phenomenon (BWE) is used as an excuse to change the SC planning system. For example, instead of founding their plans on communicating with their immediate neighbours, the SC members may decide that each member of the SC should plans it output according to the last member in SC (usually a retail), using the same reasoning mechanism and taking into account its own historical data (Lecic - Cvetkovic et al., 2012).

The often cause of SCPS changes is the necessity to improve the SCM system (in order to improve the quality of plans, eliminate conflicts, increase the level of communication within the SC and with the environment), or the application or changes of meta-managerial tools, reducing costs, reducing the duration of production and business cycles, improving decision-making (by introducing higher mathematics and related disciplines), introduction of APS and the like. Along with the improvement of SCPS, it is necessary to adapt its software support (RQ4). Only together they perform their function in the SCM.

If the software is not flexible, if there is no automatism in its adaptation to changes in SC and in its planning system, the question of the adequacy of such software support arises. SSA4SCPS indicator should signal the need for software updates. Maintenance of the adequacy of the software is important for all participants in the SC; in several ways: as a sign that SC is uniformly developed and remains competitive, but also as an incentive to occasionally check whether at least one element from the set {"*Planning system in SC*" * "*Software support to SCPS*"} has been improved (and caused the improvement of the other one) in the given period. Practice shows that the improvement of the planning system in the SC is inevitable, even desirable,

but that it is also necessary to keep the adequacy of the planning software in SC (RQ5). It is not difficult to keep SSA4SCPS within the limits of admissibility - if there are necessary resources (e.g., money, time, staff readiness for change).

Given the importance and the task of SCPS imrovement, including the importance, and the task of maintaining the adequacy of the software (SSA4SCPS), the question is who has a role in fulfilling these tasks (RQ6). Among the resposabile and interested are: a) Those who conceived, designed, devised the SCPS, b) Those who "produce" software support to SC planning, and c) Companies - participants in SC.

Some of the ways to keep the adequacy of the software for SCPS within the limits of acceptability (RQ7) are proposed: application of planning system engineering (processes and organizational structures) and the design of a flexible planning system for SC; the use of flexible, adaptable software solutions for planning in SC (modules and the possibility of accepting the "upgrade" - tailored to the changes in the SCPS); replacement of SCPS software (especially if it is possible to substitute it on the "old to new" principle with software provider); automatic updating of software solutions; timely defining principles for the change of software and allocation of related costs; that, from the moment of establishing SC, all participans define and agree on not only SCPS, but also the principles of its development; timely creation of a body for improving SC planning/management; the fund for improvement of SC planning/management settings; miscellaneous.

4. CONCLUSION

The paper points at the necessity of improving the planning system in supply chains (SCPS), and the need and ability to maintain the adequacy of the software to support the SC planning even when the planning improves and promotes/develops. Today, a complex planning system (planning, organizational structure in which the process takes place and the cooperation among the participants in SC) cannot function without a software support. Given the variety ranges of SC in which modern businesses operate, the complexity of planning is still growing. The competition between enterprises and their association's increases, and therefore SCs need to increase their competitiveness, i.e. to develop. Consequently, it urges the planning systems in enterprises in SC to improve, innovate, change, including the whole SC.

Due to the development of the principles and concepts of organization and functioning of SCPS, a reduction of the adequacy of existing software support occurs, and this leads to the need to provide the software that is not too expensive, which is (new or improved) adequate for the new SCPS. Therefore, the problem of maintaining the adequacy (usability, usefulness) of software packages that need to support the operation and development of the SCPS is noticed.

In addition to identifying the needs for maintaining the adequacy (or at least usability) of software support to SCPS, this paper also pointed at some possibilities to extend the duration, usefulness and/or appropriateness of software for planning in supply chains. Different aspects of cooperation/collaboration in planning in SC are presented by authors (as shown on Fig.5, Fig.6 and Fig.7) clearly showing the respective information flows between one or more participants in SC planning, with extension of closed loop for feedback/backward data collection. Some ways of keeping the SCPS software support adequacy within acceptable boundaries are also suggested.

Regarding further study on this subject, authors would like to suggest examining the scale of the software support adequacy and/or measuring its influence on business results.

REFERENCES

Barratt, M., Oliveira A., 2001. Exploring the experiences of collaborative planning initiatives, *International Journal of Physical Distribution & Logistics Management*, Vol. 31, No. 4.

Bozarth, C.C., Handfield R.B., 2006. Introduction to Operations and Supply Chain Management. Pearson Education, Inc.

Buxmann, P., von Ahsen A., Díaz L.M., Wolf K., 2004. Usage and evaluation of Supply Chain Management Software – results of an empirical study in the European automotive industry, *Info Systems Journal*, Vol. 14, pp. 295–309.

Cao, M., Zhang Q., 2011. Supply chain collaboration: impact on collaborative advantage and firm performance. *Journal of Operations Management*, *29*(3), 163-180.

Chang, Y., Makatsoris H., 2001. Supply chain modelling using simulation. *International Journal of Simulation*, Vol. 2, No. 1, 24-30.

Christopher, M., 2005. Logistics and Supply Chain Management. 3rd ed. Pearson Education Limited, Great Britain

Domínguez, R., Cannella S., Framiñán J. M., 2014. On bullwhip-limiting strategies in divergent supply chain networks (accepted for publishing). *Computers & Industrial Engineering*.

Dudek, G., 2009. Collaborative Planning in Supply Chains – A Negotiation Based Approach (2nd ed.), Springer, Berlin.

Kilger, C., Reuter B., 2005. Collaborative Planning, in: Stadtler, H., Kilger, C. (2005). Supply Chain management and Advanced Planning – Concepts, Models, Software and Case Studies, 3rd ed., Springer-Verlag, Berlin et al. 2005. pp. 259-278.

Kumar, K., 2001. Technology for supporting supply chain management: Introduction. *Communications of the ACM*, Vol. 44, No. 6, pp. 58 – 61.

Laakmann, F., Nayabi K., Hieber R., 2003. Market Survey 2003: Supply Chain Management Software – Detailed investigation of supply chain planning systems, Fraunhofer IPA Stuttgart, Fraunhofer IML Dortmund, ETH Zürich BWI

Lecic-Cvetkovic, D., Atanasov N., Babarogic S., 2010. An Algorithm for Customer Order Fulfilment in a Make-to-Stock Manufacturing System. *International Journal of Computer, Communications and Control*, 5(5), 783-791.

Lecic-Cvetkovic, D., Atanasov N., Omerbegovic-Bijelovic J., 2012. Improvement of Supply Chain Management by Bullwhip Effect Reduction. Proceedings of the XIII International Symposium SymOrg 2012, Serbia, 226-234.

Lee, H., Padmanabhan V., Whang S., 1997. The Bullwhip Effect in Supply Chains, *Sloan Management Rev*. 38, 93-102.

Omerbegovic-Bijelovic, J., 1998. Meta-management and quality of management (monograph, in Serbian), Zaduzbina Andrejevic, Belgrade.

Omerbegovic-Bijelovic, J., 2005. Planning and preparing of production and services delivering (in Serbian), Faculty of organisational sciences – Belgrade University, Belgrade.

Omerbegovic-Bijelovic, J. (editor and one of authors) et al., 2010. Basics of Operations management (in Serbian), Faculty of organisational sciences – Belgrade University, Belgrade.

Paiva, E. L., Teixeira R., Vieira L. M., Finger A. B., 2014. Supply chain planning and trust: two sides of the same coin. *Industrial Management & Data Systems*, 114(3), 405-420.

Raghunathan, S., 1999. Inter-organizational collaborative forecasting and replenishment systems and supply chain implications, *Decision Sciences*, Vol. 30, No 4.

Rohde, J., Wagner M., 2005. Master Planning, in: Stadtler H., Kilger C. (Eds.), Supply Chain Management and Advanced Planning – Concepts, Models, Software and Case Studies, 3rd ed., Springer-Verlag, Berlin et al., 2005, pp. 159-177.

Schutt, J. H., 2004. Directing the flow of product: a guide to improving supply chain planning, J.Ross Publishing&APICS, Boca Raton, Florida

Sitompul, C., 2012. A Supply Chain Planning for Small and Medium Enterprises. *Procedia Economics and Finance*, 4, 384-389.

Småros, J., 2007. Forecasting Collaboration in the European Grocery Sector: Observations from a case study, *Journal of Operations Management*, Vol. 25, No 3.

Stadtler, H., Kilger C. (Eds.), 2005. Supply Chain Management and Advanced Planning – Concepts, Models, Software and Case Studies, 3rd ed., Springer-Verlag, Berlin et al.

Stadtler, H., 2009. A framework for collaborative planning and state-of-the-art, in: Günther, H.O. and Meyr, H. (authors and editors) et al., Supply Chain Planning - Quantitative Decision Support and Advanced Planning Solutions, Springer, Berlin, 2009, pp. 3-28.

Yen, D.C., Chou D.C., Chang J., 2002. A synergic analysis for Web-based enterprise resources planning systems. *Computer Standards & Interfaces*, 24, 337–346.

Web source: http://www.softwareadvice.com/scm/supply-chain-planning-software-comparison/ (accessed: 24.04.2014)

Zamarripa, M.A., Aguirre A.M., Méndez C.A., Espuña A., 2012. Improving supply chain planning in a competitive environment. *Computers & Chemical Engineering*, 42, 178-188.

AN OVERVIEW OF CAUSES FOR BULLWHIP EFFECT AND MODES OF DECREASING THEIR EFFECT

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Abstract: *Bullwhip effect in supply chains is a topic of interest of many authors, but research has mainly been done on operational causes and only some of them. This paper gives an overview of all operational and behavioral causes of the bullwhip effect, as well as modes of overcoming them.*

Keywords*: supply chain, bullwhip effect, operational and behavioral causes*

1. INTRODUCTION

Coordination of supply chains operates well if all the participants in a supply chain (suppliers, manufacturers, distributers, wholesalers, retailers) consider how their actions affect other participants and the entire chain. Lack of information and coordination can cause the bullwhip effect, which implies a distortion of information within the supply chain because different stages in the supply chain have different demand forecasts, so that demand increasingly varies from retailer to manufacturer. Bullwhip effect was first identified by Forrester (1958). Later, the causes of the bullwhip effect were defined as “players’ systematic irrational behavior” or as a “misperception of feedback” (Sterman, 1989, Goodwin 1994). The retailer interprets small variations in customer demand as a growth trend, which leads him to increase his order. Further up the chain, the size of the orders increases. Also, retail sales may increase an order due to planned promotions. If the manufacturer interprets this increase in demand as a permanent increase, and orders from the supplier accordingly, he will have the problem of surplus stock by the end of the promotional period. Croson et al. (2004) have classified the causes of the bullwhip effect as operational and behavioral. Most authors deal with operational causes and mainly only some of them, while behavioral causes are seen as important, but insufficient research has been done. This paper provides an overview of all operational and behavioral causes of the bullwhip effect, and modes of overcoming them.

2. OPERATIONAL CAUSES OF THE BULLWHIP EFFECT

Lee et al. (1997a, 1997b) found that the information on the size of orders distort more as they move up the supply chain, thus leading to the bullwhip effect. The causes they list are: 1. processing a signal that there is demand, i.e. that it is necessary to order, 2. rationing game - when the manufacturer has limited capacities and the available quantity produced must be divide among all consumers, consumers start to order more, because they think that there will be a shortage and that they will get a certain percentage from the order, 3. determining the size of the orders, 4. price variations.

Aly (2007) showed that increasing the lead time, the time between two deliveries and the time during which an average amount of stock is consumed leads to an increase in the bullwhip effect. On the other hand, increasing the prediction frame (the number of previous weeks when demand is monitored and used to forecast future demand) leads to a reduction of the bullwhip effect

Buchmeister et al. (2008) list the factors:

- forecast errors,
- overreaction to backlog,
- lead time variability,
- no communication and no coordination up and down the supply chain,
- delay times for information and material flow,
- batch ordering (larger orders result in more variance),
- rationing and shortage gaming,
- price fluctuations,
- product promotions,
- free return of goods policy,
- inflated orders.

Chopra and Meindl (2001) list the following as obstacles to coordination in the supply chain and as operational causes of the bullwhip effect:

- **Incentive obstacles** – Incentives for the participants to purchase more, in case this leads to an increase in demand variability which is not followed by a change in demand from end buyers, decrease the supply chain profit. These include incentives for a participant's local activity, and do not increase the overall supply chain profit.
- **Information processing obstacles** – Information about demand is distorted as it moves from the retailer to the manufacturer or if the demand forecast is based on orders, instead of customer demand.
- **Operational obstacles** – If a company orders larger quantities of a product than it can sell, due to the economy of scale or the discount on purchase price, and the supplier identifies the current rise as a trend and includes it in the plan for the forthcoming period, he will have surplus stock. The longer the lead time, the higher the error.
- **Pricing obstacles** – Promotions and other short-term discounts from a manufacturer result in forward buy, where retail and wholesale buy large quantities during the promotion period to cover the needs for a longer period of time, which is followed by a decrease in orders. During the promotion period, orders are larger than sale, so after this period the orders are lower so as to sell the delivered stock.

Decreasing the Influence of Operational Causes of Bullwhip Effect

It is possible to decrease the bullwhip effect by affecting its causes. Numerous authors have dealt with this problem, and the solutions can be divided into six categories.

1. **Information sharing** is usually seen as a "remedy" for the bullwhip effect and it is generally acknowledged that it can optimize supply chain performance (Forrester, 1958, Lee et al., 1997a and 1997b, Simchi-Levi et al., 2000, Chen et al., 2000, Carlsson and Fuller, 2002, Gangopadhyay and Huang, 2004, Vujošević, 2004, Vujošević and Panić, 2004). However, some authors show that the value of information sharing varies depending on the scenario. Variation in manufacturer demand is lower when the demand is filtered through a distribution centre, than when a retailer orders directly from the producer (Baganha and Cohen, 1998). When all supply chain participants replenish stocks on the same day, information sharing has no effect on stocks (Bourland et al., 1996). Some participants find that information sharing could disclose confidential information of a company, which would lead to loss of competitiveness. To prevent abuse of information sharing, the chain participants determine the minimum amount of information which should be shared to gain benefit and not risk abuse. In addition, it has been determined that the more the participants evaluate information as useful, the more often they share and forward them. However, the participants underestimate the usefulness of information for other participants when compared to the estimated value of the information for them. The less the usefulness of the information is evaluated to be, the less they are prepared to forward this information (Nienhaus, 2006). The most common is either the type of information shared (horizontal perspective) or the number of trading partners involved in information sharing (vertical perspective). According to the type of information shared, they can be classified as (Gangopadhyay and Huang, 2004): 1. product information, 2. inventory level and consumer transaction information and 3. decision models. In this case, it is possible to share all information, share partial information or share no information. It is important that trading partners see why and which information should be shared. Li et al. (2006) differentiate three levels of information sharing: transactional, operational and strategic. Transactional information sharing includes the quantity of order, prices, sales level, product specifications, quality and delivery specifications. Operational information sharing includes an exchange of information on the level of stock, expenses, production and transport capacities and lead time. Strategic information include information on retail centers, demand in real time, understanding of market trends, what customers value most and product design. The companies that are closer to the end user have a better view of the demand and should forward this information upstream to companies who are further away from consumers. On the other hand, information that is forwarded downstream should be the information on order status, storage utilization, production schedule and inventory level. Table 1 shows the type of information which can be shared in the supply chain and why (Lee and Whang, 2000).

   Miler (1996) underlines the importance of information quality and suggests the following characteristics of information: relevance, accuracy, timeliness, completeness, coherence, format, accessibility, compatibility, security and validity.

   In addition to the type and quality of information, the mode of information sharing is also important. There are a number of variations between non-sharing and complete sharing of information. Lee and Whang (2000) propose three ways of sharing information: the information transfer model, where one partner forwards information to the other who maintains the decision-making database, the third party model

where the third partner maintains the database and gathers information and *the information hub model*, where the third partner is the system.

Table 1: Type of information shared and the aim of sharing

type of information	**aim of sharing**
inventory level	avoid double storage of safety stock (with both participants)
sale level	decrease bullwhip effect
order status	enable buyer to know where the order currently is
sale forecast	decrease safety stock of participants who are further away from the end user
production and delivery schedule	provide customer with a specific delivery time
performances (product quality, lead time, waiting time)	identify where bottleneck is
capacity	avoid rationalizations

2. **Improvement of information flow** can decrease the bullwhip effect. Since the only demand that needs to be met is the demand of the end user for the final product, all participants in the supply chain should have information about this and plan accordingly (Chopra and Meindl, 2001). Also, replenishment and delivery time for the whole supply chain must be collaboratively controlled. The most common models of replenishment which enable information sharing are: *Continuous Replenishment Programs - CRP* (Chopra and Meindl, 2001), *Manufacturing Resource Planning - MRP* II (Renko, 2011), *Enterprise Resource Planning - ERP* (Chopra and Meindl, 2001, Renko, 2011), *Advanced Planning Systems - APS* (Renko, 2011) *Vendor-Managed Inventories - VMI* (Chopra and Meindl, 2001, Renko, 2011), *Collaborative Planning, Forecasting and Replenishing Processes - CPFR* (Jovanović and Vasiljević, 2008, Renko, 2011, BLANCHARD, 2010).

3. **Collaborative observation of goals** decreases the bullwhip effect by making the decisions regarding transport, information and inventory based on their influence on profitability, and not based on the total price and particularly not the local prices of individual participants in the chain (Chopra and Meindl, 2001, Vujošević, 2004).

4. **Collaborative demand forecast and making decisions about orders** decreases the variations of orders (Chen et al., 2000, Wu and Katok, 2006). The bullwhip effect can be decreased by analyzing demand patterns and by applying appropriate demand forecast methods. Buchmeister (2008) proposes the method of moving average for demand forecast.

5. **Flexibility** of the supply chain includes process and logistics flexibility (April and Garavelli, 2007). Process flexibility refers to the number of product types produced, and logistics flexibility refers to different logistics strategies applied. Flexibility of the supply chain and the improvement of operations decrease the bullwhip effect caused by undetermined (stochastic) lead time or production capacity (Chopra and Meindl, 2001, Aprile and Garavelli, 2007). Improvement of operations includes (Chopra and Meindl, 2001): decrease in lead time and the quantity of order i.e. decrease stock. Safety stock should be decreased as we move up the supply chain and maximum stock level should be limitied (Buchmeister, 2008). By decreasing the replenishment lead time, uncertainty of demand can be decreased, and this is achieved by increasing manufacturer flexibility and electronic exchange of information (Chopra and Meindl, 2001). A decrease in quantity of goods ordered, decreases demand variance between specific supply chain phases. The main obstacle for this decrease is the transport cost, if the cost is fixed for a vehicle. The solution is to load the vehicles with smaller quantities of products, if they can be transported together. This increases the cost of delivery, but it can be regulated by implementing a technology which simplifies the delivery process. One of the convenient ways for decreasing transport costs is the so called *milk runs,* which means that one vehicle transports a smaller quantity of a product for more retailers. Another way of having smaller orders are incentives for customers when ordering, so that demand is leveled in time (Chopra and Meindl, 2001).

6. **Strategic pricing and stabilization of orders** encourage retailers to order goods in smaller quantities and thus reduce the forward buy. If they are offered a discount on the total amount of goods purchased within a certain longer period, this will reduce the size of orders at shorter intervals. It is possible to completely eliminate promotions and charge every day low prices (*EDLP - Every Day Low Price*), limit the amount of goods that may be ordered or bound the size of promotions offered to retail to the amount sold to the end user.

3. BEHAVIOURAL CAUSES OF THE BULLWHIP EFFECT AND DECRESAING THE EFFECT OF BEHAVIOURAL CAUSES OF THE BULLWHIP EFFECT

The second category of the causes for the bullwhip effect are behavioral causes, which refer to a bounded rationality of the decision maker, particularly on wrong account of feedback and time delays, and can be classified into five groups.

1. The causes of imbalance can be external, such as change in customer demand which is not timely forecasted. However, if the decision makers doubt that their suppliers and customers would make wrong decisions, they may drop the balance strategy to provide stocks for the case of non-optimal behavior of partners. These are internal causes. Uncertainty caused by internal actions of partners in a supply chain can be labeled as **coordination risk** (Croson et al., 2004).

2. If the participants cannot predict how other supply chain partners would act, because they have limited knowledge or insufficient trust in the motives or cognitive abilities of the partners, variance in demand arises (Croson et al., 2004). This is not only the **distrust** that other participants would obey the rules; it is the distrust that they would know how to implement a rule. Lack of trust leads to work doubling. The more important the available information is, the more likely it is that it has not been shared or that it is ignored, because it is not trusted (Chopra and Meindl, 2001).

3. Sterman (1989a) and Croson and Donohue (2006) have shown that the supply chain partners behave as if there are oscillations in demand even when there are none, thus causing the bullwhip effect, which indicates **cognitive limitations** of the participants in causing the bullwhip effect. People find it difficult to simultaneously monitor and reflect on their inventory, inventories in progress, how much has been ordered, what the unmet demand is and how much to order. The way in which the participants are presented with the simulation game can affect their way of thinking. They think more about movement, changes and differences than stock. If the participants' calculations in a way emphasize lead time, for example, the participant takes the time into calculations more often and shows better results (Schaffernicht, 2006). Participants perceive their actions locally and cannot see the impact of their actions on others. Thus, a participant does not learn from their own actions, because the consequences of certain actions are best reflected elsewhere (Chopra and Meindl, 2001).

4. People often order based on the shortage between the target and current stock levels, ignoring the amount they have ordered, which has not yet arrived. If the system is out of balance, rational decision makers will try to restore the system back into balance, but if they apply sub-optimal decision making rules based on inadequate mental models, they can increase the imbalance and get into an infinite loop. Various authors (Sterman 1987, Kampmann, 1992, Diehl and Sterman, 1995, Croson and Donohue, 2006) showed that even when all participants know what the optimal ordering policy is and when demand is constant and known to all, still the majority of participants **underweight the supply line**. This proves that the bullwhip effect is partly a behavioral phenomenon. Participants react to the current local situation, before identifying the problem model for the whole chain (Chopra and Meindl, 2001).

5. Some **personality traits** may influence the decision-making process. Ruel at all. (2006) examined the extent to which risk taking, ambiguity, self-efficiency and locus of control may influence decision-making and performance. Self-efficiency can be described as a person's belief in their ability to perform a task. Locus of control is a tendency of people to attribute the causes of their behavior either to themselves (internal) or to environmental factors (external). People with an internal locus of control believe that they can control their results, and people with external locus find that their results are a product of circumstances that are beyond their power. People who are prone to risk have higher backorder costs than those who are moderately or highly prone to risk. The authors believe that such persons are cautious when placing orders, and it happens that they have insufficient stock. Only the manufacturers had positive stocks, but they also had a lower level of stock than manufacturers who are more prone to risk. Retailers who are less prone to risk place larger orders on average when compared to people who are more prone to risk on the same position. It is highly probable that people, who are less prone to risk, react more slowly to changes in demand, but when they respond, they place larger orders. As a result of this behavior, retailers who are not prone to risk cause a greater bullwhip effect and incur higher costs. In contrast, wholesalers, distributors and manufacturers who are not prone to risk and behave the same way, cause a smaller bullwhip effect and have lower costs, because in these positions it is better to react more slowly to changes in demand. People who perceive themselves as less efficient, have higher costs due to lack in stocks, but lower storage costs in comparison to the people who see themselves as more efficient. People prone to risk react more quickly, which proved to be good in the position of a retailer, but bad in other positions. People who prefer unambiguous situations have higher costs due to shortage in stocks, probably because people who like ambiguity feel better in ambiguous situations. The level of

orders is higher as people are less inclined to ambiguous situations. People who have an external locus of control were making larger storage costs and placed larger orders. Participants blame each other for the variability of demand (Chopra and Meindl, 2001). Nienhaus et al. (2006) and Nienhaus (2002) have identified two extreme types of behavior called “safe harbor” and “panic”. “Safe harbor” means that people order more than they need to ensure the level of safety stock. This increases their stock, but forces their suppliers to either increase their orders or to pay for unmet demand. “Panic” means that a participant just forwards the orders placed, and empties their warehouse at the beginning. Initially, it does not affect other participants, but if the end-user demand increases, a participant behaving this way must order more than a participant with safety stocks would. This is when this strategy is having the same negative effect as the previous one. The authors have showed that the optimal value is attainable only if a player is a computer. The more people participate in the simulation, i.e. as more people take part, rather than a computer, the result is worse. If a player chooses the “panic” strategy, they pay high penalty, and if the strategy “safe harbor” is played, they pay high storage costs (Nienhaus, 2006).

Decreasing the Influence of Behavioral Causes of the Bullwhip Effect

Croson and Donohue (2006) showed that, after the common knowledge and trust that everyone will make optimal decisions has been established, providing additional stocks does not eliminate the risk of coordination, but reduces order oscillations that could occur due to internal risk of wrong decision making. Therefore, the authors introduce the concept of coordination stocks. Unlike safety stock, which protect against external uncertainty, coordination stocks provide protection from non-optimal decisions of the participants in the chain. In addition, to overcome the coordination risk, a common knowledge about optimal orders should be created, to reduce the effects of suboptimal activities (Croson et al., 2004).

Long-term relations between the participants in a supply chain change the supply chain performance (Chen et al., 2012). Belavina and Girotra (2001) showed that in the case of one-off sales, a centralized supply chain generates higher gross profit, and individual participants generate higher profits in a centralized supply chain. If the sale is repeated, as long as the participants behave in the agreed manner, balance is maintained. If a participant disturbs the balance by deviating from planned actions, other participants also deviate, i.e. take punitive action, as they have strategic memory which influences decisions in subsequent periods if the sales repeat (Belavina and Girotra, 2001). If the sale is repeated, a decentralized supply chain generates higher profit than a centralized.

All of these actions are much more successful if there is trust and strategic partnerships within the supply chain. This ensures more successful information sharing and the reduction of prices between phases of the supply chain. Successful cooperation is beneficial when executing a specific task around which partners work together, but also improves the quality of the relationship between the partners. The highest value of better relations between a supplier and its customer is a satisfied end user. The basic purpose of cooperation between the participants in a supply chain is the reduction of costs and the possibility to give the customer a better offer, so that supply chains compete, rather than companies within a supply chain. Collaboration means that two or more companies share responsibility for the exchange of mutual information on planning, management, execution and performance measurement. There are two types of collaboration in a supply chain (Barratt, 2004 in Van de Vijver, 2009): vertical, between different levels of a supply chain and horizontal, between participants on the same level, but from a different supply chain. The elements necessary for successful collaboration are (Barratt, 2004 in Van de Vijver, 2009):

- Trust – reliance on an exchange with a partner who we trust
- Mutuality – mutual benefit and risk sharing
- Information sharing – transparency and quality of information flows
- Communication and understanding – clear lines of communication
- Openness and honesty – results in high level of trust, respect and devotion.

A research conducted by Mentzer, in Poirier (2002) identified enablers, impediments and benefits from collaboration in supply chains. Enablers are:

- Common interest and clear expectations – All participants should take part in the results of collaboration in order to achieve long-term cooperation. Everyone should have a clear understanding of what is expected from them.
- Openness and trust – For a partnership to be functional, all participants should speak openly about their practices. This sometimes means sharing confidential information and it is necessary for the partners to be responsible and ethical.
- Acknowledging who and what is important – The participants and activates that bring most benefit should be selected.
- Leadership – A leader who supports collaboration is essential.

- Cooperation, non-punishment – When things do not go as planned, punitive actions sometimes help, but an appropriate approach for good cooperation is collaborative problem solving.
- Benefit sharing – Partners should share both benefit and damage.

Impediments, i.e. obstacles to collaboration and their consequences are (Van de Vijver, 2009):
- Lack of mutual commitment – partners are not motivated to cooperate with each other
- Unclear roles and responsibilities – partners are dissatisfied with relations, because they feel the other partner is not meeting the responsibilities
- Insufficient information on the added value of collaboration – partners are insufficiently interested in collaboration
- Opportunistic behavior of partners – partners lose trust.

Based on the experiences of 20 professionals in managing supply chains from various sectors and industries, Quinn (2000) concludes that collaboration in supply chains can bring benefits if the enablers are in the right place and if the impediments can be overcome. Enablers have more to do with the style of management and interpersonal relationships, than with technology. Collaboration is a process which evolves through three stages (Lapid et al. 2002):
- Initial level of collaboration, where chain members exchange information to complete day-to-day transactions
- Cooperative collaboration, where chain members have simultaneous access to information needed
- Cognitive collaboration, where chain members share information to collaboratively increase the level of knowledge and make decisions - “win-win” partnership.

Relations within a supply chain can be based on either power or trust. If the relations are based on power, in the long term it leads to increased profits of one participant at the expense of others, and others are seeking alternative ways to survive. If the balance is once disturbed, unjust division may be detrimental to the company. The more powerful party has greater control and the ability to profit at the expense of the weak. Relations should be beneficial for both parties. The stronger party must accept its responsibility for partner profitability. Relationships based on trust imply that every participant is interested in the welfare of others and that they will not act without taking into account the impact of their actions on others. Trust can be based on retention or built through various formal contracts, or based on a process where trust is built over time as a result of long-term cooperation between two or more groups. It is most common to start with the trust based on a contract, which then evolves into process trust.

The ways companies can have a positive influence on the development of partnerships are (Van de Vijver (2009): transparency with the aim of avoiding suspicion, teams whose members are from two/more companies working in the same office on solving a common problem, defining the common key performance indicators, face to face meetings.

Chopra and Meindl (2001) propose the following activities for successful coordination:
- Measuring the bullwhip effect
- Devotion to coordination on the part of top management
- Allocation of resources to coordination
- Focus on communication with other phases
- Tendency to achieve coordination in the whole supply chain
- Use of technology for improving connections and communication within the chain
- Division of benefit from just coordination

As for interpersonal aspects of collaboration, three aspects are mainly discussed: 1. the influence of emotions (Andersen and Kumar, 2006, Hutt et al., 2000, Bagozzi 2006), 2. the role of trust (Jap and Anderson, 2003, 2005, Jeffries and Reed, 2000) and 3. the importance of maintaining relationships (Welling and Kamann, 2001, Ulaga, 2003). Interpersonal trust has the most positive effect when opportunism is low. However, if the inclination to opportunism is high, confidence can be harmful and show its “dark side” and even induce opportunistic behavior on one side. One of the ways of increasing trust and improving relationships is socialization, which represents “interactions and communication between participants and between organizations, whose aim is to build rapport and improve communication and problem solving”. It was found that there was a significant positive impact of socialization on supply chain performance; however, if there is a previous bad experience with partners, socialization does not give expected results (Van de Vijver, 2009).

4. CONCLUSION

The paper gives an overview of the causes of the bullwhip effect, both operational and behavioral, as well as modes of overcoming them. Although the authors agree that the bullwhip effect is to some extent a behavioral phenomenon, behavioral causes are rarely investigated. Therefore, further research could take this course. Since supply chain management and the reduction of the bullwhip effect emphasize the importance of cooperation, further research could examine the impact of cooperation between participants in a supply chain on the bullwhip effect.

REFERENCES

Ameera Aly Ismail (2007). A Simulation Model to Investigate Critical Factors Influencing the Bullwhip Effect in a Supply Chain, Faculty of Management and Information Systems, The French University in Egypt, Retrieved from http://oro.univ-nantes.fr/sujets-09-10/aly.pdf

Anderson, E., Jap, S. D., (2005). The dark side of close relationships, MIT Sloan Management Review, 46(3), 75-82

Andersen, P. H., Kumar, R., (2006). Emotions, trust and relationship development in business relationships: A conceptual model for buyer-seller dyads, Industrial Marketing Management, 35 (4), 522-535.

Ayers, J.B. (2006). Handbook of Supply Chain Management, (2nd ed.) Taylor & Francis Group, Boca Raton, USA.

Bagozzi, R.P. (2006). The role of social and self-conscious emotions in the regulation of business-tobusiness relationships in salesperson-customer interactions, Journal of Business & Industrial Marketing, 21 (7), 453-457.

Bandura, A., (1977). Self-efficacy: Towards a unifying theory of behavioural change, Psychological Review, 84, 191-215.

Blanchard, D., (2010). Supply Chain Management Best Practices, John Wiley & Sons, Inc., Hoboken, New Jersey.

Baiman, S., Fischer, P.E., Rajan, M.V., (2001). Performance measurement and design in supply chains, Belavina E., Girotra K., The Benefits of Decentralized Decision-Making in Supply Chains, Management Science, 47(1),173-188

Bourland, K., Powell, S., Pyke, D., (1996). Exploring timely demand information to reduce inventories, European Journal of Operation Research, 92, 239-253.

Buchmeister, B., (2008, January). Investigation of the bullwhip effect using spreadsheet simulation, International Journal Of Simulation Modelling, 7(1), 29-41.

Buchmeister, B., Pavlinjek, J., Palcic, I., Polajnar, A., (2008). Bullwhip effect problem in supply chains. Advances in Production Engineering and Management, 3(1), 45-55.

Cachon, G.P., Zipkin, P.H., (1999). Competitive and cooperative inventory policies in a two-stage supply chain, Management Science, 45(7), 936-853

Carlsson, C. and Fuller, R. (2002). A fuzzy approach to taming the bullwhip effect. In Advances in Computational Intelligence and Learning: Methods and Applications, Deventer, The Netherlands, The Netherlands. Kluwer, B.V., 247-262.

Chen, F., Drezner, Z., Ryan, J., Simchi-Levi, D. (2000). Quantifying the Bullwhip Effect in a Simple Supply Chain: The Impact of Forecasting, Lead Times, and Information. Management Science, 46(3), 436-443.

Chen, L., Gilbert, S., Xu, X., (2012). The role of revenue-focused managerial performance in supply chain coordination, Production and Operations Management.

Chopra, S, Meindl, P., (2001). Supply Chain Management: Strategy, Planning, and operation, Prentice Hall, Upper Saddle River, New Jersey

Croson, R.T.A., Donohue, K.L., Katok, E., Sterman, J., (October 2004).Order Stability in Supply Chains: Coordination Risk and the Role of Coordination Stock, MIT Sloan Working Paper 4513-04. Retrieved from http://www.utdallas.edu/~emk120030/Order_Stability_0719.pdf

Croson, R., Donohue, L., (2006, March). Behavioral Causes of the Bullwhip Effect and the Observed Value of Inventory Information, Management science, Vol. 52, No. 3, 323-336, DOI 10.1287/mnsc.l050.0436

Diehl, E., Sterman, J.D., (1995). Effects of Feedback Complexity on Dynamic Decision Making. Organizational Behavior and Human Decision Processes 62 (2), 198-215.

Forrester, J. (1958, July - August). Industrial dynamics, a major breakthrough for decision makers. Harvard Business Review, 36, 37 -66.

Forrester, J. (1961). Industrial Dynamics, MIT Press, Cambridge MA.

Gangopadhyay, A., Huang, Z. (2004). Studying the Value of Information Sharing in E-Business Supply Chain Management, Journal of International Technology and Information Management, 2004 13(1), 49-60

Goodwin, J., Franklin, S. (1994). The beer distribution game: using simulation to teach systems thinking, Journal of Management Development, 13(8), 7-15.

Hutt, M. D., Stafford, E. R., Walker, B. A., Reingen, P. H., (2000). Defining the social network of a strategic alliance, Sloan Management Review, 41 (2), 51-62
Jap, S. D., Anderson, E., (2003). Safeguarding interorganizational performance and continuity under ex post opportunism, Management Science, 49 (12), 1684-1701.
Jeffries, F. L., Reed, R., (2000). Trust and adaptation in relational contracting, Academy of Management Review, 25 (4), 873-882.
Jovanović, B., Vasiljević, D., (2008). Kolaboracija u lancu snabdevanja, VI Skup privrednika i naučnika SPIN 2008, Operacioni menadžment i evropske integracije, Zbornik radova, Centar za operacioni menadžment, FON i Privredna komora Srbije, Beograd, 252-256.
Kampmann, C.E., (1992). Feedback Complexity and Market Adjustment: An Experimental Approach, PhD Dissertation, Sloan School of Management, MIT, Cambridge, MA.
Lapide, L., Derome, J., Radjou, N., (2002, April). Analysts' panel discussion, Supply Chain World North America : Extending Collaboration to End-to-End Synchronization in: Ayers, J.B. (2006), Handbook of Supply Chain Management (2nd ed.) Taylor &Francis Group, Boca Raton, USA, 96.
Lee, H., Padmanabhan, V., Whang, S. (1997a). Information Distortion in a Supply Chain: The Bullwhip Effect. Management Science, 43(4), 546-558.
Lee, H., Padmanabhan, V., Whang, S., (1997b). The bullwhip effect in supply chains, Sloan Management Review, 38(3),93-103.
Lee. H.L., Whang, S., (2000). Information sharing in a supply chain. International Journal of Manufacturing Technology and Management 20(3/4), 373–387.
Li J., Sikora R., Shaw, M.J., Woo Tan, G., (2006). A strategic analysis of inter organizational information sharing, Decision Support Systems 42(1), 251–266.
Nienhaus, J., (2002, October). What is the Bullwhip Effect caused by?, Study based on the Beer distribution Game online, Supply Chain World Europe 2002, Amsterdam, 28-30
Nienhaus, J., Ziegenbein, A., Schoensleben, P., (2006). How human behaviour amplifies the bullwhip effect, A study based on the beer distribution game online, Production Planning and Control, 17(6),547 - 557.
Poirier, C., (2002). The Supply Chain Manager's Problem-Solver: Maximizing the Value of Collaboration and Technology, St. Lucie Pres, A CRC Press Company, Boca Raton London New York Washington, D.C.
Quinn, F., (2000). Collaboration: More than Just Technology, The Aspect Project, Accenture Publication, New York, 222–223.
Renko S., Vertical Collaboration in the Supply Chain Faculty of Economics & Business, University of Zagreb, Croatia DOSTUPNO U SUPPLY CHAIN MANAGEMENT - NEW PERSPECTIVES, Edited by Sanda Renko
Rotter, J.B., (1990). Iinternal versus external control of reinforcement: A case history of a variable, American Psychologist, 45, 489-493
Ruël, G., van Donk, D.P., van der Vaart, T., (2006, June). The Beer Game Revisited: Relating Risk-Taking Behaviour And Bullwhip Effect, Proceedings of the 13th International EurOMA Conference, Glasgow, Scotland, 1, 403-412, Retrieved from http://www.bdk.rug.nl/organisatie/clusters/PSD/pdf/Euroma2006RuelDonkVaart.pdf
Simchi-Levi D., Kaminsky, P., Simchi-Levi, E., (2000). Designing and managing the supply chain: concepts, strategies, and case studies, Boston: Irwin/McGraw-Hill.
Schaffernicht, M., (2006). Modifying the Beer Game to make its dynamic structure more salient, Proceedings of the 24th International Conference of the System Dynamics Society
Sterman, J.D., (1987). Testing Behavioral Simulation Models by Direct Experiment. Management Science 33 (12), 1572-1592.
Sterman, J. (1989). Modelling managerial behaviour: Misperceptions of feedback in a dynamic decision making experiment, Management Science, 35(3), 321 -339.
Ulaga, W., (2003). Capturing value creation in business relationships: A customer perspective, Industrial Marketing Management, 32 (8), 677-693.
Van De Vijver, M., (2009). Collaboration in Buyer-Supplier Relationships, Phd Thesis, Retrieved from http://arno.uvt.nl/show.cgi?fid=90480
Vujošević, M., Panić, B., (2004, April). "Efekat biča i metode koordinacije u lancima snabdevanja", E-trgovina 2004 International e-business conference, CD, http://events.e-trgovina.co.yu/2004/index.html
Vujošević, M., (2004, September). "Kooperacija i koordinacija kao uslov uspešnosti lanaca snbabdevanja", XI naučni skup Tehnologija, kultura i razvoj, Palić, 110-19.
Welling, D. T., Kamann, D.J. F., (2001). Vertical cooperation in the construction industry: Size does matter, Journal of Supply Chain Management, 37 (4), 28-33.
Wu, D., Katok, E., (2006, December). Learning, Communication and the Bullwhip Effect, Journal of Operations Management, 24(6), 839–850

MAINTENANCE MANAGEMENT MODELS – A COMPARATIVE ANALYSIS

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Abstract: *This article deals with three concepts of maintenance management: (i) Total Productive Maintenance (TPM), (ii) Reliability Centered Maintenance (RCM) and (iii) Life Cycle Cost (LCC). The article is based on the works of prominent and distinguished authors in the field of maintenance concepts. The purpose of the article is to compare these concepts: their goals, methods they are based on, system reliability, system failure, their costs, advantages and disadvantages and other characteristics. The original result achieved through this analysis is a systematic representation of the three concepts with their main advantages and disadvantages, which should be useful to maintenance managers and anyone who is engaged in maintenance management.*

Keywords*: Total Productive Maintenance, Reliability Centered Maintenance, Life Cycle Cost, advantages, disadvantages, criteria*

1. INTRODUCTION

Subject of this work are management models, total productive maintenance, reliability centered maintenance and terotechnology (product economic lifecycle) and their analysis.

The goal of the research is a comparative analysis of management models with the aim of determining advantages and shortcomings of each model, as well as possibilities of their integration to achieve maximal performances of technical systems.

In the second chapter of this paper the theoretical background is given. An overview of the chosen models is given in third, fourth and fifth chapter, while the sixth chapter, named Comparative analysis, shows tabular review of the mentioned models comparison. This chapter considers resemblances and differences between the models and potential for their integration in order to attain minimal maintenance costs. In the final, seventh chapter the authors' conclusion and suggestion about further analysis are given.

2. THEORETICAL BACKGROUND

Literature shows that manufacturing organizations worldwide are faced with numerous challenges in trying to operate successfully in today's competitive environment. Modern production requires organizations to have effective and efficient maintenance in order to be successful.

During the past two decades, manufacturing organizations used different approaches in order to improve maintenance effectiveness as said in Roup, J. (1999), (p. 5-32). One approach for improvement of maintenance activities is implementation and development of Total Productive Maintenance (hereinafter: TPM) strategies. Moore, R. (1997), (p.88-90) said that implementation of TPM enables organizations to substantially transform their factories by integration of culture, process and technology, .

TPM concept originated from the Japanese production industry (adopted in Japan in 1951). It was initially aimed at elimination of production loss due to limitations in JIT (*just in time*) process in production. Seiichi Nakajima, the vice president of Japanese Institute of Plant Engineering, promoted TPM in Japan and became known as the father of TPM. Contemporary equipment management was started by preventive maintenance and developed into productive maintenance. TPM is based on teamwork and inclusion of all levels and functions in an organization, from the top management to the manufacturing workers.

Numerous researchers emphasized the importance of TPM implementation, both in production environment Ahmed, S., Hassan, M.H. & Taha, Z. (2005) and Ahuja, I.P.S. & Khamba, J.S. (2007), and service sector Patra, N.K., Tripathy, J.K. & Choudhary, B.K. (2005) and Pramod, V.R., Devadasan, S.R., Muthu, S., Jagathyraj, V.P. & Moorthy, G.D. (2006). TPM is considered to be a Japanese response to American approach to Preventive maintenance as it said in Wal, R.W.E. & Lynn, D. (2002). It is widely recognized as a strategic tool for improvement of production performances by boosting effectiveness of production plants Dwyer, J. (1999) and Dossenbach, T. (2006) and it was accepted as the most perspective strategy for maintenance improvement, aimed to achieve success at high-demanding market in Nakajima, S. (1988). It is a proven production strategy, which has been successfully applied worldwide in the past three decades for

reaching organizational goals related to achievement of essential competence in competitive environment like it was discussed in Ahuja, I.P.S., Singh, T.P., Sushil, M. & Wadood, A. (2004) (p. 422-426)

Problems with Reliability Centered Maintenance have been studied for a long time by numerous scientists and experts in this field. Best known works regarding reliability centered maintenance are: Heap, F. H., & Nowlan, F. S. (1978) and Moubray, J. (1997) and there is also a large number of works dealing with this issue. All these works are more focused on maintenance than reliability. Prominent author Smith, A. M. (1993) said: "(…) How to introduce RCM model depends on experience of owner and employees."

Back in December 1978, Heap, F. H., & Nowlan, F. S. (1978), have published the report "Reliability Centered Maintenance". The report was the result of a multi-annual work aimed at finding a new, cost-effective model for maintenance of complex systems. It was named Reliability Centered Maintenance (RCM) because it was focused on safety and reliability of equipment and minimization of costs. Until then, managers usually practiced repair of all machines as a way to prevent failures. Gradual development of RCM model in American aviation industry has lead to the application of this approach in other industries. If proper tools and procedures are applied, RCM model is simple to apply and reduces the costs and risks in a system.

According to Gibbons, P., & Friis, J. (2013) RCM is: "Approach using reactive, proactive and preventive maintenance and strategies in integrated manner, in order to increase probability that machine or component will operate in demanded mode during its overall economic life, with minimal maintenance. In Technical Manual (2006) (p. 4), it is written that savings after introduction of RCM model at annual level are between 30 and 50%.

The Oxford Dictionary Oxford Dictionary website – 2013 defines ***terotechnology*** as "the branch of technology and engineering concerned with the installation and maintenance of equipment" (downloaded from The Oxford Dictionary website, 2013). However, this definition does not explain the essence of the term – there are other concepts concerned with sustainability (such as RCM and TPM), while terotechnology is just one of them. The main idea behind terotechnology is that the domain of sustainability management should not only include the period of system technological use, but also the whole system life cycle. In other words, as defined by the British Standard BS:3811, terotechnology is "A combination of management, financial, engineering, building and other practices applied to physical assets in pursuit of economic life-cycle costs." (downloaded from the website www.plaint-maintenance.com, 2013).

The term *terotechnology* first appeared in 1971 when the *Supplement to Radio and Electronic Engineer* published the article "Terotechnology – A New Approach to An Old Problem*"* by professor Leonard Atkinson*.* Atkinson claimed that sustainability system, which was in use at that time, is set up too narrowly and that a lot of savings could be achieved by taking into account the system life cycle cost (downloaded from the IeeeXplore website, 2013).

Today, the term *terotechnology* is mainly obsolete, and replaced with the term *life cycle cost (LCC)*. Therefore, the term *life cycle costs* will be used in this article, along with the references concerning the LCC analysis. It is important however, to stress that LCC approach as known today, in addition to its implementation in the field of sustainability management, could also be used in project management, product analysis and other areas. Ralph Horne, Tim Grant and Karl Verghese (2009) in their book "*Life Cycle Assessment: Principles, practice and Prospects"*, claim that the LCC concept is created with a new generation of energy technologies in the post-World War 2 era. As more complex nuclear technologies were developed, more researches were conducted in order to answer questions such as whether a given nuclear technology produced more energy than it consumed as well as analyses of uranium mining, waste management, and transportation impact. Further, such researchers followed to development, marketing and service management sectors, i.e. to all LCC costs related to nuclear power plant"s management and usage. In time, this approach started to be applied in other fields, such as maintenance management. (p.2)

3. TOTAL PRODUCTIVE MAINTENANCE

As it was noted in Suzuki, T. (1994) Total productive maintenance can be regarded as a machine medicine. It is a maintenance program which includes a new definition of the concept for plants and equipment maintenance. The goal of this program, particularly emphasizing maintenance, is to significantly increase production and simultaneously raise employees moral and job satisfaction and to reduce urgent and unscheduled maintenance to the minimum.

Japan Institute of Plant Maintenance defines TPM as:

- T = Total – Inclusion of all employees at each level of organization
- P= Productive – Efficient use of all resources
- M = Maintenance – Maintenance of Staff/Machines/Materials in optimal condition

TPM is an innovative Japanese maintenance concept. Its roots go back to 1951 when preventive maintenance concept, accepted from USA, was introduced for the first time in Japan. *Nippondenso* was the first company introducing preventive maintenance in 1960. Combination of Preventive Maintenance concept, Prevention of Maintenance concept and Improving Maintenance concept resulted in Productive maintenance concept as it was stated in Venkatesh, J. (2007). The goal of productive maintenance was maximal effectiveness of plants and equipment:

1. Achieve minimum 90% OEE (Overall Equipment Effectiveness);
2. Machine should work during breaks as well (Breaks are for staff, not for machines);
3. Run business with no complaints of consumers;
4. Reduce production expenses by 30%;
5. Achieve 100% success in goods delivery in accordance with buyers" demands;
6. Keep working environment safe;
7. Increase by three times employees suggestions for improvements and in this way develop multi-skilled and flexible workers.

The main system of measurement connected to TPM is Overall Equipment Effectiveness (OEE) which was originally developed in Japan in the 70"s as a system for determining production effectiveness. It includes three basic indicators of equipment performances and reliability like it was said in Gupta, A.K., & Dr. Garg, R.K., (2012), (p.1-2). Hence, OEE is function of three following factors:

1. Availability or readiness (deadlocks; scheduled and unscheduled, replacement of tools, service of tools, change of work)
2. Equipment effect ratio (real capacity compared to the incorporated one)
3. Participation of accurate products in overall number of products (malfunctions and reproduction)

TPM reminds of Total Quality Management – TQM concept. Many of tools, such as encouraging employees to take active part in increasing effectiveness process and benchmarking, used in TQM concept are also included in TPM concept.

4. RELIABILITY CENTERED MAINTENANCE

According to Rausand, M., & Vatn, J. (1998), (p.1-26) main goal of RCM model is to provide effective and applicable maintenance, taking into consideration four factors: safety of staff, impact to environment, production capacities of company and material losses (costs). Effective maintenance requires an increase of reliability in order to provide better safety of staff and, in so doing, to ensure better production capacity. By increasing production capacities, costs are reduced, as well as losses due to failures. By applying contemporary methods and appliances in the production process, harmful effects to environment are reduced and reliability of systems is increased. The conclusion is that the main goals are maximal reliability and minimal costs, which contributes to increased safety of staff and productivity.

RCM model determines conditions that must be fulfilled so that a physical device, in its operating context, could continue to work in a way that consumers expect. Smith, A. M. (1993) stated that RCM approach has four key features. Each of these is defined and discussed here.

The most important feature of RCM is maintenance of continual equipment functionality of overall system. The fact is that equipment functionality has to be provided so that overall system could be effective, but RCM approach starts from the desired output, as a primary task. The basic idea is to establish necessary functions for creation of the final product and then provide equipment functionality which performs these functions.

The next feature is based on functionality failure, in other words, loss of system function. It is necessary to study all potential in the state of equipment, in order to determine possible deadlocks and failures. The main goal is to identify possible failures in equipment components, which could potentially endanger system functionality.

The third feature of the RCM approach means defining priorities as a basis for establishing the distribution of resources and budget. Here, the goal is to define which failures have more importance and, according to defined priorities, to remedy them. Distribution of priorities is based on „"decision tree"" method.

Previously mentioned features help to establish location of failure occurrence, cause of occurrence, as well as priority for taking measures to remedy these failures. The next step (i.e. the fourth feature of RCM) is to apply appropriate methods for failures removal, which must be applicable and effective. The idea is to carry out only applicable methods for failures removal which are the most convenient as well. By doing so, we can prevent removal of failures with minor priority, in order to prevent unnecessary waste of limited resources.

RCM approach combines different models such as preventive, proactive maintenance, „"work until failure"" and uses advantages of each model to provide equipment effectiveness and functionality at lowest costs.

Advantages achieved by application of this approach have already been proved in numerous industries: military industry, aviation, navy, chemical industry, oil industry, small and middle size companies, as well as in hospitals, railroads, ships, wind turbines. According to Smith, A. M. (1993) key advantages are: improvement of system performances, lower maintenance costs, longer economic life of equipment, simple database maintenance, minimization of repairs, risks included in analysis, better staff motivation, teamwork. Shortcomings of this model are mentioned on the website Energy.Gov (2013) and they are: high costs for staff training and teaching, as well as longer necessary time frame to achieve results through return of investments.

From the text above it can be concluded that RCM approach has four basic tasks:

- Machine maintenance
- Indentifying possible causes of machine failures
- Lowering costs
- Extending the life cycle of machines

5. LIFE CYCLE COST

The core idea of the LCC approach is usually presented with the famous “tip of the iceberg” metaphor. When a company purchases expensive installations and systems, it is a big mistake to take into account only acquisition costs. They are the *tip of the iceberg*. In the effort to minimize costs, a company often focuses on activities that will reduce its short-term costs, which could have a very negative effect on its long-term costs. Therefore, when a company considers the acquisition of some equipment, it should also take into account the labor costs, operating costs, scheduled maintenance costs, unscheduled maintenance costs and conversion/decommission costs. Paul Barringer (2007) in his article *Life Cycle Cost & Reliability for Process Equipment* state that these are the key elements of the LCC structure which should be assessed prior to purchase of equipment, as well as for product pricing calculation (p.6).

The object of LCC analysis is to choose the most cost-effective approach from a number of alternatives so that the least long term cost of ownership is achieved. LCC analysis helps engineers to justify equipment and process selection based on total costs, rather than making decision on the initial equipment/services purchase price only. Furthermore, the LCC could be used for the system effectiveness calculation. System effectiveness is derived from the relationship between LCC and technical effectiveness. This relationship can also be used as a benchmark, i.e. as a basis for the two systems comparison. This is also a statement claimed by Paul Barringer (2008) in his article *Life Cycle Cost And Good Practices* (p.7).

Christer Idhammar, Reliability and Maintenance Management Consultant and Vice President of IDCON said that the concept of Life Cycle Cost is not properly practiced in many organizations because management is often focused on short-term cost reductions instead on what drives the cost. He gives two main examples to illustrate the importance of understanding the total amount of costs in a company. One example is about a preventive maintenance program. A good preventive maintenance program reduces final costs, but it costs money to be implemented in mid-term. Although some effects could be seen after a year, significant results emerge only after three to five years. Due to staff turnover, it often happens that the management team that carried out LCC implementation left the company and could not claim the results. Selection of equipment based on Life Cycle Cost is another example. The proper equipment might cost more, but cost of ownership is lower. Therefore, understanding the whole picture, in the process of equipment or system acquisition is the key issue of the LCC approach (downloaded from the website www.idcon.com, 2013).

6. COMPARATIVE ANALYSIS

One of the essential criteria in comparison of these three models is their focus, i.e. a particular field affected by the models to achieve their goal. These criteria make substantial difference between the three models. It is also significant to point out the origin of each model in order to make it easier to understand the concepts they are based on. The approach to employees is one of the criteria giving insight into the models and it shows that they are applied in organizations in approximately the same manner, which suggests the possibility of combining them to achieve the desired objective. The comparative analysis can be seen in Table 1 shown below. The table and the comparative analysis is the result of the work of the authors.

Basically, TPM approach is more focused on management, while RCM approach is more focused on engineering. LCC approach implies use of accounting methods and exercising different analyses to determine various costs, their bearers and position of costs. It would be wrong to say that these three approaches are not compatible, bearing in mind that they achieve the same goals in different manners.

Table 1: Comparative analysis

Criteria	Total productive maintenance	Reliability centered maintenance	Economic Life cycles costs
Origin	Japan-car factory	USA-military aircraft industry	USA and Great Britain – nuclear technology and aircraft industry
Focus	Equipment (system input and causes of failure occurrence)	Reliability of system and equipment	Reduction of overall costs of economic life cycle of equipment
Applicability	Car industry, microelectronics, movies, plastic, administration	Military industry, energetic, aviation, nuclear plants, wind turbines, small and middle size companies	Energetics, nuclear plants, aviation, big companies and supply chains
Costs	Reduced (30-50%)	Reduced (30-50%)	Reduced up to 80-90%
System reliability	Increased (10-250%)	Increased (40-70%)	/
Failure occurrence	Reduced	Reduced	Reduced
Methods based	Preventive, productive, improvement of maintenance, prevention of maintenance	Preventive, proactive, conditions centered maintenance, „work until failure“	Preventive, proactive maintenance, accounting methods of costs conversion and , statistical methods of risk estimation and probability related to certain costs, long-term approach
Goals	-Increase OEE to 90% -Consumer's satisfaction -Reduction of production costs for 30% -Safe working environment	-Safety of staff -Reduced impact to environment -Increase of production capacities -Costs reduction	-Reduction of overall costs of system or equipment economic life cycle -Calculation of price for customer -Support in making decisions (selection among more equipment alternatives considering all costs)
Advantages	-Increase of equipment and machine effectiveness -Increase of production quality -Reduction of losses when production starts -Reduction of maintenance time and costs	-Increase of performances -Increase of staff and system safety -Lower costs -Longer economic life of equipment -Minimization of repairs -Motivated staff and team work	Minimization of overall equipment economic life cycle costs by long-term and comprehensive approach and analysis of all costs
Shortcomings	-High cost for staff training who to deal with equipment maintenance	- High costs for staff training and teaching and equipment - Potential savings are not easy to achieve	-Effects of application are noticeable after 3-5 years the least -It requires collection and processing of large number of information from different company departments - It requires close cooperation and team work of the employees from different company

			departments, which might be difficult to achieve - Inconsistency in information processing and application of different accounting methods in different fields make results invalid
Approach to employees	-Staff practise self-maintenance -Inclusion of all employees -Staff development -Inclusion of top management in early stage -Circles of employees	-Expert team for introduction of RCM model -Introducing model to all employees -Association of employees from different departments	LCC approach requires team work and cooperation of employees from different departments in order to collect all necessary information about overall costs

In a technical system it is necessary to establish priorities on what is the first to be repaired or improved. It could be the purity of a system, inclusion of employees, preventive maintenance or environment issues. When every problem of one system is defined and when priorities are assigned, there is decision to be made regarding the maintenance type to be applied, with the possibility of combining RCM and TPM model. According to Moore, R. (1997) (p.88-90) RCM approach is based on establishing standards of preventive maintenance, and TPM approach carries out further improvement within the overall system. This is so called integrated system, aiming to take the best of each model in accordance with the company"s goals. There is no conflict as long as powers of TPM approach supplement weaknesses of RCM approach and vice versa.

LCC approach enables consideration of the bigger picture. Each maintenance concept used in some system implies certain costs and resources, necessary for its application. LCC approach puts the scheduler in a position to assess costs of each maintenance model. Costs of maintenance models determined in this manner constitute the basis for their comparison. It is significant to mention that during comparison of different models only their distinguishing aspects are taken in consideration.

As a conclusion of this comparative analysis arises the viewpoint that TPM and RCM concepts could and should be combined, while LCC approach presents a tool for their costs comparison and independent method providing complete consideration of different systems.

7. CONCLUSION

The present work arrives at the conclusion that total productive maintenance is an approach that is primarily based on inclusion of all employees into the maintenance process, thus accomplishing minimum costs and optimal engagement of each individual in a company. As for reliability centered maintenance, it can be concluded that it is primarily a preventive model, aimed at improving the reliability of the overall technical system, through maintenance of critical components. By so doing, maintenance costs are reduced and economic life of equipment is extended, which leads to the increase of functionality and productivity of the overall system. The essence of the third model, LCC, is to provide significant support in decision making. It"s vital feature and main advantage is in providing consideration of the bigger picture, in terms of time and value. Each of these models has its advantages and shortcomings and different approaches in the maintenance process. However, the possible conclusion is that the main goal of these models is minimization of costs in a technical system. According to the accomplished analysis, we can conclude that these models are mutually compatible, capable of being successfully combined within one technical system, in order to achieve minimal costs and maximal productivity.

8. REFERENCES

Ahuja, I.P.S., Singh, T.P., Sushil, M. & Wadood, A. (2004). Total productive maintenance implementation at Tata Steel for achieving core competitiveness, Journal of Manufacturing Technology Management, 45(3), 422-426.

Ahmed, S., Hassan, M.H. & Taha, Z. (2005). TPM can go beyond maintenance: excerpt from a case implementation, Journal of Quality in Maintenance Engineering, 11(1), 19-42.

Ahuja, I.P.S. & Khamba, J.S. (2007). An evaluation of TPM implementation in an Indian manufacturing enterprise", Journal of Quality in Maintenance Engineering, 13(4), 338-352.

Barringer Paul, P.E., (2007). Life Cycle Cost & Reliability for Process Equipment. Paper presented at the 8th Annual ENERGY WEEK Conference & Exhibition.

Barringer Paul, P.E., (2008). Life Cycle Cost And Good Practices. Paper presented at the NPRA Maintenance Conference.

Dossenbach, T. (2006). Implementing total productive maintenance, Wood and Wood Products, Journal of Quality in Maintenance Engineering 111(2), 29-32.

Dwyer, J. (1999). More than a maintenance technique, Works Management, 52(9), 15-16.

Energy.Gov (2013). Reliability Centered Maintenance. Retrieved from http://energy.gov/eere/femp/reliability-centered-maintenance

Farr, J.V. (2009). System Life Cycle Costing: Economic Analysis, Estimation and Management, (3rd ed.). Boca Raton Taylor & Francis, 1-6.

Gupta, A.K., & Dr. Garg, R.K., (2012). OEE Improvement by TPM Implementation: A Case Study, International Journal of IT, Engineering and Applied Sciences Research (IJIEASR), 1(1), 1-2.

Heap, F. H., & Nowlan, F. S. (1978). Reliability Centered Maintenance. *United Airlines and Dolby Press.*

Glossaryy

Horn. R., Grant, T. & Vergese, K. (2009). Life Cycle Assessment: Principles, practice and Prospects, (3rd ed.). Collingwood, Vic. : CSIRO Pub.

IDCON (2013). Retrieved from http://www.idcon.com/resource-library/articles/maintenance-and-design-for-reliability/493-life-cycle-cost.html

IeeeXplore. (2013). Terotehnology: A new aproach to an old problem. Retrieved from http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=5268645&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F5266378%2F5268644%2F05268645.pdf%3Farnumber%3D5268645

Igbaa, J., Kazem A., Anyanwu-Ebob, I., Gibbonsa P.,Friisb J. (2013). A Systems Approach towards Reliability-Centered Maintenance (RCM) of Wind Turbines, Paper presented at the Conference on Systems Engineering Research.

Moubray, J. (April 1997). Reliability-Centered Maintenance, (2nd ed.). New York : Industrial Press.

Moore, R. (1997). Combining TPM and reliability-focused maintenance, Plant Engineering, 51(6), 88-90.

Nakajima, S. (1988). Introduction to Total Productive Maintenance (2nd ed.). Cambridge, Mass. : Productivity Press.

Oxword Dictionaries. (2013). Terotechnology. Retreived from http://www.oxforddictionaries.com/definition/english/terotechnology

Patra, N.K., Tripathy, J.K. & Choudhary, B.K. (2005). Implementing the office total productive maintenance ('office TPM') program: a library case study, Library Review, 54(7), 415-424.

Palival, S., Varshney, A.R., & Awanna, D.S., (2013). Relationship and comparison Between in JIT, TQM and TPM: A Rewiew, International Journal of Mechanical Engineering Research and Development (IJMERD), 3(2), 64-65.

Plaint-maintenance (2013). Retrieved from http://www.barringer1.com/lcc.htm

Pramod, V.R., Devadasan, S.R., Muthu, S., Jagathyraj, V.P. & Moorthy, G.D. (2006). Integrating TPM and QFD for improving quality in maintenance engineering, Journal of Quality in Maintenance Engineering, 12(2), 71-150.

Rausand, M., & Vatn, J. (1998). Reliability Centered Maintenance, Risk and Reliability in Marine Technology, 1-26.

Roup, J. (1999). Moving beyond TPM to total plant reliability: redefining the concept to optimize benefits, Plant Engineering, 53(2), 5-32.

Smith, A. M. (1993). Reliability-centered maintenance. New York: McGraw-Hill

Suzuki, T. (1994). TPM in Process Industries (1st ed.). Portland, Or. : Productivity Press.

Technical Manual, (October 2006). Reliability-Centered Maintenance (RCM) for Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) Facilities, 2-4.

Venkatesh, J. (2007). An Introduction to Total Productive Maintenance, Plant Maintenance Resource Center,1-21.

Wal, R.W.E. & Lynn, D. (2002). Total productive maintenance in a South African pulp and paper company: a case study, The TQM Magazine, 14(6), 359-366.

NOVEL APPROACH TO BUSINESS PROCESS PERFORMANCE MEASUREMENT

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Abstract: *In the literature, as in practice, there are number of models and frameworks that provide guidelines for the performance measurement system development and review performance measurement problems from different perspectives. In the paper, some of the most important performance measurement models are considered, and it is noticed that the majority of models takes into account the strategy or goals while determining performance, most of them don't specify performance indicators, but give an indication for their determination and none of them link directly organizational goals and performance indicators. In other words, none of them specify their interdependence, which would allow model flexibility. Furthermore, the novel approach to business process performance measurement is proposed, which starts from business system goals, decompose them on the lower level objectives and link them to the key processes of business system. Suggested approach allows interconnection between organization's top level goals and key process performance indicators, by using lower level objectives, which enable model flexibility.*

Keywords*: process performance measurement model, objectives, performance indicator, flexibility*

1. INTRODUCTION

Business processes performance measurement has began in the early 20th century, when, among the others, Frank and Lilian Gilbreth formally related performance measures to processes (Towers, 2005, p.10). Although much has changed in the meantime, the business process performance measurement practice of is becoming increasingly important. According to Antonucci at al. (2009, p. 11), it is the performance of the business processes, not the organizational functional units or a set of assets, that has to be manager's central focus in order to gain true benefits of a performance management initiative. Through performance measurement, managers receive the information for defining, improving and managing the key business processes.

Nowadays, there are a number of performance measurement models that include or strongly rely on performance planning, job design, performance measures determination and monitoring, and on the reward system definition (Sikavica and Hernaus, 2011, p.433). Those frameworks assist in this performance measurement system building process by clarifying boundaries, specifying dimensions or views and may also provide initial intuitions into relationships among the performance dimensions (Rouse and Putterill, 2003, p.792).

In the paper, some of the most important performance measurement models are briefly described, as the results of their comparative analysis. After that, a new performance measurement approach is proposed, which overcomes some of the shortcomings of existing models. At the end, some conclusions are drawn, and direction of future research is proposed.

2. THEORETICAL BACKGROUND

Performance measurement systems models may be considered as a means of reaching performance objectives (Lisiecka and Czyż-Gwiazda, 2013). In the literature, as in practice, there are number of models and frameworks that provide guidelines for the performance measurement system development. The objective for such models is to help organizations to define a set of measures that reflects their objectives and assesses their performance appropriately (Kennerly and Neely, 2002, p. 146). Those models are multidimensional, balancing financial and nonfinancial measures. Some of them are:

- *Activity Based Costing (ABC)*, developed by R. Cooper and R.S Kaplan (1991), has been promoted and adopted as a basis for making strategic decisions and for improving profit performance (Cagwin and Bouwman, 2002, p.1). ABC model assigns more accurately than traditional instruments, the costs of an organization's activities to its products and processes (Kueng, 2000, p.69). ABC has emerged as a tremendously useful guide to management action that can translate directly into higher profits Because

ABC reveals the links between performing particular activities and the demands those activities make on the organization's resources it can give managers a clear picture of how products brands, customers, facilities, regions, or distribution channels both generate revenues and consume resources (Cooper and Kaplan, 1991, p.130).

- *Brown's performance measurement concept* (Brown,1996) shows links between five stages in a business process and their performance measures. These stages are defined as inputs, processing system, outputs, outcomes, and goals respectively. The model demonstrates how inputs to the organization affect the performance of processing systems and ultimately the top-level objectives of the organization (Kennerly and Neely, 2002, p. 147)
- *Balanced Scorecard* proposed by Kaplan and Norton (1993) is a strategic management instrument: (1) to clarify and translate vision and strategy; (2) to communicate and link strategic objectives and measures; (3) to plan, set targets and align strategic initiatives; and (4) to enhance strategic feedback and learning (Kaplan and Norton, 1996, p. 10). The method looks at four interconnected perspectives: Financial, Customer, Internal business process and Learning and Growth. Customer satisfaction drives financial success; effective and efficient business processes ensure high levels of customer satisfaction; and sustained, continuous improvement enhances the organization's operational performance (Franceschini at al, 2007, p.124)
- *Business System Design Decomposition framework* (Taticchi at al, 2010), offers a holistic approach to performance measurement, identifies cause-effects relationships in business processes, measures the performance versus stakeholders and offers interlinking between performance indicators. BSDD is based on strengths of the Axiomatic Design and Analytic Hierarchy Process techniques. (Taticchi at al, 2010, p.229).
- *Data envelopment analysis (DEA)* (Charnes at al, 1978), is a mathematical programming model applied to observational data which provides a new way of obtaining empirical estimates of external relations – such as the production functions and/or efficient production possibility surfaces that are a cornerstone of modern economics (Adler at al, 2002, p.250). DEA enables measuring the level of efficiency of non-frontier units, and to identify benchmarks against which such inefficient units can be compared (Cook and Seiford, 2009, p.2)
- *Demand to measure model* (Ljungberg, 2002), classifies process measures in to main groups: process/activity measures and resource measures. Interrelating of this two groups of measures facilitate evaluation of efficiency and productivity (Ljungberg, 2002, p.267). Purpose of this seven-step method is to identify and derive proactive process measures.
- *DOE/NV model*, proposed by U.S. Department of Energy Nevada Operations Office (Bellman at al, 1994), is standardized approach to developing and implementing performance measurement systems. Performance measurement process has been separated into 11 discrete steps. Those steps present a guideline, intended to show the process generically. Different organizations who have vast knowledge of their own internal processes should feel free to adapt the guidelines where necessary to best fit within their operations (Bellman at al, 1994., p. 9)
- *EFQM model*, proposed by European Foundation for Quality Management (EFQM), is used to assess an organization's progress towards excellence, independently of the organization's type, size, structure, and maturity. The model is based on nine criteria. Five of these are classified as "Enablers" (cover what an organization does) and four as "Results" (cover what an organization achieves) (Franceschini at al, 2007, p.131).
- *Kanji Business Excellence Measurement System* (Kanji, 2002), based upon Kanji's Business Excellence Model and Kanji's Business Scorecard (KBS), These are made up of several criteria that correspond to the Critical Success Factors, i.e. the areas that must perform well if an organization is to succeed. They form, respectively, Part A and Part B of the Performance Measurement System and should be applied simultaneously, since they form a single and complementary view of organizational performance (Kanji, 2002, p. 718).
- *Tableau de Bord* (de Guerny at al, 1990) establishes a hierarchy of interrelated measures and cascading measures to different organizational levels, forcing functions and divisions of an organization to position themselves in the context of the company's overall strategy (Kennerly & Neely, 2002, p. 148). This concept is designed to help the personnel pilot the organization by identifying key success factors, especially those that can be represented as indicators (Franceschini at al, 2007, p.127)
- *Performance measurement matrix* (Keegan at al, 1989) categorizes performance measures as "external" or "internal" and "cost" or "non cost". This is a simple and flexible framework, and whilst it does not reflect all attributes of measures that are increasingly considered necessary, the matrix is capable of accommodating any measure of performance (Neely at al, 1995, p. 97). However, the matrix does not make explicit the links between the different dimensions of business performance (Anderson & McAdam, 2004, p. 469).
- *Performance pyramid* (Judson, 1990; Lynch and Cross, 1991), ties together the hierarchical view of business performance measurement with the process view. It cascades measures down the organization so that measures at department and work-center level reflect the corporate vision as well as internal

business unit objectives. This strategic measurement and reporting technique also supports the need to include internally and externally focused measures of performance (Neely at al, 2007, p.146)

- *Performance Prism* (Kennerly & Neely, 2002, p. 151) reflects the growing importance of satisfying stakeholder requirements, considering five distinct but linked perspectives of performance: stakeholder satisfaction, strategies, processes, capabilities and stakeholder contribution. In this framework, results (stakeholder satisfaction) are function of determinants (the other prism, facets) (Neely at al, 2007, p.156)
- *Framework of results and determinants* (Fitzgerald at al, 1991) is based on the premise that there are two basic types of performance measure in any organization, those that relate to results (competitiveness and financial performance) and measures that focus on the determinants of those results (quality, flexibility, resource utilization and innovation). Framework highlights the fact that the results obtained are function of past business performance with regard to specific determinants (Neely at al, 2000, p.1122).
- *Supply Chain Operations Reference (SCOR) model,* developed in 1997 by Supply Chain Council is business process reference model that contains all supply chain activities from supplier's supplier to a customer's customer. SCOR contains four levels of process detail. SCOR also includes methodology that enables companies to analyze and improve their supply chain operations by helping them to communicate supply chain information across the enterprise, measure performance objectively, identify supply chain performance gaps and improvement objectives (Scheer at al, 2002, p.50)
- *Theory of Constraints* (Goldratt, 1984) offers a systematic and focused process that organizations use to pursue ongoing improvement successfully. Within the TOC three global performance measures are used for assessing a business organization's ability to obtain the goal (i.e. making money). These global measures are net profit, ROI and cash flow (Tangen, 2004, p.732).
- *TQM performance measurement model* (Sinclair & Zairi, 1995) is based on concept of Total Quality Management and is designed to integrate measurement within the overall management process. The model consists of five levels: strategy development and goal deployment; process management and measurement; performance appraisal and management; break-point performance assessment; and reward and recognition systems concept.

Mentioned models consider performance measurement issues from different perspectives. Besides tendency to link operations and processes to strategic goals, they integrate financial and non-financial measures, and focus all business activities on customer requirements (Lynch & Cross, 1995, p.6). Nevertheless, these different approaches have led to numerous definitions of a performance measurement system, but still, there is little consensus regarding its main components and characteristics. (Dumond, 1994, p.17).

3. COMPARATIVE ANALYSIS OF EXISTING MODELS OF PERFORMANCE MEASUREMENT - THE RESULTS

Each of these performance measurement models suggests that it is unique and comprehensive. However, each model offers a different perspective on performance. Based on this, the following questions arise: Which process performance measurement model should be selected and applied? Which model is appropriate? When to use a certain performance measurement model?
To respond to those and similar questions, a comparative analysis of above mentioned models was done according to ten selected criteria. Those criteria are:

- Model purpose
- The basis for performance measures determination
- Performance measures (categories)
- The interconnections between performance measures
- Specificity of indicators to be measured
- Complexity
- Stakeholders, considered within the model
- System improvements incorporation
- Possibility to compare with competition
- Interdependency between process indicators and organizational goals

Comparation of models according to cited criteria is described in the paper „Process performance measurement models" (Simeunović at al, 2013, p.226). The results of comparative analysis show that all models consider performance from different perspectives, and that they are designed for different purposes. Analysis also show that the majority of models takes into account the strategy or goals while determining performance, which isn't surprising since this is the way to ensure obtaining reliable information about achieving of strategic goals, and taking corrective action , if necessary.

It should be noted that most of the studied models doesn't specify performance indicators, but gives an indication for their determination, because the indicators are viewed as too specific to each individual company.

However, what is most notable is that none of these models link directly organizational goals and performance indicators, in other words, they don't specify their interdependence, which would allow model flexibility. This is important because the environment is dynamically evolving, and goals, as well as the organization's strategy should be changed in time and when they change, some of performance indicators also have to be changed. Therefore, there is the need for performance measurement system flexibility. According to Franceschini at al (2007, p.55), one of the most critical aspects in operations management is "translating" a firm's goals into performance indicators. Those remarks are not surprising since even two decades ago numerous authors espoused the need for reflection on measures to ensure that they are updated to reflect these continuous changes (Meyer & Gupta, 1994; Ghalayini & Noble, 1996; Dixon et al., 1990; Wisner & Fawcett, 1991).
So, the crucial question is: How to enable flexibility in measuring performance, i.e. how to respond quickly to changes of the business system goals, and adapt performance indicators, so the performance measurement results are kept up to date and provide timely and accurate information?

4. PROCESS PERFORMANCE MEASUREMENT MODEL BASED OF OBJECTIVE-INDICATORS LINKAGE

In order to overcome mentioned shortcomings of performance measurement models, and, particularly, to enable flexibility in measuring performance, the novel approach was proposed. This approach allows direct linking of organizational goals and process performance indicators. In order to apply this approach, it is necessary for an organization to have well-designed process model, that is the base for process management. Graphical interpretation of creation the foundation for processes management, and, therefore, for performance measurement is shown in Figure 1.

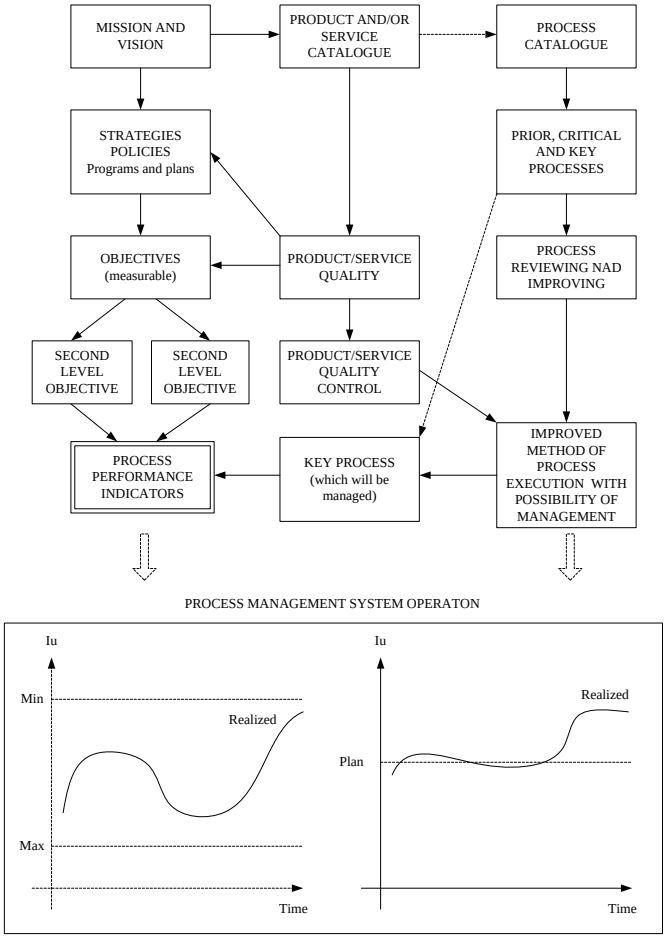

Figure 1: Establishing foundation for process management (adapted from Radović at al, 2012a, p. 611)

The first step in establishing process-oriented performance measurement system (figure 1) is the development of mission and vision statement. The mission can be seen as the far goal that may never be reached. It should describe what the organization is in business to do. The vision is where the company wants to go, the ideal future state of the organization (Radović at al, 2009). Well-defined mission statement should facilitate product/service identification, on the one hand, and identification of stakeholders, and their requirements, on the other hand, vision statement, along with identified stakeholders, are the basis for defining those product/service quality features by which the organization meets the requirements of stakeholders. Considering the importance of stakeholders for the success of the organization, their requirements should be than incorporated into the strategy and translated into measurable organizational goals. Those goals have to be defined according to stakeholders needs. Furthermore, company should decompose those organizational goals to lower level objectives of organizational units. At the same time, according to mission, the basic product/service (or more basic products/services) should be identified, and the product/service catalogue should be created, which is the basis for business process identification, i.e process model design. Next step is to identify those processes and activities that (from process model) lead to achievement of organizational goals, and whose performance indicators should be measured. However, since it is impossible to simultaneously improve all processes, or to measure performances of all processes, due to limited resources and time, considering that all performances are not equally important, efforts should be focused on measuring the performances of those processes whose execution contributes to achievement of the organizational goals or stakeholders requirements. So, the list of prior, critical and key processes should be created, whereby the key processes are those processes through which the specificity of business system can be recognized and which contribute to business system goals realization. Given the above mentioned, it is necessary to select the key processes that will be measured and managed.
The final step is to translate the top level goals into key process performance indicators which lead to the achievement of these goals. The degree to which goals, as a mission, are met is determined by measuring and comparing process performance with a defined goal.
Goal translation into key process performance indicators should enable determination of their interdependency. This would allow achieving of performance measurement system flexibility, i.e. possibility of rapid adaption of performance indicators according to changes in organizational goals and strategies. Translation process is performed as follows.
When the goals at the highest level of organization are defined based on the requirements and expectations of customers, shareholders, employees, the state, local communities, and other stakeholders, it is necessary to determine what an organization needs to do for achieving those goals. Therefore, the strategic goals of the organization, aligned with the requirements of stakeholders, are decomposed into the lower level objectives, i.e. objectives of the business system units. If an organization achieves objectives of its organizational units, the top level goals will be achieved too. The goals of organization units are considered as second level objectives, and they should be defined according to SMART principles. In this step, it's necessary to define the units of measurement, reference values (values that are required for goal achieving), the method of measuring these goals, and to describe how (in which interval) the trend of achieving these goals will be followed. Next step is to determine which processes in organization should be performed in order to achieve those second level goals. Those are the key processes, and performance of these processes should be measured, since they contribute to defined goals realization.
The logic and procedure for translating the business system's goals in process performance indicators are shown in Figure 2.

Starting from the procedure described above, interdependencies between business system's goals and organizational unit's objectives can be identified, as the interdependencies between organizational unit's objectives and key process performance indicators, and therefore the direct linkage between business system's goals and process performance indicators

The proposed approach for measuring performance has been applied in over 30 companies in Serbia in the period from 2010 to the present, and the preliminary results show the satisfactory success in measuring business performances in these companies.

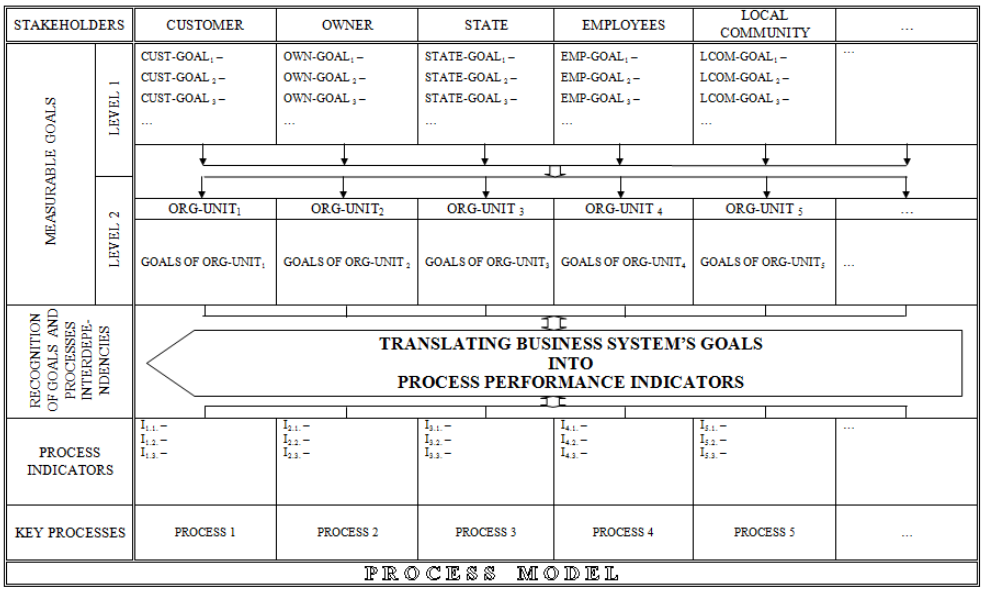

Figure 2. Procedure for translating the business system's goals in process performance indicators (Radović at al, 2012b, p.129)

5. CONCLUSIONS AND FURTHER RESEARCH

It is well-known that the performance measurement is vital for business system success and development. In the literature, there are number of process performance measurement models and frameworks. In this paper, some of those models are briefly described, and the results of their comparative analysis are shown. According to those results, each of the models has a purpose in the practice, and none of them can be selected as the best or the most successful model.

Generally, those various models and frameworks have a clear academic grounding, and are "philosophically" sound – they do provide guidance on how a company should design its unique performance measurement system, but they rarely help with the practical realization of specific measures at an operational level. The measurement practitioner still has to translate the framework into practical measures. (Tangen, 2004, p.736). However, what is most notable is that none of those models link directly organizational goals and performance indicators, in other words, they don't specify their interdependency which would allow model flexibility.

Accordingly, the novel process performance measurement approach is suggested, which starts from business system goals, decompose them on the lower level objectives and link them to the key processes of business system. Suggested approach allows interconnection between organization's top level goals and key process performance indicators, by using lower level objectives. This should enable model flexibility, i.e. rapid adaption of performance indicators according to organizational goals changes.

The next step would be, according to linkages between goals and process indicators that are identified in companies in which this approach has been applied, to define the general set of business system's goals and process performance indicators, and to determine their direct relationships, which would be applicable in all companies. This would be further research direction of authors.

REFERENCES

Adler, N., Friedman, L. & Sinuany-Stern, Z. (2002). Review of ranking methods in the data envelopment analysis context. European Journal of Operational Research, 140(2), 249–265.

Anderson, K. & McAdam, R. (2004). A critique of benchmarking and performance measurement: Lead or lag? Benchmarking: An International Journal, 11(5), 465 – 483.

Antonucci, Y.L., Bariff, M., Benedict, T., Champlin, B., Downing, B. D., Franzen, J., Madison, D. J., Lusk, S., Spanyi, A., Treat, M., Zhao, L., & Raschke, R. L. (2009). Guide to the Business Process Management Common Body of Knowledge (Version 2). Chicago: ABPMP.

Bellman, R., Droemer, D., Lohmann, M. & Miller, C. (1994). Performance Measurement Process Guidance Document. Las Vegas, NV: Department of Energy.

Brown, M.G. (1996). Keeping Score: Using the Right Metrics to Drive World-Class Performance. New York: Quality Resources.

Cagwin, D. & Bouwman, M.J. (2002). The association between activity-based costing and improvement in financial performance. Management Accounting Research, 13(1), 1-39.
Charnes, A., Cooper, W.W. & Rhodes, E. (1978). Measuring the efficiency of decision making units. European Journal of Operational Research, 2(6), 429-444.
Cook, W. & Seiford, L. (2009). Data envelopment analysis (DEA) - Thirty years on. European Journal of Operational Research, 192(1), 1-17.
Cooper, R. & Kaplan, R. (1991). Profit priorities from activity-based costing. Harvard Business Review, 69(3), 130-135.
de Guerny, J., Guiriec, J.C. & Lavergne, J. (1990). Principes et Mise en Place du Tableau de Bord de Gestion (6th ed.). Paris: J. Delmas.
Dixon, J. R., Nanni, A. J., & Vollmann, T. E. (1990). The new performance challenge: Measuring operations for world-class competition. Homewood, IL: Business One Irwin.
Dumond, E. J. (1994). Making best use of performance measures and information. International journal of operations & production management, 14(9), 16-31.
Fitzgerald, L., Johnston, R., Brignall, T.J., Silvestro, R. & Voss, C. (1991). Performance Measurement in Service Businesses. London. Chartered Institute of Management Accountants.
Franceschini, F., Galetto, M. & Maisano, D. (2007). Management by measurement - Designing key indicators and performance measurement systems. New York, Springer Berlin Heidelberg.
Ghalayini, A. M., & Noble, J. S. (1996). The changing basis of performance measurement. International Journal of Operations & Production Management, 16(8), 63-80.
Glad, E. & Becker, H. (1997). Activity-Based Costing and Management. New York, John Wiley &Sons.
Goldratt, E.M. (1984). The Goal. Great Barrington, MA, The North River Press.
Judson, A.S. (1990) Making Strategy Happen, Transforming Plans into Reality. London: Basil Blackwell.
Kanji, G. K. (2002). Performance measurement system. Total Quality Management, 13(5), 715-728.
Kaplan, R. S. & Norton, D. P. (1996). *The balanced scorecard: translating strategy into action*. Boston, Harvard Business Press.
Norton, D., & Kaplan, R. (1993). Putting the balanced scorecard to work. Harvard Business Review, 71(5), 134-140.
Keegan, D. P., Eiler, R. G., & Jones, C. R. (1989). Are your performance measures obsolete. Management accounting, 70(12), 45-50.
Kennerley, M., & Neely, A. (2002). Performance measurement frameworks: a review. Business performance measurement: Theory and practice, 145-154.
Kueng, P. (2000). Process performance measurement system: a tool to support process-based organizations. Total Quality Management, 11(1), 67-85.
Lisiecka, K. & Czyż-Gwiazda, E. (2013, June). Performance measurement models - comparative review, Paper presented at the 57th EOQ Congress: Quality Renaissance - Co-creating a Viable Future, Tallinn, Estonia
Ljungberg, A. (2002). Process measurement. International Journal of Physical Distribution & Logistics Management, 32(4), 254-287.
Lynch, R.L. & Cross, K.F. (1991). Measure Up! Yardsticks for Continuous Improvement. Cambridge, MA, Blackwell.
Lynch, R.L. & Cross, K.F. (1995). Measure Up!: How to Measure Corporate Performance. Oxford, Blackwell Publishers
Meyer, M. W., & Gupta, V. (1994). The performance paradox. Research in organizational behaviour, 16, 309-369.
Neely, A., Gregory, M., & Platts, K. (1995). Performance measurement system design: a literature review and research agenda. International journal of operations & production management, 15(4), 80-116.
Neely, A., Mills, J., Platts, K., Richards, H., Gregory, M., Bourne, M., & Kennerley, M. (2000). Performance measurement system design: developing and testing a process-based approach. International Journal of Operations & Production Management, 20(10), 1119-1145.
Neely, A., Kennerley, M., & Adams, C. (2007). Performance measurement frameworks: a review. in: Business Performance Measurement, Unifying theories and integrating practice (pp. 143-162). Cambridge, Cambridge University Press.
Radovic, M., Camilovic, S., Rakic, Z., Simeunovic, B., Tomasevic, I., & Stojanovic, D. (2012a). Process management as basis for quality management in service industry. *TTEM-Technics Technologies Education Management*, *7*(3), 608-614.
Radović M., Tomašević I., Stojanović D., & Simeunović B. (2012b) Inženjering procesa. Beograd: FON.
Radović M., Tomašević I., Stojanović D., & Simeunović B. (2009, September). Establishing system for process oriented performance management. paper presented in12th International QMOD and Toulon-Verona Conference on Quality and Service Sciences.
Rouse, P., & Putterill, M. (2003). An integral framework for performance measurement. *Management Decision*, *41*(8), 791-805.

Scheer, A-W., Abolhassan, F., Jost, W. & Kirchmer, M. (2002). Business Process Excellence, ARIS in Practice, Berlin: Springer-Verlag.
Sikavica P., & Hernaus T. (2011). Dizajniranje oganizacije - strukture, procesi, poslovi. Zagreb: Novi informator.
Simeunović,B., Stojanović, D., Tomašević, I., & Radović, M. (2013, November). Modeli za merenje performansi procesa. Paper presented at the IX Symposium of Business and Science SPIN '13 .
Sinclair, D., & Zairi, M. (1995). Effective process management through performance measurement: Part III-an integrated model of total quality-based performance measurement. Business Process Re-engineering & Management Journal, 1(3), 50-65.
Tangen, S. (2004). Performance measurement: from philosophy to practice. International Journal of Productivity and Performance Management, 53(8), 726-737.
Taticchi, P., Cagnazzo, L., Santantonio, M., & Tonelli, F. (2010). A framework for performance measurement and management based on axiomatic design and analytical hierarchy process. In Business Performance Measurement and Management (pp. 229-240). Berlin: Springer Berlin Heidelberg.
Towers, S. (2005). In the beginning. In: In Search of BPM Excellence. Tampa: Meghan-Kiffer Press.
Wisner, J. D., & Fawcett, S. E. (1991). Linking firm strategy to operating decisions through performance measurement. Production and Inventory Management Journal, 32(3), 5-11.

BPM PRACTICE: EXPERIENCES FROM COMPARISON STUDY IN SERBIA 2012-2014

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Abstract: *The purpose of this paper is to compare business process management and business process improvement practice in Serbia from study in 2012 and 2014 in order to notice if there is any progress in implementation of those practices or companies process maturity level according to CMMI model, and whether there are changes in problems and challenges that companies in Serbia encounter while trying to implement process change initiatives. Questionnaire was sent to approximately 500 companies in Serbia based on the similar research in 2012 and response rate was higher. Results of the comparison study show that process maturity level increased over a two years period, that the main business driver for process change is need for cost reduction and main challenge is lack of interest within top management. This paper suggests steps for further efforts in process management and improvement practice and can be useful for practioners and researchers on this field in similar economies.*

Keywords*: Business process management, Process improvements, Serbian industry*

1. INTRODUCTION

Today, there is declining number of customers who make the decision solely on price, and cost, quality, delivery speed and reliability play a decisive role in selecting product and/or service. (Simeunović et.al, 2012) Stojanovic et.al. (2012a) stated that “constant intensification of global competition and increasing of market demands, force all business systems, to find new ways of preserving and improving its competence and achieve advantage on market in terms of prices, deadlines, quality goods and services”. (p.205) Madison (2005) considers that 85% of all problems in the company can be attributed to the processes, and 15% to people, and solving problems in processes may lead to customer satisfaction improvement, cost and cycle time reduction (p. 3). Radović et.al. (2012) describes processes as elements of business system structure, which increasingly gaining the importance, because they are entity which can be used for the best establishing of new business systems, analyzing, improving and developing of existing business systems and managing of his parts and system in the whole. (p.4)

Business Process Management (BPM) has emerged as a concept in literature and practice in the last two decades. So, many associations of process professionals like BPTrends or Process Excellence Network analyze and monitor development of BPM practice in the world for several years (Wolf and Harmon, 2012; Process Excellence Network, 2012). First research of this kind was conducted in Serbia two years ago. The motivation to repeat the similar study after two years was to notice if there is any progress in process work in Serbia and to create a picture of what process management programs might look like in the following period. In the research, authors used questionnaire which was sent to 500 companies which operate in Serbia via e-mail and LinkedIn professional network.

After an introduction, a brief literature review will be given about business process management and improvement. Chapter three will present research methodology that was used for the purpose of this paper, and the main results of the research will be given in chapter 4. These results will be discussed in chapter 5, and the conclusion and future implications will be given afterwards.

2. THEORETICAL BACKGROUND

“Processes are vital for any organization, and they constitute a business system and things that it does, so it can be said that any business system can be managed by managing its processes”. (Stojanović, 2012c, p.1374) Lientz and Rea (2001) stated that “company profitability depends on processes”. (p.15) Business process management and process improvement are important themes for researchers and practitioners, because process improvement represents bottom-line of business enhancement. (Siha & Saad, 2008, p.778). Jeston and Nelis (2006) defined BPM as “achievement of organizational objectives, through the

improvement, management and control of essential business processes", and emphasized that the "process management is an integrated part of "normal" management" (p.11) Therefore, the first part of the research is dedicated to ways in which companies understand BPM and how they describe level of interest for process improvements.

In order to recognize the level of adoption of process management practice in Serbia, authors used CMMI model, which contains five level of process maturity (initial, repeatable, defined, managed, optimizing). Stojanović et.al. (2012c) stated that "key assumption of the model is that immature companies cannot provide the consistency of their performance, while mature companies make quality products at effective and consistent manner", and key point of the model is to understand where the organization is today and where it wants to get. (p.1374)

Skalle et.al. (2009) emphasized that one of the areas that are in focus of BPM is business process design and improvement in order to fulfil or exceed customer expectation, while achieving organizational goals. Work on process improvements is one of the important parts of BPM and is recognized as one of the main priorities of companies according to Gartner survey from 2009. (Zellner, 2011) Business process improvement was one of the sources of competitive advantage, but now is a necessity for surviving on the market. (Stojanovic, 2012b, p.281) Also, one of the shortcomings of BPM is long duration of implementation and companies cannot wait long to see the results, so they need to define improvement projects which will achieve and show results quickly and these projects can be a key drivers for successful BPM deployment. One part of the survey is dedicated to process improvements as part of the BPM in order to comprehend success factors for process improvements so as BPM.

The main goal of this research is to evaluate level of adoption of process practice and to investigate what are drivers, challenges and trends for process work in Serbia in the following period, and to propose further efforts in process management and improvement practice which can be useful for practitioners and researchers on this field.

3. RESEARCH METHODOLOGY

The purpose of this study is to determine if there are any changes in the extent to which companies in Serbia have adopted process management and improvement practices, whether their process maturity level is higher or lower according to CMMI model, and what are the problems and challenges that companies in Serbia encounters while trying to implement process change initiatives. Besides that, it would be interesting to see:

1. What are factors for success in process improvement and management?
2. What is next for process management is Serbia?

In order to compare results, similar survey instrument to the one used in 2012 research was used, with additional questions concerning business process improvement (BPI) practice. Questionnaire included 28 questions divided into three groups: the first group are general questions about company and respondents, second group are questions about process maturity and third group of questions refers to business process improvement practice. The questions required single or multiple choices and some of them included an open form in case when offered answers couldn't reflect the views of the respondents.

The research instrument was mailed to general managers, CEOs, process analysts at a random sample of 500 manufacturing and service organizations in the Serbia. A total of 89 usable responses were returned, resulting in a response rate of 17,60 percent. The 300 of 500 companies were included in previous research. In 2012 research instrument was sent to 300 companies and response rate was 13,66 percent. This year, authors also used social professional network group LinkedIn to contact potential respondents. All of these responses were included in the results presented in this paper.

After the questioners were filled by the participants, the statistical package SPSS was used for calculation of frequencies and X^2 test (with significance set to 0.05) and Man-Whitney U test (with asymptotic significance value set to 0.05). In order to see is there any difference between results from 2012 and 2014, Z test was used.

4. RESULTS

Among 89 respondents in the research, 10,1% were general managers, 7,9% were executive officers, 22,5% were business function/department managers, 13,5% were business analyst, 14,6% were process analyst, 12,4% were consultants, 9% were researchers, while 10,1% of respondents stated that their position was something else. In comparison with previous research, new job title is defined – process specialist/analyst, because authors assumed that BPM practice is developed from 2012 and that this job title is present in

companies in Serbia. Majority of the companies included in the research were large companies (46,1%) with more than 250 employees. Also, majority of companies were service oriented 60,7%, 20,2% were manufacturing companies, while 19,1% were operating both in service and manufacturing industry.

Most companies were domestically owned (66,3%), about a third of them have foreign owners (24,7%), and with the rest (9%) the ownership was shared between domestic and foreign owners.

Figure 1 presents the comparison of the way the respondents understand the term Business process management

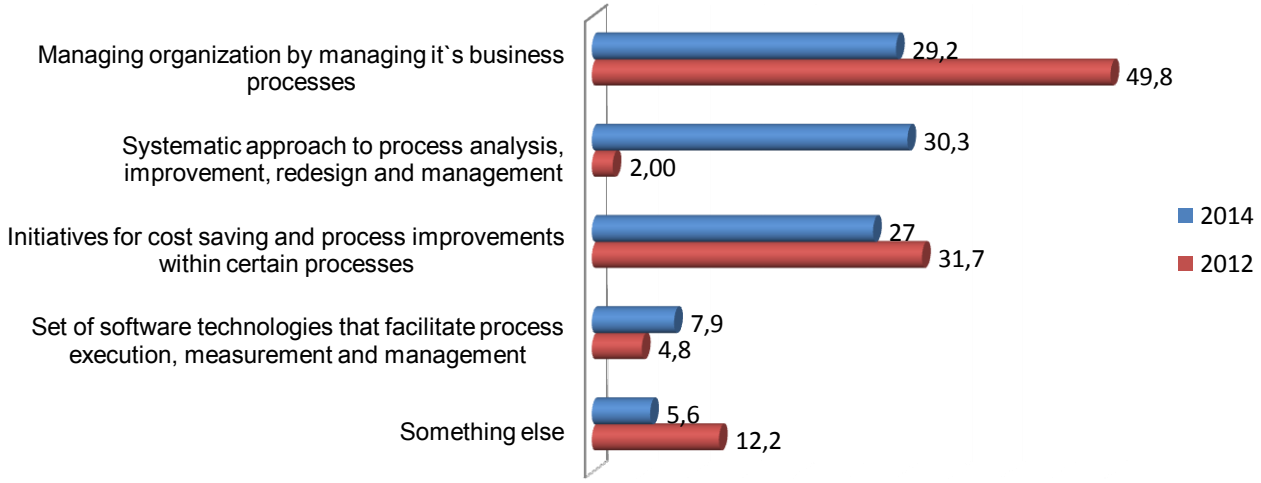

Figure 1: Companies' understanding of Business process management concepts in 2012 and 2014

Figure shows that respondents mostly indicated that their organizations understand BPM as systematic approach to process analysis, improvement, redesign and management (30,3%) or managing organization by managing its business processes (29,2%). Initiative for cost saving and process improvement of certain processes is also represented in 27%.

The participants were asked to explicitly position their company at one of the levels offered by CCMI maturity model. The results are shown in Figure 2.

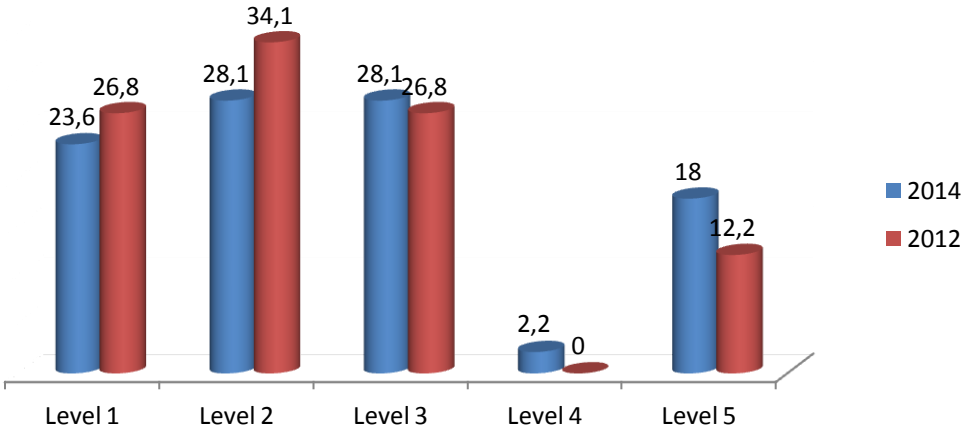

Figure 2: Levels of CMMI process maturity of companies in Serbia in 2012 and 2014

In 2014, most of the companies are on second or third level of process maturity (28,1%), and there's increasing number of companies which are on the Level 4 or 5. None of the respondents placed it's company's processes on Level 4 in 2012 and only 12,2% (5 of them) were at level 5, but in 2014, 2,2% (2 companies) are at level 4 and 18% (6 companies) are at the highest level of process maturity.

Table 1 shows that in 2012 and 2014, majority of the companies stated that they are undertaking activities concerning process maturity "in some cases" or "always" . Also, in 2014 percent of companies that answered "never" is much lower than 2012, and on the other side there is higher number of companies that gave answer "always" than in 2012.

Table 1: Questions concerning process maturity in 2012 and 2014

	2014	2012	2014	2012	2014	2012
Questions concerning process maturity	Never		In some cases		Always	
Business processes documented and updated	6.8	12.2	53.9	63.4	39.3	24.4
Business processes measured and monitored	11.2	14.6	48.3	46.3	40.4	39
Core business process models include activities of suppliers and partners	25.8	30	57.3	51.2	16.9	9.8
IT support in accordance with business processes	8.9	9.8	58.4	70.7	32.6	19.5
Skills needed for activities are defined and documented	12.6	12.2	58.4	75.7	29.2	12.2
Managers are trained for analysis, design and business process management	17.9	19.6	56.2	68.3	28.9	12.2
Process managers use data about performances in order to manage processes	16.8	17.1	59.6	65.9	23.6	17.1

In 2012, only 2,4% of the respondents stated that process improvement initiatives are always being able to identify and remove problems and inconstancies, while 82,9% stated that problems are frequently solved by process improvement initiatives. On the other side, in 2014, 15,7% said that that process improvement initiatives are always being able to identify and remove problems, and 73% stated that problems are frequently solved by process improvement initiatives. Difference between these results is confirmed with Z test (Z=-2.2041, p=0.027)).

In 2014, 58,4% of the companies stated that they don't have formal group for process management, while in 2012 that number was 39%, or if they have formal process management group, location is within their executive management (18%), while in 2012 24,4% of the companies stated the same (Z test also confirmed that there is significant difference between results for the companies which do not have formal group (Z=-2.0581, p=0.039).

Comparison of main drivers behind business process change initiatives identified among companies operating in Serbia are given in figure 3 (multiple answers were allowed).

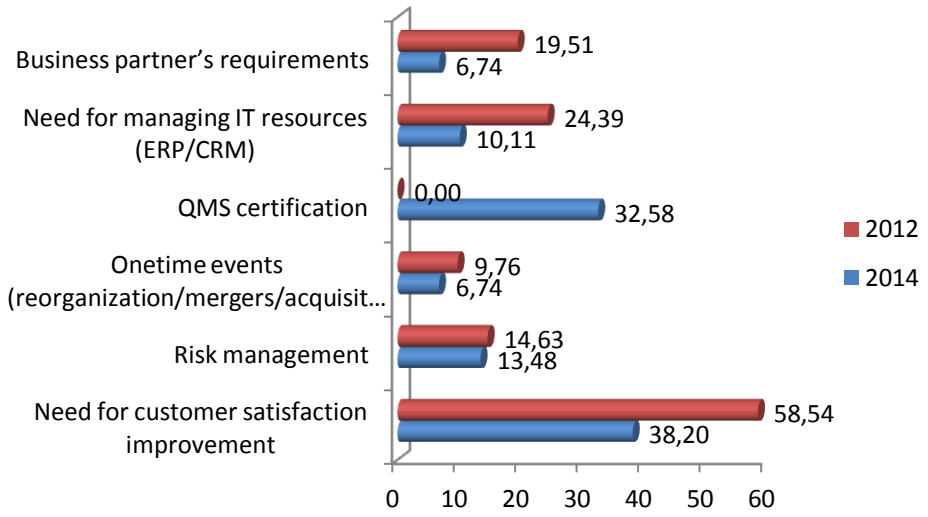

Figure 3. Main drivers for business process change initiatives

Main driver for business process change in 2012 were need for customer satisfaction (58,54%), need for managing IT resources (19,51%) and business partner`s requirements (19,51%). In 2014, need for customer satisfaction was also main driver for 38,2% companies, but other drivers were changed. QMS certification was the second driver with 32,58%, and the others drivers have approximately the same percent. Z test also confirmed significant difference between results for "need for customer satisfaction improvement" (Z=2.1672, p=0.03) and QMS certification (Z=-4.1467, p=0.00).

With regard to process initiatives that companies have undertaken so far, new answers were added in 2014, in accordance with development of process improvement practice: Modeling/documenting processes

Redesign of processes with reference models, Lean Six Sigma improvement projects and Process excellence concepts. Comparison of the results is given in table 2 (multiple answers were allowed)

Table 2: Comparison of the process initiatives that companies have undertaken so far

Business process initiatives undertaken so far	2014 %	2012 %
Business process architecture development	51,69	41,46
Business process measurement system development	53,93	58,54
Modeling/documenting processes	65,17	-
Business Process management	58,43	56,10
Process managers training for process analysis/redesign	14,61	26,83
Core processes redesign	35,96	17,07
Redesign of processes with reference models	3,37	-
Six Sigma improvement projects	3,37	4,88
Lean improvement projects	8,99	12,20
Lean Six sigma improvement projects	4,49	-
Continuous process improvement projects/KAIZEN	12,36	19,51
Process automation projects	35,96	34,15
Process excellence concepts	5,62	-

Z test shows that there is significant difference in the application of core processes redesign ($Z=-2.183$, $p=0.029$).

Challenges and resistances encountered while trying to broaden business process initiatives differ from previous study. The main challenges in 2012 were that multiple process change projects require same resources and management doesn't want to invest in process change projects at this time. In 2014, main challenge is lack of interest within top management and also management doesn't want to invest in process change projects at this time. But, five companies stated that they haven't encountered any type of resistance. Results are given in table 3 (multiple answers were allowed)

Table 3: Comparison of challenges and resistances encountered while trying to broaden business process initiatives

Challenges encountered	2014 No. of companies	2012 No. of companies
Lack of interest within top management	31	8
Management doesn't want to invest in process change projects at this time	24	11
Multiple process change projects require same resources	18	11
Previous process improvement projects were unsuccessful	13	0
Management requires ROI that is not achievable	7	2
No resistance	5	1
Something else	2	17

Table 4 present which process initiatives companies plan to undertake in the following period.

Table 4: Process initiatives that companies plan to undertake in the following period

Business process initiatives undertaken so far	No. of companies
Core processes redesign	32
Business Process management	24
Process managers training for process analysis/redesign	22
Business process measurement system development	22
Modeling/documenting processes	20
Business process architecture development	19
Process automation projects	17
Redesign of processes with reference models	13
Continuous process improvement projects/KAIZEN	12
Lean improvement projects	11
Lean Six sigma improvement projects	10
Six Sigma improvement projects	9
Process excellence concepts	6

The third part of the survey consisted of questions regarding business process improvement. A majority of companies reported that process improvement is part of normal work environment (50,6%), and 30,3% stated that interest in process improvement was expanding. Companies that reported expanding interest for process improvement were so far engaged in following business process initiatives: Modelling/documenting

processes (14 companies), Business process architecture development (11 companies) and Business process management (11 companies). These companies plan to implement Business process management (13 companies), and will continue to work on process modelling and business process measurement system development. Companies with expanding interest in BPI also have core process redesign in their plans. Companies in which process improvement is a part of normal work environment have so far implemented following initiatives: Business process management (36 companies), Business process measurement system development (35 companies), and Business process architecture development (33 companies).

More than one third of companies stated that they were engaged in business process improvement for more than two years (36%), and one third of companies reported that they work more than five years on process improvements (34,8%). The focus of business process improvement initiatives is mainly on production/operations (28 companies), IT business unit (27 companies) and sales (24 companies) or customer service (23 companies). According to the survey, 22 companies reported that they apply business process improvement methodologies in the whole company. In accordance with expansion of application of BPI in companies, majority of the respondents had enterprise-wide improvement projects (34,8%). Companies stated that their process improvement project length is 6-12 months (19,1%), while 15,7% reported that average project length is less than three months. Companies whose process improvement project length is 3-6 months account for 15,7%. Survey shows that 44,9% of the companies expect that number of employees dedicated to process improvement will increase, and 42,7% stated that number of employees will remain the same. Only 12,4% said that this number will decrease in the future. The same situation is with budget for process improvement program. Among the companies that have deployed business process improvement initiatives, 32,9% reported that their BPI program was successful, and 20% rate their programs as unsuccessful. Survey shows that 25 of 26 companies which report that they were successful in BPI program were engaged with the program for more than two years..

Chi-square and Mann-Whitney test were used in order to test whether interdependence between the basic parameters of the company, drivers and challenges with process management and improvement practice in companies in Serbia exists. The main driver for business process change in manufacturing companies is QMS certification (X^2=7.535, df=2, p=0.025), while service companies listed QMS certification as the main driver to a much lesser extent. Large companies are increasingly facing with challenge of lack of interest within top management, while in the small companies that challenge is much less frequent (X^2=11.419, df=2, p=0.002). Companies that have not yet started with process improvement initiatives reported that the main reason was lack of interest within top management (X^2=8.111, df=3, p=0.04). On the other side, companies that work longer than 5 years on process improvement state that the main challenge for widening BPM initiatives across the company is that multiple project compete for the same resources (X^2=7.696, df=3, p=0.04). Service companies are more oriented to process improvement deployment in IT sector, while none of the manufacturing companies report any initiative within this sector (X^2=12.049, df=2, p=0.000). Small companies implement more BPI methodologies more in sales and marketing business unit than large companies (X^2=5.935, df=2, p=0.04). Large companies are mostly oriented to enterprise wide deployment of BPI (X^2=5.928, df=2, p=0.037). Mann-Whitney U test shows that companies faced with lack of interest within top management were unsuccessful in their process excellence program (U=540,00, Z=-3,336, p=0,001), and that companies which do not have a formal group for BPI are less successful in their improvement programs (U=702,50, Z=-2,331, p=0,02).

4. DISCUSSION

Majority of respondents are functional/department managers as in previous study, but also significant percent of respondents are process analyst. Respondents job title preliminary show that companies are aware of business process importance. Respondents' understanding of BPM is different in 2014 compared to 2012, but not significantly. Companies are more oriented to process improvement in order to reduce costs, but respondents also understand that BPM enables managing whole organization through business process management, like in previous study. In 2012 study, majority of the companies were at Level 1 or 2 of CMMI process maturity, while in 2014, there is growing percent of companies which are on the Level 4 or 5. Still, the majority of the companies are at Level 2 or 3, which is in accordance with companies in the world (Wolf and Harmon, 2012). Other answers to the questions concerning process maturity are in accordance to these results (see table 1). This can be a consequence of the greater business process awareness in companies.

The number of respondents who reported that process improvement initiatives are always being able to identify are remove problems is higher in 2014, compared to 2012 study. This corresponds with higher process maturity level, which implies that processes are well documented, monitored and measured. with this situation, it is significantly easier to detect errors when they happen, as well as to react in short time and with greater accuracy, thus making problem solving more efficient.

Companies in Serbia still do not have formal group for process work, and this can be a future task for our companies, especially because Chi-square test shows that companies which do not have formal BPI group are less successful in their process improvement program.

Regarding the main driver for business process change, there is significant difference between results, since companies are less oriented on improving customer satisfaction, and more on cost reduction and QMS certification. Chi-square test shows that QMS certification as driver for process change is more typical for manufacturing companies than services. The number of companies engaged in core process redesign increased in 2014, while number of companies engaged in incremental improvement activities, such as Lean, Six Sigma, or Kaizen, decreased.

Situation that might concern practitioners is growing lack of interest within top management for process improvements, especially in large companies. This is the main obstacle in starting with process improvement initiatives. The main cause of unsuccessfulness of BPI program is also lack of interest within top management. Companies in Serbia are also facing with the problem that management doesn't want to invest in process change projects at this time, which can be attributed to different priorities in transitional economies. Companies that work longer than 5 years on process improvement have a problem with lack of resources for realisation of multiple projects. It is encouraging that 5 companies stated that they do not have resistance at all, and that majority of companies reported that process improvement is part of normal work environment or that interest in process improvements was expanding.

The results show that more companies were engaged with business process architecture development, process modeling, and process measurement. This contributes to the higher overall level of process maturity in companies operating in Serbia. These projects established a foundation for future business process initiatives, which is why it is not surprising that these companies are expecting for process improvement to become everyday effort. This is why these companies, encouraged with positive results obtained at a lower level of process improvement, are ready to tackle greater projects regarding process improvement, such as core process redesign.

Continuous process improvement is traditionally focused on operations. However, there's a trend of shifting continuous process improvement practices toward service sector. By combining continuous improvement practices with IT knowledge, new process improvement concepts, such as Lean IT and agile programming, emerged. This new body of knowledge made IT sector very appealing for process improvement initiatives, especially within service industry.

Majority of the companies had enterprise-wide deployments of process improvement work, what is reflective of the fact that majority of companies worked on those improvements more than 2 years. Average length of process improvement project is less than six months, which indicates that quick wins are necessary in order for bigger process improvement initiatives to gain acceptance.
Survey shows that 25 of 26 companies which report that they were successful in BPI program deployed longer than two years BPI, so it can be concluded that past experience with process improvement projects plays a significant role in the success of improvement initiatives. Large companies are more oriented to enterprise wide deployment of BPI, while small companies implement BPI methodologies in specific business units (frequently marketing and sales).

5. CONCLUSION

Considering the results obtained from the comparison study, it can be concluded that companies in Serbia have greater process awareness now than in 2012, when this research was conducted for the first time. Companies in Serbia are at greater level of process maturity which is now closer to the leading global companies. In favour of this fact is that process specialists are able to solve the problems in companies. This higher level of process maturity helps companies to focus their process improvement efforts, thus making problems more manageable, and problem solving more efficient.
Although quick wins are essential for maintaining the momentum of process improvement efforts, more companies recognize the need to advance to a higher level of business process management. This includes establishing enterprise-wide system for process measurement and management, as well as redesign of core processes.

Formal process groups are a major process improvement success factor, which is why one of first steps in embracing process improvement practice should be the formation of specialized process teams, dedicated solely to business process management promotion.

Challenges for process improvement are also new, with lack of interest within top management being the most significant of them all. Top management should be the driving force behind all change initiatives, which is why their support is of the outmost importance. In order to obtain this support, an aggressive education policy is needed, in order to present all benefits that business process management might bring to companies strengthening business-academia connections should be one of key steps in this effort.

REFERENCES

Jeston, J., & Nelis, J. (2006). Business Process Management: Practical Gudelines to Successfull Implementations. Oxford: Elsevier Ltd.

Lientz, B. P., & Rea, K. P. (2001). Professional's guide to process improvement: maximizing profit, efficiency, and growth. Harcourt Professional Publishing.

Madison, D. (2005). Process Mapping, Process Improvement and Process Management. Paton Professional.

Process Excellence Network (2012). Trends and Success Factors in Business Process Excellence. Retrieved from http://www.processexcellencenetwork.com/lean-six-sigma-business-transformation/white-papers/trends-and-success-factors-in-business-process.

Radović, M., Tomašević, I., Stojanović, D., & Simeunović, D. (2012). Inženjering procesa (2nd ed.). Belgrade, Serbia: Faculty of Organizational Sciences.

Siha, S. M., & Saad, G. H. (2008). Business Process Improvement: empirical assessment and extensions. Business Process Management Journal , 14 (6), 778-802, doi: 10.1108/14637150810915973

Skalle, H., Ramachandran, S., Schuster, M., Szaloky, V., & Antoun, S. (2009). Aligning Business Process Management, Service Oriented Architecture and Lean Six Sigma for Real Business Results . Retrieved from Red books IBM: http://www.redbooks.ibm.com/redpapers/pdfs/redp4447.pdf

Simeunović B., Tomašević I., Stojanović D., Radović M.,& Slović D. (2012, september) Lean Implementation in Transitional Countries: Case of Serbia. Paper presented at the Universidade Lusiada - Porto at International Conference IS2012 ″Innovation fo Sustainability″.

Stojanovic, D., Simeunovic, B. & Radovic., M. (2012a, September). Lean Thinking in Serbian Industry. Paper presented at the University of Novi Sad, Faculty of Technical Sciences, in 1nd International Scientific Conference On Lean Technologies.

Stojanović, D., Simeunović, B., & Tomašević, I. (2012b, May). Selection of Six Sigma business process improvement projects. Paper presented at Serbian Project Management Association in XVI International conference of project management.

Stojanović, D., Simeunović, B., & Tomašević, I. (2012c, Jun). The State of BPM in Companies in Serbia. Paper presedented at University of Belgrade, Faculty of organizational sciences in XII International Symposium of Organizacitional Sciences ″Innovative Management & Business Performance″.

Wolf, C., & Harmon, P. (2012). The State of Business Process Management 2012. Retrieved from http://www.bptrends.com/bpt/wp-content/surveys/2012-_BPT%20SURVEY-3-12-12-CW-PH.pdf

Zellner, G. (2011). A structured evaluation of business process improvement approaches. Business Process Management Journal, *17*(2), 203-237. doi: 10.1108/14637151111122329

OPERATIONS MANAGEMENT RESEARCH: AN UPDATE FOR 21ST CENTURY

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Abstract: *First systematic operations management research agenda emerged in 1980, with subsequent updates and additions in 1981, 1987, 1989, and 1999. Since no similar research has been conducted in 2000's, we believe it is time to assess operations management research in the 21st century. In this paper, we have studied the operations management output from eight academic journals in 4 years period (2009-2012), and compared the results with similar research conducted in the 1980's and 1990's, in regard to topics covered in operations management articles, and methodology used in operations management related research. The results show that there's a significant difference in topical coverage of operations management research being performed in the 2000's vs. the 1990's and the 1980's. Growth of interest in strategy is evident from the results, while modelling still stays dominant method in operations management research. However, a certain shift towards empirical research methodologies is present.*

Keywords*: Operations management, research topics, methodology, literature*

1. INTRODUCTION

Operations management (OM) can be defined as a design, operation, and improvement of the systems that create and deliver company's primary products and services (Chase et al., 2006) (p.9). The field of OM has been evolving for decades now, trying to distinct itself from the fields of operations research, management science, and industrial engineering by establishing its own body of knowledge and literature (Buffa, 1980; Meredith et al, 1989; Pilkington and Liston-Heyes, 1999). Operations management academics have researched OM related academic journals (Buffa, 1980; Chase, 1980; Miller and Graham, 1981; Hill et al., 1987; Amoako-Gyampah and Meredith, 1989; Meredith et al., 1989; Pennirselvam et al., 1999) in an attempt to establish a research agenda that will be in accordance with the needs of the industry.

In order to test if the proposed agendas have been followed, we've conducted the analysis of OM themed articles published in a four years period, from 2009 to 2012. The main goal was to study current trends regarding topical and methodological coverage of OM output, and compare it to trends and directions proposed in previous research. In order to compare the results of our research to research conducted in the 1980's and 1990's, we have modelled our study after the ones done by Amoako-Gyampah and Meredith (1989) and Pennirselvam et al. (1999).

The remainder of the paper is organized as follows: after the short review of similar research conducted in the past, methodology used in this study will be presented; after that, the results of the study will be presented; our results will be compared to the results from similar research performed in the 1980's and the 1990's; discussion and conclusions will follow.

2. LITERATURE REVIEW

The literature review will mainly be focused on studies similar to ours. Buffa (1980) proposed a first systematic OM research agenda. His agenda was aimed at solving real life problems in operations, and his predictions were that OM would move away from mathematical modelling. Buffa considered OM research to be narrow, based mostly on single-criterion quantitative models. He emphasized the importance of strategic planning decisions, and identified main topics to be manufacturing strategy and technological choice, job design, capacity planning, and facility location choice. Buffa also identified operations planning and control as an important topic to be addressed in the future, as well as operations in service systems.

Chase (1980) classified and evaluated OM research prior to 1980's. His results show that inventory control and scheduling are two most frequent subjects in OM research, and that research was mainly oriented towards solving problems on a micro level. He identified the evident lack of integrative component of the research, which he thought was bad for the field. Model formulation and mathematical/computer manipulation of the model were identified as dominant research strategies, thus rendering OM research

rather abstract, and making it technique oriented instead of knowledge oriented. Chase also observed that operations management does not draw upon management theory, which he found to be very unfortunate, since managerial issues such as organizational structure might be constraining factors for OM application.

Miller et al. (1981) used Delphi-like procedure among researchers and practitioners in order to generate discussion of potential agenda for operations management. The authors identified four main areas of operations management research: operations policy, operations control, service systems, and productivity and technology. Miller et al. (1981) state that more application work and field based research is needed, but that the peer review process and time constraints stand as an obstacle to action oriented research. The authors also emphasize the need for more human and organizational oriented research.

Hill et al. (1987) analyzed if Miller et al. (1981) agenda was being followed by surveying dissertations in Business Administration and Management completed in the U.S.A. during the period 1980–1986. Their research reports that inventory control and scheduling are still most popular research topics. They also report the increase in popularity of process design, strategy and quality. Hill et al. (1987) identified the need for new research methodologies to address more managerial and macro-level issues.

Meredith et al. (1989) summarized previous research, and concluded that OM research failed at being integrative and useful to operations managers and practitioners. Authors proposed a framework for research methods, and applied the framework to operations management research. They have identified quality management and technology implementation as fertile areas for future research.

Amoako-Gyampah and Meredith (1989) analyzed articles in the field of operations management appearing in ten journals for the time period of 1982-1987. The authors compared their findings to pre 1980's OM research, and concluded that work measurement significantly lost in popularity compared to previous research, while process design gained in popularity. Their research shows that inventory control has held high popularity in research topics. Amoako-Gyampah and Meredith (1989) also surveyed the proceedings of Decision Sciences Institute for 1986 and 1987, in order to compare published research with pipeline research. Inventory control and scheduling remained the most popular topics in pipeline research, while service system research has shown increase in popularity in pipeline research (14% of articles in pipeline research vs. 6% of articles in published research). The authors also surveyed the research approaches used in OM research, and the results show that modelling and simulation have been predominantly used as research methods.

Pennirselvam et al. (1999) compared the results of their study with the ones presented by Amoako-Gyampah and Meredith (1989). Their findings show significant changes in the kind of research being performed in the 1990's compared to the research in the 1980's, with greater interest in strategy and quality. The authors state the OM research is more integrative in nature in the 1990's. Modelling is still dominant methodology used in research, while the expected increase in case study research was not met. The authors also conducted a study of pipeline research, and identified quality as most popular topic.

3. RESEARCH METHODOLOGY

In order to compare the results of our study with the ones presented by Amoako-Gyampah and Meredith (1989) and Pennirselvam et al. (1999), we analyzed the same journals covered in their studies. Impact factors analysis and journal categorization show that these journals are still relevant in the field of OM. Research that analyzes the relative importance of journals used in operations management back up this claim (Theoharakis et al., 2007; Machucha et al., 2007; Barman et al., 2001; Soteriou et al., 1999;). We have surveyed original seven journals covered in Pennirselvam et al. (1999) research: International Journal of Operations and Production Management (IJOPM), International Journal of Production Research (IJOPR), Journal of Operations Management (JOM), Production and Operations Management (POM), Decision Sciences (DS), Management Science (MS), and IIE Transactions (IIET). We added International Journal of Production Economics (IJPE) to our study, since it is perceived by OM academics as a high quality OM-related journal.

We classified the articles from the selected journals by topic areas and by research methodologies. The topic areas chosen were those used in similar research (Chase, 1980; Amoako-Gyampah and Meredith, 1989; Pennirselvam et al., 1999). This allowed us to compare our results to previous findings. First step in article analysis was to determine whether the article in question was and OM article or not. If the article is an OM article, OM topics areas were analyzed, as well as methodology used in the article. All doubts regarding OM/not OM classification, topic and method coverage were resolved by consensus between authors. Emerging topics, such as supply chain management, role of operations in sustainability, performance measurement and management, lean/agile operations, and new product/service design/development were

identified, and fitting those articles into one of 17 OM topics category was quite a challenge. Some of the articles surveyed address more than one OM topic. In such cases, we counted each of the topics that were addressed because the objective of this research was to identify the current topics of interest. We also kept track of the type of topics that are studied in combination and the frequency of topic combination occurrences to look for trends in integrative research in OM. Also, multiple research methods were used in some articles. We have identified single methods, as well as combinations of methods.

4. RESULTS OF TOPIC/METHODS ANALYSIS

The following sections will cover the analysis of topical coverage and methodology used in OM output analyzed in this study.

4.1 Topical coverage

We have analyzed 4318 articles published between 2009 and 2012, and identified 2802 as OM articles. Total number of counted OM topics is given in Table 1.

Table 1: Total number of OM topics counted

No of articles	No of topics	Topics counted
2324	1	2324
456	2	912
22	3	66
Total OM topics counted		3302

Table 2 presents the coverage of OM topics by journals. It shows that's strategy has gained in popularity in recent years, accounting for 18.63%. Inventory control and scheduling are still positioned high, accounting for 17.84% and 15.35% respectively. Process design and quality are also positioned in the top part of the table, accounting for 9.96% and 8.03% respectively.

Last two columns in Table 2 show percentages of topics for periods 2009-2010 and 2011-2012. The results show that topics have held their positions for both time periods, although there was a decrease in percentage for strategy in 2011-2012 period, as well as a slight increase in percentage for scheduling for the same period. It can also be seen that topics occupy same positions in two-year time periods and in four year (cumulative) time period.

In order to look for integrative research in operations management, we have analyzed types of topics that are studied in combination, as well as the frequencies of their occurrence. The results show that most popular combination is inventory and control and scheduling, accounting for 7.11%. Combination of strategy and process design follows with 4.18%, followed by distribution and inventory control, and forecasting and inventory control with 3.14% for each combination. Besides combinations mentioned above, there are 142 more, but most of them have total count of 1 or 2.

During the study, we have also identified emerging topics in operations management, which were not covered by the original list of OM topics described by Chase (1980), and Amoako-Gyampah and Meredith (1989). Supply chain management (SCM) is by far the most common emerging topic, with total count of 573 (47.95%) occurrences. SCM is not that new of a field in OM research, but since it was not included in the original 17 topics, we have decided to count it as an emerging topic. SCM is followed by Role of operations in sustainability with total count of 100 (8.37%) occurrences, Performance measurement and management with total count of 99 (8.28%) occurrences, Lean/agile operations with total count of 91 (7.62%) of occurrences, and New product/service design/development with total count of 78 (6.52%) of occurrences. All other emerging topics comprise remaining 21.26%.

4.2 Research methods

Table 3 presents a matrix of methods used in OM research by journals. The matrix consists of single methods used in research, as well as combination of methods that we have encountered in our study. Methods are sorted by frequency of occurrence. The results in the table show that modeling is still used the most in OM research, with the account of 43.61% in total. The percentages are similar in periods 2009-2010 and 2011-2012, as can be seen from last two columns of the table.

Table 2: Topical coverage of operations management research

Topic area	DS		IIET		IJOPM		IJPE		IJPR		JOM		MS		POM		Total	%	%	%
	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012			2009/ 2010	2011/ 2012
Strategy	20	13	8	8	41	40	111	116	48	94	25	23	22	24	13	9	615	18.63	20.37	17.32
Inventory control	3	7	19	18	5	3	111	170	85	98	2	7	19	10	13	19	589	17.84	18.18	17.58
Scheduling	1	1	15	11	1	3	54	38	121	230		3	3	3	6	17	507	15.35	14.21	16.21
Process design	4	1	12	20	6	15	46	50	67	78	5	8	8	3	1	5	329	9.96	10.54	9.53
Quality	5	3	15	14	12	21	25	33	39	60	6	16	7	7	1	1	265	8.03	7.78	8.21
Distribution	4	2	10	9	2	6	18	60	10	45	7	5	5	4	1	7	195	5.91	4.03	7.31
Purchasing	3	1	4	2	14	10	8	34	16	31	13	12	5	10	1	3	167	5.06	4.53	5.46
Capacity planning		1	8	2		3	25	24	16	27	1	3	2	5	2	1	120	3.63	3.82	3.50
Services	8	1	5	3	6	9	4	8	1	1	3	10	5	8	11	17	100	3.03	3.04	3.02
Maintenance			10	10	2		12	9	7	29	1			2	1	1	84	2.54	2.33	2.70
Aggregate planning	1		1	1	5		13	15	18	15		2	1		2	2	76	2.30	2.90	1.85
Facility layout			1	2	1	1	4	5	22	29	1		1			2	69	2.09	2.12	2.07
Forecasting		1		1		3	24	14	4	4		1	4	3	4	3	66	2.00	2.55	1.59
Facility location	1		7	2		1	11	20	3	4	1		1		1	1	53	1.61	1.77	1.48
Project mngmnt	2	1			3	3	7	8	2	3	2	4	1		1	1	38	1.15	1.27	1.06
Quality of work life					1	3	3	5		3		1			1		17	0.51	0.35	0.64
Work msrmnt			1	1		1	1	1		3		1		1	1	1	12	0.36	0.21	0.48
Topic count	52	32	116	104	99	122	477	610	459	754	67	96	84	80	60	90	3302	100.00	100.00	100.00
Number of articles	35	29	88	78	90	103	399	512	432	673	49	69	67	54	55	69	2802			
Total percentage	1.25	1.03	3.14	2.78	3.21	3.68	14.24	18.27	15.42	24.02	1.75	2.46	2.39	1.93	1.96	2.46	100.00			

Table 3: Methodologies used in OM research

Methodology	DS		IIET		IJOPM		IJPE		IJPR		JOM		MS		POM		Total	%	%	%
	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012	2009/ 2010	2011/ 2012			2009/ 2010	2011/ 2012
Modeling	9	9	44	35	1	3	164	218	254	356	6	4	14	12	37	56	1222	43.61	43.54	43.67
Case Study	3	1	3	10	27	28	32	54	30	72	14	20	22	16	2	3	337	12.03	10.95	12.85
Survey	13	9	2		46	54	46	78	19	15	15	29	1	2	5	2	336	11.99	12.10	11.91
Theoretical/conceptual	3		5	6	8	2	44	47	45	49	3	1	9	7	3		232	8.28	9.88	7.06
Simulation	2	1	5	10			37	31	56	46	2	2	4	3	4	6	209	7.46	9.05	6.24
Modeling and Simulation		1	4	4			8	6	4	63				2			92	3.28	1.32	4.79
Laboratory Experiment		3	2	3			25	36	2				2	4	1	1	79	2.82	2.63	2.96
Modeling and Case Study			6	3			7	8	1	42	2		2		1		72	2.57	1.56	3.34
Field Study	5	4	1		4	3	19	9	6	6		6	1	2		1	67	2.39	2.96	1.95
Literature review			1	2	1	5	7	6	9	9		1	11	4	2		58	2.07	2.55	1.70
Modeling and Laboratory experiment		1	11	3			4	14									33	1.18	1.23	1.13
Modeling and Survey					1	5	1	2			2	2		1			14	0.50	0.33	0.63
Theoretical/conceptual and Modeling			1				1	1		5		2					10	0.36	0.16	0.50
Theoretical/conceptual and Case Study					1	1	2		1	3							8	0.29	0.33	0.25
Modeling and Field Study			1	1					1	3	1			1			8	0.29	0.25	0.32
Simulation and Case Study				1			2		1								4	0.14	0.25	0.06
Theoretical/conceptual and Laboratory Experiment								1	1				1				3	0.11	0.16	0.06
Theoretical/conceptual and Field study			1					1				1					3	0.11	0.08	0.13
Theoretical/conceptual and Survey					1					1	1						3	0.11	0.16	0.06
Theoretical/conceptual and Simulation									1	1	1						3	0.11	0.16	0.06
Literature review and Theoretical/conceptual						2						1					3	0.11	0.00	0.19
Literature review and Case Study										1	1						2	0.07	0.08	0.06
Literature review and Simulation									1								1	0.04	0.08	0.00
Simulation and Field Study										1							1	0.04	0.00	0.06
Simulation and Laboratory Experiment			1														1	0.04	0.08	0.00
Literature review and Survey											1						1	0.04	0.08	0.00
Article total	35	29	88	78	90	103	399	512	432	673	49	69	67	54	55	69	2802	100	100	100
Article percentage	1.25	1.03	3.14	2.78	3.21	3.68	14.24	18.27	15.42	24.02	1.75	2.46	2.39	1.93	1.96	2.46	100			

It is interesting to note that case study is second most popular method used in OM research, accounted for 12.03%, which is a significant increase in popularity compared to study performed by Pennirselvam et al. (1999). Survey is very close, accounting for 11.99%, while simulation decreased from 17.84% in 1999 to 7.46%. Modelling is mostly used in inventory control and scheduling research, which in accordance with results from previous studies. Empirical methods, namely case study and survey, are predominantly used in research that is dealing with strategic issues of operations management. All other research methodologies account for less than 8%.

Modeling and simulation is the most popular combination used in OM research, accounting for 3.28%. It is also interesting to note the number of times a "hard" methodology, such as modeling or simulation, is backed up with "soft", empirical methodology, namely case study, field study, or survey. The results show that a total number of combinations of "hard" and "soft" research methods accounts for mere 3.53%.

5. COMPARISON WITH PREVIOUS STUDIES AND DISCUSSION

Our main goal was to study research topics and methodology used in operations management research, and to compare it with previous studies of similar type, in order to see whether the established research agendas are being followed, and to see if new trends arose in the 21st century. Table 4 shows comparison of findings from our study, with findings presented by Amoako-Gyampah and Meredith (1989), and Pennirselvam et al. (1999) in their studies.

Table 4: Comparison of OM topics in 1980's, 1990's, and 2000's

Topics	Amoako-Gyampah and Meredith study		Pennirselvam et al. study		Our Study	
	Ranking	%	Ranking	%	Ranking	%
Inventory control	1	28.15	2	16.19	2	17.84
Scheduling	2	16.89	1	25.54	3	15.35
Process design	3	15.23	4	11.29	4	9.96
Aggregate planning	4	11.26	15	0.66	11	2.30
Services	5	6.29	8	2.71	9	3.03
Quality	6	3.97	3	11.34	5	8.03
Strategy	7	3.64	5	10.88	1	18.63
Project management	8	3.31	12	1.74	15	1.15
Capacity planning	9	2.98	9	2.09	8	3.63
Maintenance	10	2.65	10	2.04	10	2.54
Purchasing	11	1.66	11	1.99	7	5.06
Facility layout	12	1.66	6	7.61	12	2.09
Forecasting	13	1.32	14	1.02	13	2.00
Quality of work life	14	0.33	17	0.20	16	0.51
Facility location	15	0.33	13	1.07	14	1.61
Distribution	16	0.33	7	3.12	6	5.91
Work mesurement	17	0.00	16	0.51	17	0.36
Total		100.00		100.00		100.00

In order to test the proportions obtained from our research with the ones given by Amoako-Gyampah and Meredith (1989), and Pennirselvam et al. (1999), we have performed a chi-square test, and hypothesized that relative proportions from all three studies are the same. The results from the chi-square test indicate that the differences between the proportions from all three studies are significant, at an alpha level of 0.01.

The topic that contributes the most to the difference between the proportions is strategy. Our study shows that strategy is the most popular OM research topic, while it was ranked as 5th and 7th topic in Amoako-Gyampah and Meredith (1989), and Pennirselvam et al. (1999) studies, respectively. This rise in popularity was predicted by Amoako-Gyampah and Meredith (1989), and confirmed by Pennirselvam et al. (1999) study, as well as in our study. It is interested to note that growth in popularity of strategy corresponds to the growth of popularity of emerging topics. To test this, we have analyzed further the relationship of emerging topics with the traditional OM topics, and found out that in most of the cases emerging topics were included under strategy, where more than 50% of articles about supply chain management were dealing with strategic issues of operations management. The situation is even more indicative with lean/agile operations, where nearly 70% of the articles were included under strategy. Inventory control and scheduling are still positioned high on the list (2nd and 3rd place), as was the case with previous research. Inventory control and scheduling are two topics that are traditionally combined one with another, but what is interesting is the rise of combinations of inventory control with other OM topics, especially the ones that are dealing with logistical aspects of operations, namely purchasing and distribution. This is an encouraging fact, showing a sign of

integrative approach of current OM research. Process design is also positioned high on the list, as was the case with previous research. It is frequently combined with strategy, which was also shown in Pennirselvam et al. (1999), but there's an increase of process design/quality combinations compared with the mentioned study.

As far as methodology goes, modeling is still number one choice among OM researchers. This fact is unsettling, because it contributes to the fact that OM is perceived as an artificial discipline, detached from real-life problems, since modeling is still utilized more than empirical research. What gives hope is the fact that the results show the increase of survey and case study utilization in OM research. This corresponds to the rise of interest in strategic issues of operations, since survey and modeling are methods mostly used in strategy research. This deflection from artificial and axiomatic research is also noted by Craighead and Meredith (2008), but it is not enough to make a paradigm shift in operations management research. Although it wasn't addressed explicitly in this study, action based research is still not used enough in OM research, whiles many scholar stress the importance of action oriented research, since it can contribute to knowledge as well as to practice (Coughlan and Coghlan, 2002; Näslund et al., 2010; Sheikhzadeh and Heidari, 2012). The popularity of modeling can be attributed to one of two factors. Firstly, high level of rigor is required in top-ranked scientific journals, which puts reviewers in a tough position. Reviewers are often unable to recognize the work properly executed with less-of-a-standard methodologies, while some reviewers perceiving case and action-based methodologies as less structured than traditional analytical modeling (Barratt et al., 2011). Secondly, in today's "publish or perish" environment, the authors are forced to walk the tested paths, and use "proven" methods in their research. This saves their time, since they don't have to spend months (or even years) in a real life environment trying to solve concrete problems, and grants them a better starting position in a review process, since they too are aware that a high level of rigor can more easily be followed by utilizing traditional research methods, such as mathematical optimization or simulation.

Pennirselvam et al. (1999) stated in their study that a new, more relevant list of OM topics might be needed, having in mind the rise of popularity of supply chain management and new product/service development/design. We concur with this point, as our study also shows the popularity of supply chain management, as well as other topics, such as lean/agile operations and performance measurement and management.

6. CONCLUSIONS AND FURTHER RESEARCH

The main goal of this study was to compare the current state of operations management research (topic- and methodology-wise) with similar research conducted in the past. The results have confirmed some conclusions from the past research, and have backed up some predictions regarding topical coverage of OM research. Two main problems still are the lack of integrative approach to OM research, and detachment of OM research from real-life problems. Although some advancement has been made, the number of articles which combine several topics in one research is still relatively small. Mathematical modelling is still dominant methodology used in OM research, although case study and survey gained in popularity. This gain is in correlation with the rise of popularity of strategic topics, since these two methodologies are most frequently used in this type of research.

An update of OM topics list is definitely needed, since it is hard to categorise some articles that are OM in nature by using the existing topic list. Some new topics have been noted in earlier research, such as supply management, new product development, and sustainability and environmental concerns. In the meantime, more topics have emerged, such as lean/agile operations and performance measurement and management.

Previous studies compared published research to pipeline research, and the result show differences both in topical coverage and in methodologies being utilized. The future of our research would be to cover more years with published research, and also to analyze conference proceedings in order to see if anything has changed regarding the relationship between published and pipeline research. It would also be interesting to see if new research methodologies are being used with the emerging topics, and to devote a special study to action-based research, and the way it is represented in top-tier OM related journals. Since action research is advocated by many OM scholars, we think that a separate study on action research in operations management is needed.

REFERENCES

Amoako-Gyampah, K., & Meredith, J. R. (1989). The operations management research agenda: an update. Journal of Operations Management, 8(3), 250-262.

Barman, S., Hanna, M. D., & LaForge, R. L. (2001). Perceived relevance and quality of POM journals: a decade later. Journal of Operations Management, 19(3), 367-385.

Barratt, M., Choi, T. Y., & Li, M. (2011). Qualitative case studies in operations management: trends, research outcomes, and future research implications. Journal of Operations Management, 29(4), 329-342.
Buffa, E. S. (1980). Research in operations management. Journal of Operations Management, 1(1), 1-7.
Chase, R. B. (1980). A classification and evaluation of research in operations management. Journal of Operations Management, 1(1), 9-14.
Chase, R., Jacobs, F., Aquilano, N. (2006). Operations Management for Competitive Advantage. McGraw-Hill, New York.
Coughlan, P., & Coghlan, D. (2002). Action research for operations management. International journal of operations & production management, 22(2), 220-240.
Craighead, C. W., & Meredith, J. (2008). Operations management research: evolution and alternative future paths. International Journal of Operations & Production Management, 28(8), 710-726.
Hill, A. V., Scudder, G. D., & Haugen, D. L. (1987). Production/Operations Management Agenda for the 80's: A Progress Report. In Proceedings of the 1987 DSI Conference, Decision Sciences Institute, Boston, MA (pp. 840-842).
Machuca, J. A., González-Zamora, M. D. M., & Aguilar-Escobar, V. G. (2007). Service operations management research. Journal of Operations Management, 25(3), 585-603.
Meredith, J. R., Raturi, A., Amoako-Gyampah, K., & Kaplan, B. (1989). Alternative research paradigms in operations. Journal of operations management, 8(4), 297-326.
Miller, J. G., Graham, M. B., Freeland, J. R., Hottenstein, M., Maister, D. H., Meredith, J., & Schmenner, R. W. (1981). Production/operations management: agenda for the'80s. Decision Sciences, 12(4), 547-571.
Näslund, D., Kale, R., & Paulraj, A. (2010). Action research in supply chain management—a framework for relevant and rigorous research. Journal of Business Logistics, 31(2), 331-355.
Pannirselvam, G. P., Ferguson, L. A., Ash, R. C., & Siferd, S. P. (1999). Operations management research: an update for the 1990s. Journal of Operations Management, 18(1), 95-112.
Pilkington, A., & Liston-Heyes, C. (1999). Is production and operations management a discipline? A citation/co-citation study. International Journal of Operations & Production Management, 19(1), 7-20.
Sheikhzadeh, A., Heidari, H. (2012). Operations management research: a 10-year survey. In: Proceedings of the 2012 International Conference on Industrial Engineering and Operations Management, Istanbul, Turkey (pp. 2472-2481).
Soteriou, A. C., Hadjinicola, G. C., & Patsia, K. (1999). Assessing production and operations management related journals: the European perspective. Journal of Operations Management, 17(2), 225-238.
Theoharakis, V., Voss, C., Hadjinicola, G. C., & Soteriou, A. C. (2007). Insights into factors affecting Production and Operations Management (POM) journal evaluation. Journal of Operations Management, 25(4), 932-955.

ORGANIZATION OF BUSINESS SYSTEMS

COMPARISON OF DIFFERENT QUANTITATIVE APPROACHES TO ASSESMENT OF ORGANIZATIONAL CULTURE

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Abstract: *Different authors point out that the organizational culture is a very important aspect of every organizational system. They all agree that it is usually influenced by various factors and that their combinations generate different types of culture. However, if its elements are managed properly, organizational culture can present valuable competitive advantage and the source of organizational development. It is crucial for management of every organization to adequately deal with the cultural issues, to continuously project the desired condition of culture and to put the efforts on reaching it. In order to define necessary steps for improving the culture, current state of culture should be specified first, and then compared to the designed one. It means that organizational culture needs to be measured somehow. This article will provide two approaches for measuring and comparing the culture among individuals and organizations. Two models, developed by different researchers, but with significant similarities, will provide the method not only for quantifying the organizational culture, but also for developing certain factors that determine it, in order to improve the organizational performance. The results can present the managerial guidelines for leading organizational development through implementing changes in the culture.*

Keywords*: Organizational culture, behavior styles, quantitative approach, measuring, organizational change*

1. INTRODUCTION

The appearance of culture as a concept which is substantial for organizations has generated numerous questions and unresolved issues for the organizational design and development. Opened questions remain concerning the content of culture, the influence on organizational results, the possibility of measuring the culture and the feasibility of cultural change. It is generally accepted that the organizational culture is an important element of all organizations and an integral part of the organizational development (Waterman Jr., Peters, & Phillips, 1980).

Culture has been treated by organizational researchers as a set of cognitions shared by members of a social unit (O'Reilly, Chatman & Caldwell, 1991). These cognitions are developed through social interaction and process of socialization when individuals are in connection with different elements of culture. Professor Geert Hofstede defines national culture “as the collective programming of the human mind that distinguishes one group or category of people from another” (Hofstede, Hofstede, & Minkov, 2010). The "category" can refer to nations, regions within or across nations, ethnicities, religions, occupations, organizations or genders. At organizational level, he defines culture “as the collective programming of the minds of group members by which one group distinguishes itself from other groups”. According to Hofstede, differences between nations are on the deepest level of culture, on the level of values, as presented on Figure 1.

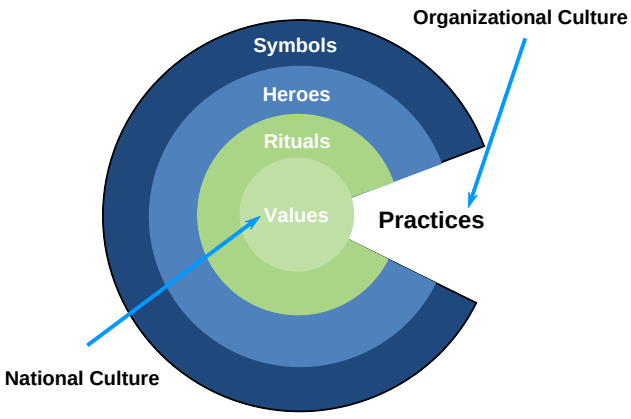

Figure 1: Different levels of culture (Hofstede, Hofstede, & Minkov, 2010)

Organizations that exist within the same national culture differ among themselves on a higher level of culture, the levels called practice (organizational rituals, heroes and symbols). It is level of practice which provides the information about the appropriateness of behaviors. Practice reinforces ways of thinking and behaving of individuals. It strengthens the connection between features in the environment and an individual's responses. There is an interpretation that individuals in organizations develop appropriate behaviors to reduce ambiguity and uncertainty of different events.

Different views on organizational culture and its components will be described in section 2 of this article. As presented on Figure 1, organizational culture can be layered. Each segment of the culture can be compared for different individuals, groups, nations, organizations etc. In order to compare any two features, they must be measured first. In section 3 of this article will be presented two tools for measuring the organizational culture. Each of them focuses on different elements of this phenomenon. However, the results that they provide have numerous similarities, which will be pointed out in the discussion part. Finally, certain conclusions and directions for future research will be given in section 5 of this paper.

2. THEORETICAL BACKGROUND OF ORGANIZATIONAL CULTURE

Relationships among people are recognized as a very important component in different organizational models (Jevtić, 2013). Waterman Jr. et al. (1980) propose *Stuff* as one of the elements in their 7S model. *People* are important part of Star model (Kates & Galbraith, 2007). Harold Leavitt (1965) also recognizes *People* as an organizational factor in his Diamond model. Such relations between members of an organization, together with their thoughts and perceptions, can be described as organizational culture. Different authors have different understandings and approaches to organizational culture.

Charles Handy (1976) describes four types of organizational culture: power culture, role culture, task culture and person culture. A *Power culture* characterizes influence that comes from a one person of group of people. Other members of organization, in which this culture is dominated, are as powerful as their possibility to freely get in touch with the supreme authority and with as few intermediaries as possible. Quick decision making and little bureaucracy are also characteristics of this culture. A *Role culture* characterizes highly defined structure and bureaucracy. In this culture, influence derives from a position in organizational structure, but not from expertise of employees. Role culture increases by procedures, job descriptions and role definitions. A *Task culture* characterize by the structuring of employees within teams. Power derives from expertise as long as a team requires expertise. This culture often exists within the matrix structure. *A Person culture* characterizes situations in which individuals are more important than the organization itself. This culture is appropriate for some professional partnerships, where each partner brings specific expertise to the organization.

Deal and Kennedy (1982) defined organizational culture as *the way things get done around here.* They differentiate four types of cultures: work-hard, play-hard culture, tough-guy macho culture, process culture and bet-the company culture. Those four types of cultures differ on how quickly the organization receives feedback, the way members are rewarded, and level of risks taken.

Cooke and Rousseau (1988) define culture as the behaviors that members believe, are required to fit in and meet their expectations, within their organization. Twelve behavioral norms are grouped into three general types of cultures. *Constructive cultures* characterize interactions among members and approach tasks in ways that help them meet their higher-order needs. *Passive-defensive cultures* characterize interactions among members in ways that will not threaten their own security. *Aggressive-defensive cultures* characterize interactions among members in forceful ways to protect their status and security.

Edgar Schein`s (1992) model of organizational culture has three levels. At the first level are organizational attributes that can be seen, felt and heard – known as *artifacts*. At this level of organizational culture we can see visible items, such as dress code, office design, furniture, rewards and recognition to employees, but also elements as logo and slogan of the company, mission statement and other elements. At the next level of organizational culture are values which represent preferences of individuals regarding certain aspects of business performance (i.e. loyalty and quality of provided services to consumers). Examining this level of organizational structure is mostly realized by interviewing members of the organization and by using questionnaires to obtain information regarding attitudes of employees. According to Schein, the lowest level of organizational structure assumes organizational assumptions. These are the elements of culture that are unseen and not cognitively identified in everyday interactions between organizational members. Surveys and interviews cannot be used for collecting data related to these characteristics of the organization.

Robert Quinn and Kim Cameron (2011) researched what makes organizations effective and successful. Their model of organizational culture distinguishes four culture types. Competing values produce polarities like: flexibility versus stability and internal versus external focus. These two polarities construct the quadrant with four types of culture. A c*lan culture* describes friendly workplace where leaders act like father figures. Clan culture organizations have internal focus and flexible structure. An *adhocracy culture* describes dynamic workplace with leaders that stimulate innovation. Adhocracy culture organizations have external focus and flexible structure. A *market culture* describes competitive workplace with leaders like hard drivers. Market culture organizations have external focus and high level of control. A *hierarchy culture* describes a structured and formalized workplace where leaders act like coordinators. Hierarchy culture organizations have internal focus and high level of control.

3. MEASURING THE ORGANIZATIONAL CULTURE

The study of organizational culture comes from qualitative research methods in the field of organizational behavior (Janićijević, 2011). This was expected, if we take into consideration that the main fields of interests of researchers from that area were social interaction, socialization, behavior and other areas which are typical for qualitative research. On the other hand, qualitative and quantitative methods are complementary approaches in studying organizations and their elements. Qualitative researches are useful in early phases of process of developing a concept (such as organizational culture) when there is no developed terminology used to describe phenomena and when there is a lack of information. The advantages of quantitative methods in examining the attributes of organizations also include the possibility of comparing the results between the organizations, cross-sectional comparisons, possibility of repeating the research in different organizations performed by different researchers, as well as objective interpretation of the obtained results. Two quantitative methods for measuring the organizational culture will be described in further text.

3.1. Organizational Culture Inventory

Inventory which was developed by Robert A. Cooke is one of the quantitative approaches to the assessment of a specific aspect of organizational culture – the shared norms and expectations that guide the think and behavior of members (Cooke & Rousseau, 1988). Rather than measuring organizational culture directly, Organizational Culture Inventory (OCI) focuses on the behavioral norms and expectations associated with the shared beliefs and values held by organizational members (Cooke & Szumal, 1993). Thus, inventory connects the aspects of culture that have the greatest impact on the activities of member and outcomes of the organization. Statements in the inventory describe some of the thinking and behavioral "styles" which members of an organization might be expected to adopt in carrying out their work and interacting with others. These statements measure 12 different cultural styles.

OCI measure more global aspects of culture such as shared beliefs and values and this is what differentiate the OCI from other tools for measuring organizational culture. Although the beliefs and values influence the behavior of people, in the case of norms and expectations, this impact is more direct. By measuring norms and expectations, the OCI makes the concept of culture somewhat less abstract and easier for understanding. The 12 styles of behavior are visualized on "Circumplex", researched and developed by Robert A. Cooke and Clayton Lafferty, in the period from 1973 to 2009, which shows the results for all styles and represents a cultural profile of the respondent's organization, as presented on Figure 2.

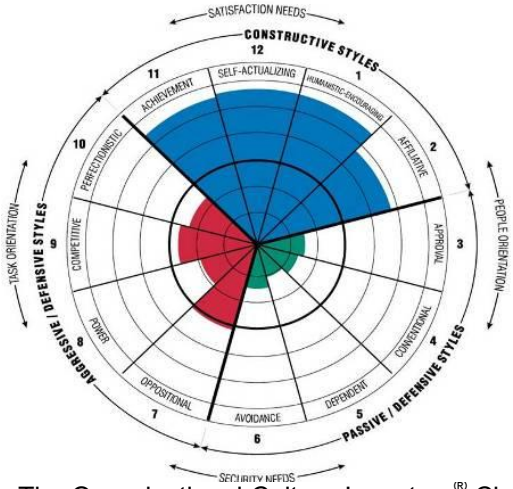

Figure 2: The Organizational Culture Inventory® Circumplex

According to these 12 types of norms we can make distinction between three general clusters:

1) **Constructive cultures** expect their members to interact with people and perform their tasks from the perspective of satisfying the higher-order needs (Self-Actualizing, Achievement, Humanistic-Encouraging and Affiliative norms).

2) **Passive/Defensive cultures** direct members of organization to interact with people in ways that will not jeopardize their own security (Approval, Conventional, Dependent, and Avoidance norms).

3) **Aggressive/Defensive cultures** encourage that the approach to tasks is directed towards protecting their status and security (Oppositional, Power, Competitive, and Perfectionistic norms).

The **Constructive** cluster considers norms of culture which are promoting the needs which has the higher-order of satisfaction and satisfaction behaviors. Constructive cultural norms are:

- (**11 o'clock** position) *Achievement culture.* This culture is typical for organizations which appreciate members who set and accomplish their own goals. These goals are ambitious but realistic. In realizing these goals, employees set up plans for reaching the goals, and **enthusiastically** pursue them. Organizations with achievement culture are effective and solve problems in a proper way. Their clients and customers are well-served, and organizations' and their members' orientation is healthy.

- (**12 o'clock** position) *Self-Actualizing culture.* Valuing creativity, quality and growth of an individual in cooperation with his task accomplishment are characteristics of this culture. In self-**actualizing** cultures employees are pushed towards personal development and enjoy in their work. Although these organizations are challenging for control, they attract outstanding employees and provide high-quality outputs with high level of innovativeness.

- (**1 o'clock** position) *Humanistic-Encouraging culture*. For these organizations it is typical to have person-center management with high level of employees' participation. Employees are pushed to be constructive and supportive which should lead towards effective organizational performance. Members of these organizations are highly satisfied **because** they have provided professional growth and active involvement in organizations' functioning and are highly committed to the organization.

- (**2 o'clock** position) *Affiliative culture.* Affiliative organizations have the constructive **interpersonal** relationships as the top priority. Loyalty, good cooperation and open communication in the work group is typical for these kind of organizations. Employees in affiliative organizations are sensitive to the satisfaction of their co-workers, friendly and open.

Cultural norms of **Passive/Defensive** cluster promote self-protective behavior in interactions with people. Passive/Defensive norms are:

- (**3 o'clock** position) *Approval culture*. Characteristic of these organizations is that they avoid conflict (mostly artificially) in interpersonal relationships. Employees are pushed to be liked by others and agree with all the decisions without giving their own opinion. Although the work atmosphere might be pleasant, effectiveness of these organizations is minimized because of limited "open-mindedness" of employees which are not giving constructive ideas.

- (**4 o'clock** position) *Conventional culture*. Traditional, bureaucratically organized and conservative organizations are typical example for conventional culture. Employees are conformists, they follow the rules, which is limiting innovation and suppressing the level of the organization's ability to adopt the changes occurred in its environment.

- (**5 o'clock** position) *Dependent culture.* If an organization has high level of hierarchical control and low level of employees' participation, we classify it as organization with dependent culture. Members of these organizations are highly limited with centralized decision of their superiors and they actions are highly directed by management. In dependent cultures, performance is not efficient because of low flexibility, no possibility to take initiative and long decision making process.

- (**6 o'clock** position) *Avoidance culture.* Organizations which do not highlight accomplishments but focusing on made mistakes are characterized with culture of avoidance. In these cultures, employees avoid responsibilities because of the negative reward system. Because the members of these organizations are not willing to take actions and make initiative, their survival is questionable.

Cluster of **Aggressive/Defensive** has norms which are oriented towards self-protective behavior and it values the way that members approach tasks. In Aggressive/Defensive cluster, norms are:

- (**7 o'clock** position) *Oppositional culture.* Prevailing negativism and confrontation is the most suitable for describing highly oppositional organizations. These organizations have employees which gain their status by high level of criticism and opposing the new ideas which enables safe decision making process. Unneeded conflicts and issues with problem solving are characteristics of oppositional cultures.

- (**8 o'clock** position) *Power culture.* When there is no participation and the functioning of the organization is based on the authority of the superiors, we have organization with power culture. In these organizational cultures, members have high control of subordinates because they believe they will be rewarded for that behavior. Low effectiveness is typical for these organizations, but members are mostly not aware of it, because subordinate they control are holding back the information and not interesting in giving the contributions.

- (**9 o'clock** position) *Competitive culture.* Competitive-oriented culture mostly values winning and employees are directed toward competing with each other. They believe their colleagues are their opponents and perceive their actions through a "win" or "lose" outcome. Because of limited interest in cooperating and highly set standards these organizations might be poorly effective.

- (**10 o'clock** position) *Perfectionistic culture.* Mostly preferred values in organizations with this culture are persistence, hard work and, of course, perfectionism. Making mistakes in these organizations is not acceptable and precisely defined goals which demand long working hours are not questionable. Although lower level of perfectionism is wanted, going to the extreme level can cause loosing the sight of the goal and becoming lost in details.

3.2. Hofstede model

Another approach to measuring organizational culture, which will be discussed here, was developed by Professor Geert Hofstede. He defines organizational culture as "the way in which members of an organization relate to each other, to their work and to the outside world that distinguishes them from other organizations" (Hofstede & Pedersen, 2002).

The questionnaire was aimed at collecting information on the same four types of manifestations of culture as covered in the interview checklist: symbols, heroes, rituals, and values. The first three are subsumed under the common label "practices" (Figure 1). Values items describe what the respondent feels "should be", practices items what she or he feels "is".

If we talk about dimensions for measuring organizational culture by using Hofstede model, we diversify two main groups of dimensions:

1) Autonomous group of dimensions
2) Semi-autonomous group of dimensions

Autonomous group includes six dimensions**:** organizational effectiveness, customer orientation, control, focus, approachability and management philosophy. On the other hand, group of **semi-autonomous group** has two dimensions: degree of acceptance of leadership style and degree of identification with the organization. In further text will be given the description of every dimension from Hofstede model.

First dimension is *Organizational effectiveness*. This dimension is closely connected with the effectiveness of the organization, and that connection is the closest among all the others. Organizational effectiveness distinguishes means and goal oriented cultures. Means oriented cultures focus on the way of performing work (the key question is "how"), while in the goal oriented cultures employees are primarily achieving internal goals (the key question is "what"), as shown on Figure 3. People from **very means** oriented culture are avoiding risks and giving limited effort at the workplace in reverse to **very goal** oriented culture.

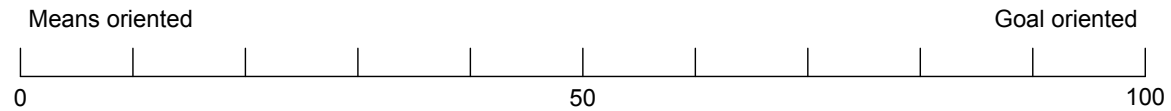

Figure 3: First dimension scale – Organizational effectiveness

Second dimension is *Customer orientation*. In comparison to the first dimension, this one is oriented towards the satisfaction of the customer or other interested parties. According to this dimension we separate internally driven and externally driven, as presented on Figure 4. In a case of **very internally** driven cultures business ethics and honesty are the most important and they work in favor of customer ant the world at large. Employees perceive that their most important task is to meet the customer's requirements in **very externally** driven cultures, and the ethical side of their performance is not in the focus. This dimension also shows how much is the organization's relations with surrounding programmed in advance.

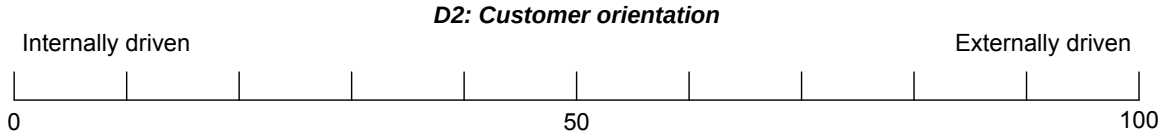

Figure 4: Second dimension scale – Customer orientation

Control, the **third** dimension of this model focuses on measuring the internal structure, control and discipline. As shown on Figure 5, this dimension classifies organizations as **easy-going cultures** if internal structure is loose, with little control and discipline and a lack of predictability, and if it has a lot of improvisation which provokes employees to think out of the box. On the other hand this dimension claims that the organization has very strict work discipline if people are prompt, cost conscious and serious. In difference to the second dimension, this dimension describes the predictability of internal functioning.

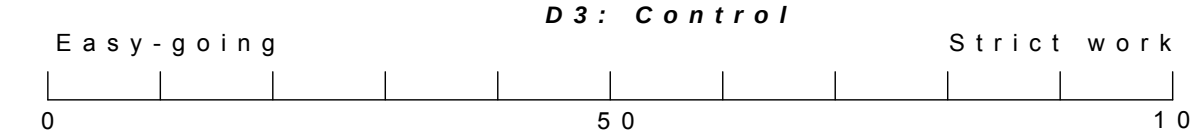

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Figure 5: Third dimension scale – Control

Fourth dimension is *Focus*. According to the focus dimension organizations are diversified by the influence of internal social norm, as presented on Figure 6. In that way, organizations are considered as **local companies** if employees identify with the boss and/or the business unit they belong to, and, the other possibility is to be a **professional company** if the identity of an employee is shaped by his profession and the content of his job. It is important to emphasize that this dimension is not related to the identification with the company as a whole, but the parts of it. The dimension related to the total organization will be explained hereinafter. Also, this dimension suggests that cultures which are classified as **very local** are short term directed and internally focused, and their characteristic is that an employee tends to be like everyone else in the organization.

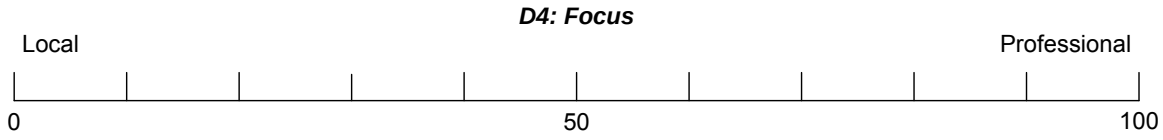

Figure 6: Fourth dimension scale – Focus

Fifth dimension is *Approachability*, presented on Figure 7. In terms of the accessibility of an organization Hofstede defined the fifth dimension, approachability. This dimension separate **open systems,** in which newcomers are immediately accepted, wheatear they are considered as outsiders or insiders. In these kinds of organizations everyone could fit in, while on the opposite side we have **closed systems** in which the situation is reversed. Also, we can mention that, from the aspect of satisfaction, employees' favorite preference is the open culture.

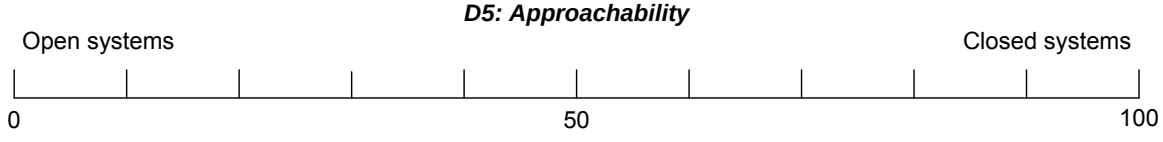

Figure 7: Fifth dimension scale – Approachability

Sixth dimension is *Management philosophy*. Management philosophy diversifies cultures to employee oriented cultures and work oriented cultures, as shown on Figure 8. **Employee oriented** organizations consider that people are more important than completing the job, no matter how high the price might be. Very employee oriented cultures take personal problems of staff into account, contrary to very **work oriented** organizations with a high pressure of performing the task if it harms employees.

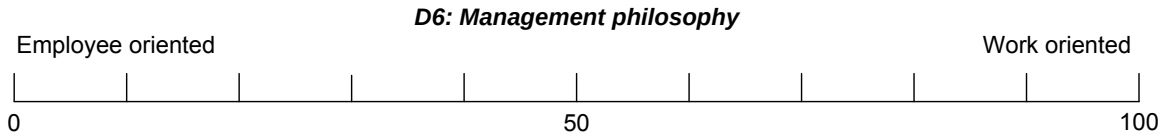

Figure 8: Sixth dimension scale – Management philosophy

Seventh dimension is *Degree of acceptance of leadership style*. In this dimensions difference is made by the answers of respondents give to the questions related to the comparison of true leadership style of their boss versus the leadership style they prefer, as presented on Figure 9. This dimension is different than the previous six, because there is no referent value, just the level of agreement with the preference of the respondents, and the value is correlated with the Power Distance Index of the 5-D Model.

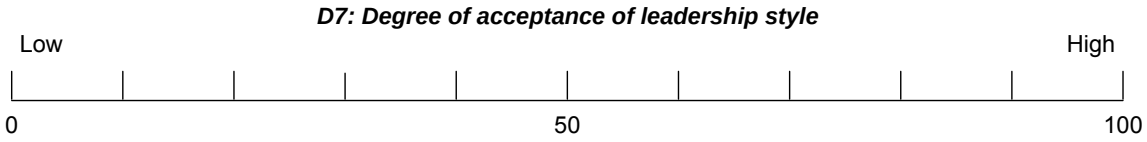

Figure 9: Seventh dimension scale – Degree of acceptance of leadership style

Eighth dimension, shown on Figure 10, is *Degree of identification with the organization*. In describing the fourth dimension, focus, we mentioned that it is not related to the identification with the company as a whole. For the information about the degree of cohesion between of the company Hofstede uses this, eight dimension. Results provided from this dimensions give us the answers about the homogeneity of the culture. As well as the previous dimension, this is also semi-autonomous dimension. We can also mention that scores achieved on this dimension has a certain degree of correlation with the scores on the second dimension, when the more internally driven organizations (low score of D2) most likely identify with the organization overall opposite to identification with stakeholders.

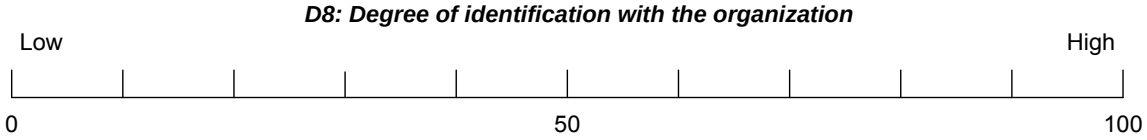

Figure 10: Eighth dimension scale – Degree of identification with the organization

All eight dimensions of Hofstede model are described in brief in Table 1.

Table 1: Overview of Hofstede model dimensions

Group of dimensions	Dimension	Dimension name	Low score	High score
Autonomous dimensions	**D1**	Organizational effectiveness	Means oriented	Goal oriented
	D2	Customer orientation	Internally driven	Externally driven
	D3	Control	Easy-going	Strict work discipline
	D4	Focus	Local	Professional
	D5	Approachability	Open systems	Closed systems
	D6	Management philosophy	Employee oriented	Work oriented
Semi-autonomous dimensions	**D7**	Degree of acceptance of leadership style	Low degree	High degree
	D8	Degree of identification with the organization	Low degree	High degree

4. DISCUSSION

Through parallel analysis of two presented models, certain resemblances can be identified. First of all, their authors have similar view on organizational culture. Both authors define the culture as the approach of the employees to their work, their mutual behavior and interaction, and their attitude towards the organization, its goals and their tasks.

Second, if the definitions of Robert Cook's behavior styles and Geert Hofstede's dimensions are analyzed, certain parallels can also be found. One of them is related to D6 dimension from Hofstede model, *Management philosophy*, and a group of Cook's behavior styles. *Work oriented* side of D6 is the combination of styles from the left hemisphere of the "Circumplex" (*Oppositional, Power, Competitive, Perfectionistic* and *Achievement*), while behavior styles from its right hemisphere (*Humanistic-Encouraging, Affiliative, Approval, Conventional* and *Dependent*) match the reverse, *Employee oriented* philosophy of D6.

Next, opposite values of D3 dimension, *Easy-going* and *Strict work discipline*, mostly correspond to contrary behavior styles, *Power* and *Affiliative*, respectively, but also to all the styles from the top hemisphere (*Easy-going*) and the bottom hemisphere (*Strict work discipline*) of "Circumplex". *Easy-going* cultures are characterized by little control and discipline, and a lack of predictability, and they have a lot of improvisation which provokes employees to think out of the box. Described behavior matches the styles which are oriented towards higher needs and self-actualization, such as *Self-Actualizing*, *Humanistic-Encouraging* or *Affiliative*. The organizations with *Strict work discipline* culture are those with people who are prompt, cost conscious and serious. Those behavior resemble the styles from bottom of the "Circumplex", like *Conventional*, *Dependent*, *Avoidance* and *Oppositional*.

Additionally, dimension D5 from Hofstede, *Approachability,* separates the organizations or organizational units in which newcomers are immediately accepted. Such behaviors are in OCI described by *Humanistic-Encouraging* and *Affiliative* styles. Contrariwise to open systems, closed systems are not friendly and do not support new members or new practices, which corresponds to *Conventional* and partly to *Dependent* behavior style.

Furthermore, reverse cultures of D1 from Hofstede model match the styles on 11 o'clock and 5 o'clock positions on "Circumplex", *Achievement* and *Dependent*. *Goal oriented* side of D1 is described as the culture where employees are focused on achieving realistic and reachable goals, and the accent in their reaching is on "what?" question. It resembles the behavior style described as *Achievement*. Reverse to that, *Means oriented* culture is oriented towards "how?" question and is looking for the answers to the same questions as those which are characteristic for behavior that belongs to *Dependent* style.

Various similarities among behavior styles from one model and cultural dimensions from other can also be recognized when different groups or combinations of styles and dimensions are analyzed.

5. CONCLUSION

Presented models of organizational culture and quantitative approach to their analysis provide multiple benefits. Both models are widely accepted as tools for organizational development. Different organizations have different organizational cultures, even though their members are of the same nationality and come from the communities where similar values are appreciated. As described in other models of organizational culture, all of the styles or dimensions are related to (and result from) organizational structural variables, reward system, leadership and managerial styles and other factors. Norms and expectations are shaped by numerous factors, most of which are controlled by the organization and its leaders. These factors are usually called the levers of organizational change and can be influenced during projects of organizational development.

Both methods for measuring organizational culture that are presented in this paper can be integrated into wider model of organizational change. Their components, behavioral norms in OCI and dimensions in Hofstede, are connected to the organizational change levers. Organizational change models enable the overview of the priorities and the definition of the initiatives which will reduce the gap among current and targeted organizational culture. The priorities are determined by the correlation analysis between organizational change levers and elements of organizational culture. This means that organizational development can be conducted through adequate improvement of different components of organizational culture (behavior styles or cultural dimensions).

In the same way, both analyzed models indicate that behavioral norms or dimensions measured by defined questionnaires are associated with important outcomes at the individual, group and organizational levels. The most immediate outcomes are motivation, inspiration, satisfaction, quality of work-life, teamwork, cooperation etc.

Described tools are widely accepted in organizational science, but there is no data that indicate that they have been used in organizations in Serbia. Such approach could be very useful for Serbian public enterprises, where dominant defensive behavior is the legacy of previous regime and inadequate organizational forms (Todorović et al., 2013). For this reason, future research should determine whether these models are applicable in local cultural values, in terms of providing adequate directions and support for successful organizational development.

REFERENCES

Cameron, K. S., & Quinn, R. E. (2011). Diagnosing and changing organizational culture: Based on the competing values framework. Hoboken, New Jersey, USA: John Wiley & Sons.

Cooke, R. A., & Rousseau, D. M. (1988). Behavioral Norms and Expectations: A Quantitative Approach to the Assessment of Organizational Culture. Group & Organization Management, 13 (3), 245-273.

Cooke, R. A., & Szumal, J. L. (1993). Measuring normative beliefs and shared behavioral expectations in organizations: the reliability and validity of the organizational culture inventory. Psychological Reports, 72, 1299-1330.

Deal, T. E., & Kennedy, A. A. (1982). Corporate cultures: The rites and rituals of organizational life, 98-103. Boston, USA: Addison-Wesley.

Handy, C. B. (1976). So you want to change your organisation? Then first identify its culture. Management Learning, 7(2), 67-84.

Hofstede, G. J., & Pedersen, P. B. (2002). Exploring Culture: Exercises, Stories and Synthetic Cultures. London: Intercultural Press.

Hofstede, G., Hofstede, G. J., & Minkov, M. (2010). Cultures and Organizations: Software of the Mind, Third Edition. New York, USA: McGraw-Hill.

Janićijević, N. (2011). Methodological approaches in the research of organizational culture. Economic annals, 56(189), 69-99.

Jevtić, M. (2013). An Approach to Organizational Design Based on Measuring the Alignment of Organizational Elements. Doctoral dissertation. Belgrade, Serbia: Faculty of Organizational Sciences.

Kates, A., & Galbraith, J. R., (2007): Designing Your Organization, 1-71. San Francisco, USA: Jossey-Bass Education.

Leavitt, H. J. (1965) Applied organizational change in industry: Structural, technological and humanistic approaches. In March, J. G. (Ed.) Handbook of organizations, 1144, 1170.

O'Reilly, C. A., Chatman, J., & Caldwell, D. F. (1991). People and organizational culture: A profile comparison approach to assessing person-organization fit. Academy of management journal, 34(3), 487-516.

Schein, E. H. (1992). Coming to a new awareness of organizational culture, 237-254. New York, USA: Sage Publications.

Todorović, I., Čudanov, M., Komazec, S. & Krivokapić, J., (2013). Improvement of Organizational Knowledge Transfer through Integration of Functional Silos in Smart Network: Case Study of Public Enterprises. In Schiuma, G., Spender, J. C., Pulić, A. (Ed.) Proceedings of the 8th International Forum on Knowledge Asset Dynamics: Smart Growth: Organizations, Cities and Communities, Institute of Knowledge Asset Management, Matera, Italy, 1644-1655.

Waterman Jr., R., Peters, T. J., & Phillips, J. R. (1980). Structure is not organization. Business Horizons, 23 (3), 14-26.

PUBLIC SECTOR DOWNSIZING THROUGH CENTRALIZATION OF NON-CORE FUNCTIONS: BELGRADE CASE STUDY

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Abstract: *One of the burning issues currently in Serbia is the reform of public sector. Present organizational model is the legacy of previous government system and disables public companies to adapt to the changes in environment. Total number of employees in public entities is extremely high, comparing to EU countries, so downsizing is one of the necessary measures and cannot be avoided. In order to successfully complete the EU integrations, Serbian government needs to propose sustainable solutions for public sector organization and management at state and local level. In many cities worldwide local governments recognized network organization as possible solution for increasing the efficiency of public enterprises and upgrading the quality of public service at the same time. Such concept is based on centralization of certain non-core functions which appear in multiple public companies, in order to secure better allocation of human resources and improve their performance. This research aims to show how centralization of adequate jobs can provide the base for reducing the number of employees in public companies, using the City of Belgrade as an example. The findings can be practically used as the guidelines for the city authorities in Belgrade during the following process of public sector restructuring.*

Keywords*: Downsizing, restructuring, public sector, public company, public enterprise, centralization, network organizational model, Belgrade*

1. INTRODUCTION

Public sector functioning is topic of many studies all over the world. Most of that studies conclude, that public spending could be much smaller and more efficient than today (Alfonso, Schuknecht & Tanzi, 2010). On the other hand, the role of local public enterprises within public sector of one country is growing with the development of that country. Industrialized countries typically spend 50% or more of public sector resources to fund local public services (IDG Policy, 2013). Explanation is that the additional services which improve the life quality are demanded, not just communal (Longo & Cristofoli, 2008). In order to adapt to new trends, public sector leaders often widen the scope of public services (Indihar, Stemberger & Jaklic, 2007) For this reasons, performance of public enterprises has become persistent topic in organizational analysis (Aharoni, 2000).

Considering public spending, situation in Republic of Serbia is more dramatic due to several factors. The first one is high overall unemployment rate of 24.1% (Statistical Office of the Republic of Serbia, 2013). That caused excessive employment in local governments, public agencies and public enterprises, usually helped by politicians. Structural reforms promoted by new Serbian government include, as one of the mayor goals, reducing public sector size and scope. This paper proposes one of the possible ways for reducing public sector scope of services, and consequently, its size, in the City of Belgrade.

Today, local public enterprises in City of Belgrade are highly specialized, and with clearly defined jurisdiction. (Todorović, Komazec & Jevtić, 2012). All enterprises are functionally organized, legally and essentially fully independent of each other, although all of them are claiming funds from city budget. This non-cooperation forces local public companies to form similar non-core organizational units, in order to provide support to primary activities and improve the output quality (Jaško, Krivokapić & Čudanov 2010). Besides increased independence of each public company, this led to growth of growth of its size, in term of number of employees (Čudanov, Jaško & Săvoiu, 2012). Large number of employees is just one of the reasons for pure performance, and former studies have shown that there is no public company in Belgrade that is without any reserves in term of number of employees (Todorović, Komazec & Jevtić, 2012).

Many of these problems could be solved by implementation of network organizational model in public sector (Todorović, Komazec & Čudanov, 2013). Network organization, through better coordination, increases the efficiency of resources allocation, brings more flexibility, enables organizational learning, improves planning process and upgrades the quality of services (Jaško, Jaško & Čudanov, 2010). Network organization of

public sector also enables wide spectrum of internal services that companies can provide to each other (Komazec, Todorović & Krivokapić, 2012). Precondition for forming a network is focusing on core business and outsourcing most of the non-core activities (Popović, Jaško & Prokić, 2010). For this reason, the basis for the successful implementation of network model in public sector is the determination of non-core activities in each public company, so some of them could be centralized at network level. This centralization will consequently emphasize double activities and a number of employees that are engaged on them at the level of whole City of Belgrade.

The purpose of this article is to analyze all the functions which exist in Belgrade public enterprises, to separate non-core from core functions, to identify the functions which appear in multiple public companies and to propose the centralization of certain non-core functions. In the second paragraph will be presented the methodology for gathering the necessary data. The third section will describe the process of identifying the functions that are adequate for centralization, and the fourth will deal with the scope of centralization. Number of employees covered by centralization and possible economic effects will be discussed in the fifth paragraph, while conclusions, limitations and directions for future research will be presented in the sixth section of this paper.

2. METHODOLOGY

All the directions for public sector downsizing through centralization that will be presented in this paper appeared during our engagement as business consultants on projects of restructuring public sector in the City of Belgrade. Our analysis included 28 public enterprises, with 21.023 employees, which provide different communal or public services to city residents.

First step was to get insight in all the activities that are performed in individual companies, for every analyzed public company, in order to classify the activities to core and non-core and to select those that could be centralized. Those activities were derived from job descriptions and later categorized to core and non-core and grouped into unique jobs and functions for all 28 companies.

Second step was to calculate total number of employees for each function. For this purpose, we analyzed the content of formal documents in every company. From systematization documentation, existing organizational structures and job classifications we managed to create the list of positions in every public company. Through salary reports we were able to relate each employee with single position from the list, and to calculate total number of employees on every position. Their sum is equal to the total number of employees in public sector. Since every position is followed by job description, we managed to link the positions to previously mentioned functions, and to determine total number of employees for each function.

Based on this, we were able to conclude whether certain non-core functions were executed in multiple enterprises and to calculate the exact number of employees for each function. These two parameters represent the main inputs for the decision making process concerning centralization of non-core functions which will be described in this paper.

3. IDENTIFYING THE FUNCTIONS THAT ARE ADEQUATE FOR CENTRALIZATION

In order to determine which functions are suitable for centralization, unique catalogue of all functions that are performed in public sector is requested to be created first. However, in order not to lose data, the catalogue ought to have two levels, which means that each function will have a list of jobs included. After that, each job from the catalogue should be assigned “1: MANY” relation with the list of public enterprises.

In order to achieve this, various positions from different public companies need to be standardized (Krivokapić, Todorović & Komazec, 2013). For example, same positions, according to job descriptions, may be named differently in two enterprises. As a consequence, all job descriptions need to be analyzed separately in order to perform job standardization. The result is the list of standardized positions, which is in “1: MANY” correlation with actual list of positions that can be found in the official documentation. Now each standardized position can be “1:1” connected to the job from the catalogue.

Finally, since every function is related to the job, standardized position, which is correlated to the actual positions in the companies, as presented on Figure 1, it is possible to conclude which functions are performed in more than one public company.

This way, not only precise number of different public enterprises for each function where it is identified can be determined, but also the exact total number of employees on each function can be calculated, since every actual position has number of employees as an attribute.

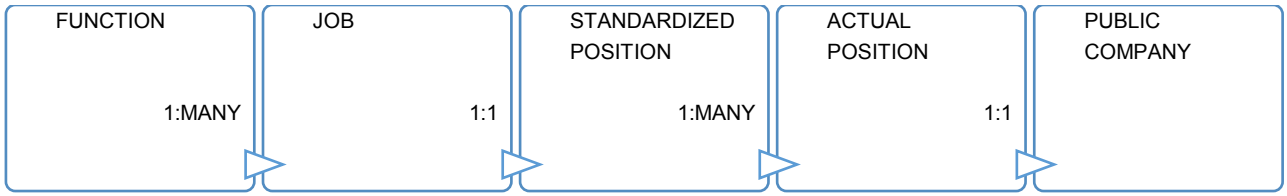

Figure 1: Process of identifying the functions which exist in multiple public companies

Complete catalogue contains 294 different jobs that are performed in Belgrade public sector. Less than 20%, 49 jobs, are performed in more than one public company. Possible explanations are highly specialized core activities in most public enterprises, which are characteristic only for the company which is providing relevant public service.

At first sight, it may seem that these 20% of jobs do not offer plenty of space for centralization. Without deeper analysis, it can be explained by the necessity for some supportive activities, such as cleaning, fire protection or IT support, which are present in almost all companies. Nevertheless, total number of employees on these jobs is 5.645, which is about 27% of total number of employees in Belgrade public sector. If only jobs which exist in 5 or more public companies are analyzed, number of examined jobs is reduced from 49 to 26, but total number of engaged employees still remains over 5.000, 5.088 to be precise, or 25% of total workforce. Same way, if the list is shortened to 21 jobs which are identified in 10 or more Belgrade public enterprises, calculated number of people that are hired just for their execution is 4.405, which is more than 20% of total number of employees in complete public sector.

Considering all of the above, the list of all functions and jobs which should be centralized in Belgrade public sector for the purpose of increasing their efficiency on city level is derived from the catalogue and presented in Table 1.

Table 1: Functions and jobs proposed for centralization in Belgrade public sector

Function	Job
Safety, security and health at work	Safety and health at work
	Security at work
	Firefighting
Finance	Finance
IT support	IT support
Internal transportation	Internal transportation (C, D and E category)
	Internal transportation (B category)
Public procurement	Public procurement
Marketing and public relations	Marketing and public relations
Vehicle maintenance	Administrative support
	Vehicle and mechanization maintenance
	Vehicle repair and maintenance services (C, D and E category)
	Technical inspection of vehicles
	Car washing
Maintenance, Hygiene, Sanitation and Cleanliness	Maintenance, Hygiene, Sanitation and Cleanliness
Legal	Legal
Media space selling	Media space selling
Registration, insurance and car washing	Technical inspection of vehicles
	Car washing
Inbound logistics	Car maintenance
Human resources	Human resources

Several jobs from the catalogue are present in all or almost all enterprises. In some cases it is expected, since certain non-core functions are necessary for normal operations in any enterprise. For the purpose of securing regular workflow, some of those jobs simply need to remain decentralized and to continue performing on company level. For example, centralization of complete storage jobs would be rather inefficient, because it would consider that every time when any office supplies are needed, centralized

warehouse should deliver paper, toner, paperclips etc. Such centralization would have a negative effect on normal, everyday operations in every public company.

Same way, there are jobs which should remain in every company due to their specificities. Accounting is an example. Although it is theoretically done by the same rules in every public enterprise, certain specificities of core business demand the adoption period for accountants, in order to achieve maximal efficiency. If the accountants were integrated and started serving 28 different companies, most of their work time would be spent on analyzing business activities and learning new accounting principles. Since their current job routine would be lost, such jobs ought to be left decentralized.

Centralization considers grouping of employees engaged on same jobs into unique organizational units (Jaško, Čudanov, Jevtić & Krivokapić, 2013). However, since some of the jobs from Table 1 have very large number of employees, next important decision that should be made concerns the scope of centralization. It ought to be determined whether all the employees on same job will be organizationally moved to centralized unit, or some of them will continue working in their current companies.

4. DEFINING THE SCOPE OF CENTRALIZATION

As already explained, introduction of network organizational model and centralization of certain non-core functions in Belgrade public sector can lead towards improved management, more efficient planning, better allocation of public resources and reduction of overheads. However, the scope of centralization cannot be the same for all functions and jobs that were marked as suitable for centralization.

IT support is one of the functions proposed for centralization on city level. Nevertheless, it does not indicate that all IT employees should be locational moved to centralized organizational unit. If that was the case, other employees in Belgrade public enterprises would be left to wait for the arrival of IT support from centralized unit every time they have even smallest technical issues with IT equipment. Described organization would disturb normal operating of individual companies. On the other hand, employees on certain IT jobs, such as software developing or database administration, can be locational centralized without any organizational barriers, since their presence in individual enterprises is not demanded constantly. In these cases, centralization increases their efficiency, but also allows better usage of public sector intellectual capacity and expertise, since functional silos will be eliminated and knowledge transfer enabled (Todorović, Čudanov, Komazec & Krivokapić, 2013).

Another example of function that is proposed to be centralized partially is HR. Same as in previous case, part of employees, those who perform everyday HR activities such as presence recording, sick benefits, holidays etc. should remain in individual companies, while employees on strategic HR jobs such as selections or trainings could be more efficient if they were moved to single centralized organizational unit.

Opposite example are public procurements. Employees on these activities are among those with the lowest performance in Belgrade public sector (Todorović, Komazec & Jevtić, 2012). At first sight it can be explained by too many employees. However, when the real needs of each company in terms of public procurement are identified, it can be concluded that most of the employees who carry out these tasks are really necessary. Underutilization of the capacity occurs due to the nature of this business. The procurement is not something that happens every day. When there are active procedures, all available resources are deployed, often even overtime. The problem is that when there are no active processes, these employees literally have nothing to do. Therefore, their average performance is low.

The solution to this problem is the complete centralization of public procurement at the city level, so the employees on these activities could serve multiple companies. Since on city level at least one procurement procedure is active almost every day, their average performance would significantly increase. Of course, this would mean that the new organizational unit does not require all the employees who are currently performing activities related to public procurements. The savings that could be achieved by reducing the number of employees on these jobs could be used for hiring new people on jobs with lack of available capacity, for expanding the scope of activities under the auspices of Belgrade public sector, or for the development of public service in another respect.

Public procurement is just one of the jobs that can be completely centralized in the network model. Other examples are marketing, vehicle maintenance etc. In certain EU countries maintenance of public equipment is specific activity under the jurisdiction of local public enterprises (Crediop, 2004), which can be guidance and encouragement for centralizing these activities in Belgrade.

As previously described, jobs and functions need to be categorized by the centralization scope criterion, to full centralization and partial centralization proposals, as shown in Table 2.

Table 2: Proposed scope of centralization for all functions and jobs

Scope	Function	Job
Full centralization	Marketing and public relations	Marketing and public relations
	Public procurement	Public procurement
	Vehicle maintenance	Technical inspection of vehicles
	Media space selling	Media space selling
	Registration, insurance and car washing	Technical inspection of vehicles
		Car washing
Partial centralization	Safety and health at work	Safety and health at work
		Firefighting
		Security at work
	Finance	Finance
	IT support	IT support
	Legal	Legal
	Internal transportation	Internal transportation (C, D i E category)
		Internal transportation (B category)
	Maintenance, Hygiene, Sanitation and Cleanliness	Maintenance, Hygiene, Sanitation and Cleanliness
	Vehicle maintenance	Administrative support
		Vehicle and mechanization maintenance
		Vehicle repair and maintenance services (C, D i E category)
		Car washing
	Inbound logistics	Car maintenance
	Human resources	Human resources

After defining centralization scope, it is possible to analyze the number of employees affected by each type of centralization, possibilities for downsizing and economic effects on the city budget.

5. DISCUSSION

In order to get full view of the size and effects of proposed centralization, we need to analyze total number of employees in Belgrade public sector who will be affected if the proposals are accepted. The results are presented in Table 3.

Table 3: Number of employees per scope of centralization, per public company and total

Public company	Full centralization	Partial centralization	No change	Total
Public company 1	2	2	34	38
Public company 2	1	13	44	58
Public company 3	11	240	1327	1578
Public company 4	12	249	2021	2282
Public company 5	42	372	2749	3163
Public company 6	12	386	1637	2035
Public company 7	6	32	184	222
Public company 8	35	2263	4201	6499
Public company 9	4	33	159	196
Public company 10	10	14	145	169
Public company 11	31	256	778	1065
Public company 12	3	48	401	452
Public company 13	9	77	1118	1204
Public company 14	2	10	93	105
Public company 15	1	5	18	24
Public company 16	2	52	257	311
Public company 17	13	28	170	211
Public company 18	1	5	53	59
Public company 19	2	20	124	146
Public company 20	1	8	245	254
Public company 21	/	22	130	152

Public company 22	5	19	169	193
Public company 23	3	13	151	167
Public company 24	/	2	14	16
Public company 25	2	26	139	167
Public company 26	/	5	34	39
Public company 27	2	13	158	173
Public company 28	1	10	34	45
Total:	**213**	**4223**	**16587**	**21023**

Table 3 shows that in each of the 28 analyzed companies are identified the employees who should be included in any of the two proposed forms of centralization. They can be deployed in new centralized organizational units, but also in a completely new public companies, if the amount of work indicates that there exists real need for their formation. In order to gain a clear insight into the extent of the jobs that need to be centralized, it is important to determine the number of employees involved in each of the jobs for which the centralization is proposed, at the entire public sector level. These data is shown in Table 4.

Table 4: Number of employees per scope of centralization, per function and job

Function	Job	No. of employees
Safety, security and health at work	Safety and health at work	39
	Security at work	356
	Firefighting	180
Finance	Finance	357
IT support	IT support	203
Internal transportation	Internal transportation (C, D and E category)	137
	Internal transportation (B category)	61
Public procurement	Public procurement	85
Marketing and public relations	Marketing and public relations	92
Vehicle maintenance	Administrative support	67
	Vehicle and mechanization maintenance	399
	Vehicle repair and maintenance services (C, D and E category)	1721
	Technical inspection of vehicles	4
	Car washing	50
Maintenance, Hygiene, Sanitation and Cleanliness	Maintenance, Hygiene, Sanitation and Cleanliness	412
Legal	Legal	130
Media space selling	Media space selling	9
Registration, insurance and car washing	Technical inspection of vehicles	14
	Car washing	9
Inbound logistics	Car maintenance	21
Human resources	Human resources	90

It can be noticed that the majority of these employees works on the vehicle maintenance. Therefore, the formation of an entirely new public enterprise that would deal with the maintenance of public equipment can be considered. As mentioned above, there are examples of such enterprises owned by local governments in EU countries. Using the same principle, the City of Belgrade may found its own security company, software engineering enterprise, marketing and PR agency, company for maintenance, hygiene, sanitation and cleanliness etc.

A key question that emerges after the centralization is the financing of this new company. Namely, if the local government continue to finance the salaries of all employees who still work on maintenance of public vehicles, there is no progress. It is, therefore, necessary to determine the market value of the services that are provided by the new company for other members of the network (other public companies). This way the transferring prices can be defined, so public funds can be shift to the account of the new company in accordance with the extent of the work and defined transferring prices. These funds will certainly be lower comparing to the total gross value currently allocated for the salaries of employees involved in these jobs. In this manner, the city budget will be significantly relieved.

On the other hand, the management of the new company will be able to make appropriate decisions independently. Either will they reduce the number of employees and adapt to the real needs of other public companies, or will promote their service and offer it to other market participants. Second option would lead to

the utilization of all available resources, but also to the occurrence of additional sources of funding that would cover the costs of the new company, at the same time.

However, jobs like public procurement, human resources, finance, legal etc. can be performed within centralized organizational units. In these cases also it is crucial to adjust the number of employees to the actual needs of public companies which use such services, since they are still financed from the city budget, so any unnecessary expenses should be avoided.

In both situations, total number of employees in Belgrade public sector can be significantly reduced, which is followed by less appropriations for salaries on city level. This way the pressure on the city budget can be considerably diminished, that is one of the main goals of public sector restructuring in the City of Belgrade. Finally, public sector downsizing is achieved without endangering the functionality of public enterprises nor the quality of public service.

Some of the non-core functions may be opened for private capital after the centralization, regardless their organizational form (new public company or centralized organizational unit). In general, studies in this scientific field conclude that in order to improve public sector governments should adopt better institutions and should transfer many non-core activities to the private sector (Alfonso, Schuknecht & Tanzi, 2010). Transferring those activities to private sector could represent acceptable model for additional downsizing, in terms of corporate social responsibility, followed by improved quality of public service due to competition.

6. CONCLUSION

In this paper we have shown that some non-core functions appear in multiple public companies in Belgrade and that number of employees involved in them has significant share in total number of employees in Belgrade public sector. The centralization of certain non-core functions at the city level can highlight the appropriate number of employees, considering the real needs, since the employees on non-core functions will be able to serve more than one public company. In such way, the results of this research can help the city authorities with finding the appropriate model for downsizing public sector in Belgrade, but also to provide useful guidelines for other local governments in Serbia, since the number of employees in public companies is one of the most important issues in the process of EU integrations.

Consequently, the centralization of adequate non-core activities will lead to the reduction of total labour cost and reduced pressure on the city budget in Belgrade, as described in this article.

After identifying the functions that should be centralized in public sector, the next task is to define centralization priorities, since not all functions can be centralized at once. This can be the topic of some future article. Future research should also analyze possible institutional alternatives for implementing network organization in public sector and propose the concrete procedure for introducing such organizational and institutional model, with the centralization of non-core functions as one of the steps.

REFERENCES

Aharoni, Y., (2000). The performance of state-owned enterprises. In Toninelli, P.A. (Ed.) The rise and Fall of State-Owned Enterprise in the Western World, 49-72. New York, USA: Cambridge University Press.

Afonso, A., Schuknecht, L. & Tanzi, V., (2005). Public sector efficiency: an international comparison. Public choice, 123(3-4), 321-347.

Afonso, A., Schuknecht, L. & Tanzi, V., (2010). Public sector efficiency: evidence for new EU member states and emerging markets. Applied Economics, 42(17), 2147-2164.

Čudanov, M., Jaško O. & Săvoiu G., (2012). Public and Public Utility Enterprises Restructuring: Statistical and Quantitative Aid for Ensuring Human Resource Sustainability. *Amfiteatru Economic Journal*, 32(2012), 307-322.

Crediop, D., (2004). Local public companies in the 25 countries of the European Union. Paris, France: Dexia.

IDG Policy Breaf. (2013). Improving Public Services and Achieving Sustainable, Inclusive Development: Development Assistance and the Role of the Local Public Sector. Urban Institute Center on International Development and Governance.

Indihar Stemberger, M. & Jaklic, J., (2007). Towards E-government by business process change - A methodology for public sector, International Journal of Information Management, 27(4), 221-232.

Jaško, O., Čudanov, M., Jevtić, M. & Krivokapić, J., (2013). Projektovanje organizacije. Belgrade, Serbia: Faculty of Organizational Sciences.

Jaško, O., Jaško, A. & Čudanov, M., (2010). Impact of Management Upon Organizational Network Effectiveness, Management, 16(56), 5-13.

Jaško, O. Krivokapić, J. & Čudanov, M., (2010). Standards of job classification as organization design tool based on Mintzberg's and Porter's theoretical assumptions, Proceedings of 7th Conference Standardization, protypes and quality: a means of Balkan countries' collaboration, Zlatibor, Serbia, June 8-9, 2010, CD edition.

Komazec, S., Todorović, I. & Krivokapić, J., (2012). Extending Holding as Institutional Model to Public Sector. In Levi Jakšić, M., Barjaktarović Rakočević, S. (Ed.) Proceedings of the 13th International Symposium of Organizational Sciences: Innovative Management & Business Performance, Faculty of Organizational Sciences, Belgrade, Serbia, pp. 1447-1454.

Krivokapić, J., Todorović, I. & Komazec, S., (2013). Job Standardization as a Tool for Improving Allocation of Human Resources in Public and Communal Enterprises in Belgrade. In Tipurić, D., Podrug, N. (Ed.) Proceedings of the 1st International OFEL Conference on Corporate Governance - Organizational, Financial, Ethical and Legal Issues of Corporate Governance, CIRU - Governance Research and Development Centre, Zagreb, Croatia, 963-971.

Longo, F. & Cristofoli, D., (2008) Strategic Change Management in the Public Sector: An Efmd European Case Book. Hoboken, New Jersey, USA: John Wiley & Sons.

Popović, N., Jaško, O. & Prokić S., (2010). Menadžment interorganizacionih odnosa. Belgrade, Serbia: Serbian economical centre fund, Institute of economic sciences.

Statistical Office of the Republic of Serbia (2014). Latest indicators - Republic of Serbia. Available from Statistical office databases as of April, 2014. Retrieved on April 20th, 2014, from: http://webrzs.stat.gov.rs/WebSite/Public/PageView.aspx?pKey=2

Todorović, I., Čudanov, M., Komazec, S. & Krivokapić, J., (2013). Improvement of Organizational Knowledge Transfer through Integration of Functional Silos in Smart Network: Case Study of Public Enterprises. In Schiuma, G., Spender, J. C., Pulić, A. (Ed.) Proceedings of the 8th International Forum on Knowledge Asset Dynamics: Smart Growth: Organizations, Cities and Communities, Institute of Knowledge Asset Management, Matera, Italy, 1644-1655.

Todorović, I., Komazec, S. & Čudanov, M., (2013). Different successful patterns for implementing holding model in public sector. Business Systems Research Journal, Vol. 4, No. 2, pp. 58-67.

Todorović, I., Komazec, S. & Jevtić, M., (2012). Benefits of Introducing Holding Institutional Model to Public Sector in the City of Belgrade. In Levi Jakšić, M., Barjaktarović Rakočević, S. (Ed.) Proceedings of the 13th International Symposium of Organizational Sciences: Innovative Management & Business Performance, Faculty of Organizational Sciences, Belgrade, Serbia, pp. 1455-1461.

ORGANIZATIONAL ANALYSIS AND DIAGNOSIS: TRACKING DOWN PROCESSES AND STRUCTURE

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Abstract: *Processes and structure are two inextricably intertwined components that must be taken into consideration while designing organization. The aim of this paper is to depict the overall methodology for analyzing and diagnozing processes and structure that can be applied to every industry with some small adjustments. The motive for undertaking its writing is the improvement of existing process and organization structure design practice. It synthesizes and systematizes existing theoretical knowledge that has been refined and proven in practice through implementation of numerous projects within one big vertically integrated profit organization operating in Serbia. The paper starts with an overview of techniques and tools for processes and structure analyses, continues with the manner in which a diagnosis report may be presented, and ends by describing its limitations and providing a recommendation for practitioners. The expected outcome of this paper is contribution to organizational performances increase of all organizations operating in Serbia and the region. In order for this to happen, managers must become aware of the importance of gaining an in-depth knowledge about the processes and organization structure. They ought to realize that this knowledge will enable them to continually improve the manner in which their organizations operate. Therefore, methodology insight provided in this paper is highly beneficial for managers and other practitioners in terms of development of their organizations' competitive advantage, which is a necessity in environment subjected to frequent changes.*

Key words: *organization, organizational analysis, organizational diagnosis, process, structure, organization design.*

1. INTRODUCTION

Quality of organization design has become accepted as one of the major factors of competitive advantage in contemporary environment, even though numerous researchers began investigating this topic back in the 1960s and 1970s (cf. Chandler, 1962; Lawrence & Lorsch, 1967; Greiner, 1972; Galbraith, 1973; Khandwalla, 1973; Mintzberg, 1979). Organization design may be regarded as an outcome of shaping and aligning all the components of an organization toward the achievement of an agreed mission and objectives (Stanford, 2007), which ultimately makes organizations actively practicing organization design high-performing systems ready to adapt to almost any shift in its environment. Since contemporary organizations are facing the unpredictable and more complex environment than ever before, in effect paying attention to a much larger number of variables in the environment and their dynamics than was the case earlier (Stefanović, Prokić & Vujović, 2012), significance of organization design for on-going operations as well as for long-term viability of organizations is obvious.

Each organization design project rests on the chosen organization design model. The organization design model is a model of an organization that identifies its main components and relations between them for the purpose of understanding the organization as a dynamic entity. The most widely used models are the following: (1) Weisbord's Six-Box Model (Weisbord, 1976), (2) Nadler-Tushman Congruence Model (Nadler & Tushman, 1980), (3) McKinsey 7S Model (Pascale & Athos, 1981; Peters and Waterman, 1982), (4) Model of Organizational Performance and Change (Burke & Litwin, 1992) and (5) Galbraith's Star Model (Galbraith, 1995; Kates & Galbraith, 2007). These models are being used because researchers dealing with organizations are unable to treat the organization in all its diversity and multidimensionality, or it is simply not practical, so they, therefore, choose one perspective, or "portion" of the reality and observe the organization through it (Morgan, 1990). Therefore, the main role of organization design models is to provide an understanding of the organization and the effects that specific actions might have within it by simplifying the reality (Janićijević, 2010). The choice of the model depends on the resources available to the organization, as well as required complexity of the organization design project, i.e. the required level of detail.

Two crucial components that are inextricably intertwined and must be taken into consideration in each organization design effort, no matter what organization design model is used, are processes and organization structure. "A process is simply a structured set of activities designed to produce a specified output for a particular customer or market. It has a beginning, an end, and clearly identified inputs and

outputs. A process is... a structure for action, for how work is done... [Business] processes are therefore the structure by which an organization does what is necessary to produce value for its customers" (Davenport, 1994, pp. 134-135). On the other hand, organization structure can be defined as "the sum total of the ways in which its labor is divided into distinct tasks and then its coordination is achieved among these tasks" (Mintzberg, 1983, p. 2).

Processes and structure are at the core of each operational effectiveness analysis that is being undertaken in order to increase the overall effectiveness and efficiency of the organization. Importance of process and structure analysis and diagnosis for in-depth understanding of the manner in which organizations are structured and the way they operate is the reason for which a profound insight on a contemporary methodology for analyzing and diagnosing these two components is presented in this paper.

The reminder of this paper is organized as follows. The next section is focused on process and structure analyses, i.e. techniques and tools for conducting these analyses. After that, an overview of process and structure diagnosis is given, as well as the tool for presenting diagnosis results to the stakeholders. Finally, in the conclusion section, limitations of the paper and a recommendation for practitioners are given.

2. PROCESS AND STRUCTURE ANALYSIS

Before tracking down processes and structure takes place, some preparations ought to be done. The most important preparations include activities such as: stakeholder identification and mapping, development of communication plan with them in order to get their support for the project, as well as early risk identification and making risk management plan. These activities will not be elaborated in this paper because it is out of its scope, but only after they are done properly, process and structure analyses can start.

In-depth knowledge about the processes and structure is necessary for each organization if it seeks to maximize effectiveness and efficiency of its operations. In order to learn about the processes and structure, and how the overall organization works, the first step that management of an organization ought to take is to acquire specific data and perform a set of analyses. The goal is to examine organization from multiple perspectives, after which these perspectives ought to be merged into one snapshot of an organization. In this section, these analyses are listed and depicted.

Process identification and classification. In order to successfully manage an organization, management needs to be familiar with the manner in which organization operate its day-to-day activities. In other words, business processes are the driving force of any organization (Hammer & Champy, 1993), which is why gaining an in-depth knowledge about them has become a necessity.

Therefore, the first step in getting to know the processes is to make a list of them. The result is a process register with the main processes or process areas. These processes are then being decomposed until the level of individual activities is reached. Since processes always achieve a certain result or output, process identification is recommended to start with identification of results or outputs, after which the task of identifying the processes that lead to them becomes a lot easier.

In the second step, identified processes are classified using one of the mostly used and accepted process classifications. Probably the most known process classification concept is the one developed by Michael Porter (Porter, 1985). Porter's value chain in which processes are classified into one of the following two groups: primary processes (processes that directly transform inputs into outputs, i.e. inbound and outbound logistics, operations, sales and marketing, and services) and support processes (those that provide support to the primary processes, i.e. infrastructure, human resources, technological development, and procurement). The other well-known process classification concept has been developed by Jay Galbraith (Galbraith, 1998). He has divided all processes into three groups. Processes at the back of the value chain include all the processes that are related to production, technology, product development, etc. Processes at the front of the value chain are those that have a direct user – external consumer. Processes in the middle of the value chain are the so-called infrastructure processes that have internal users, and that serve as a support to processes at the back and at the front of the value chain. Process classification ought to provide guidelines for further work with the processes, i.e. the sequence in which processes will be mapped, analyzed, and improved.

Process mapping and analysis. After the process classification is completed and priorities in working with processes are defined, the next step is to depict processes by mapping them out. Process mapping is an act of acquiring data about the process in order to make a graphical representation of all the activities and their sequence within the process flow in the regular situation, as well as alternative activities if some sort of

deviation occurs (Stefanović, Milovanov & Momčilović, 2013). The tool for process mapping is shown in Figure 1. Graphical representation of the process flow is given in Figure 2.

Process number	Process name	Process phase	Activity name	Activity description	Alternate scenario	Input/output documents	Duration (days)	FTEs

Figure 1: Process mapping template

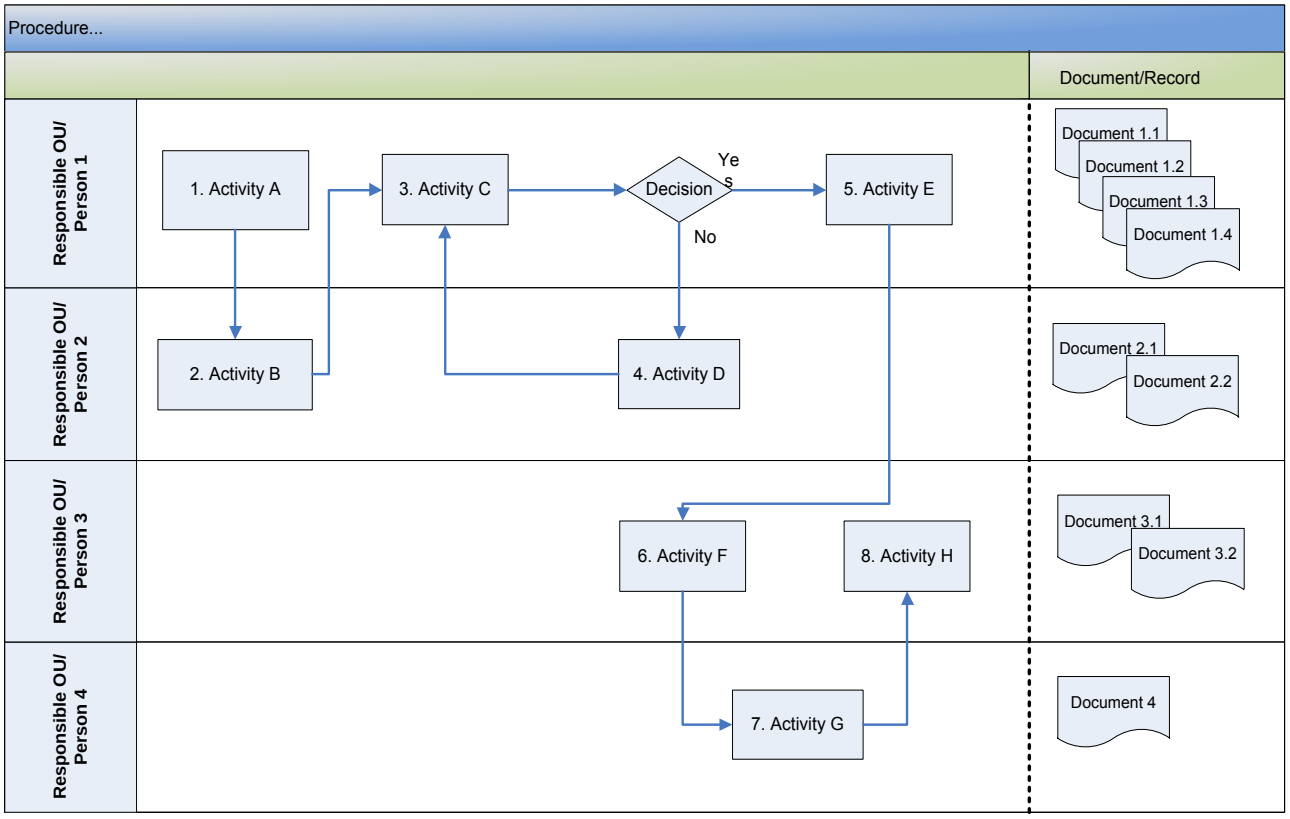

Figure 2: Process flow diagram

Obtained graphical process representation is a basis for performing several types of analyses. These analyses are expected to result in identification of the following: (1) process owner and other process participants, (2) key performance indicators (KPIs), (3) necessary competences for running the process, (4) value being added by the process, and (5) weak points and barriers.

Process/organization structure relationship mapping. Processes are not being performed by themselves, but rather by dedicated employees who are organized in a certain manner that ought to support maximization of the process performances. In other words, organization structure ought to be in the function of supporting the processes, no matter whether it is deliberately shaped or formed in an ad hoc manner. “Structures happen to be there, or, if not ready at hand, they are the outcome of the artful recombination of what is at hand under specific circumstances” (Ciborra, 1996, p. 111).

Therefore, the next step is to determine the part of the organization structure in charge for the process that is being observed, i.e. it is necessary to map the process flow through the organization structure. This kind of process representation provides additional information about weak points and barriers. Figure 3 provides an insight into the process/organization structure relationship mapping.

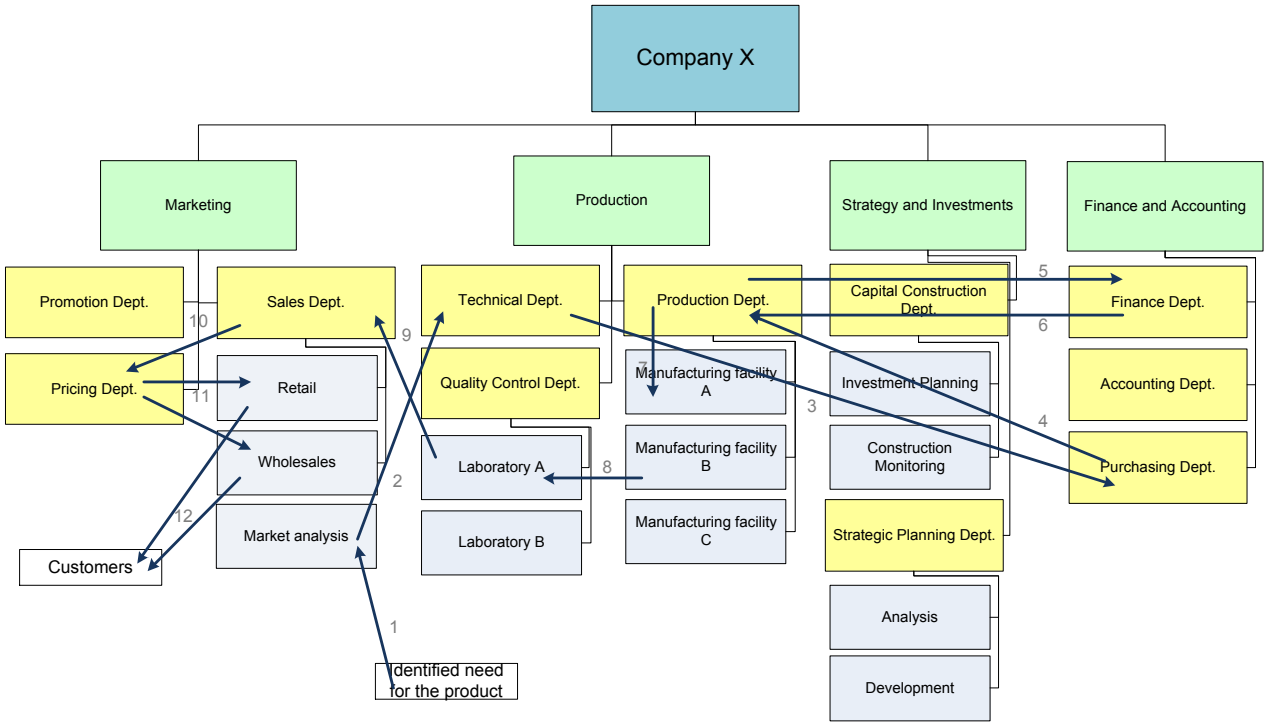

Figure 3: Process/organization structure relationship mapping

Organizational unit scope of work mapping. In this step, the researcher is taking a somewhat different perspective. Instead of tracking down the processes, the focus is now being turned toward the organization structure, i.e. organizational units in particular. The goal of this step is to determine which parts of identified processes are being performed by an organizational unit that is being observed. Therefore, while previous analysis shows the flow of one or more end-to-end processes through the organizational structure, this one is concerned with the sum of all parts of the processes (all activities) being performed by one or more organizational units. The tool for organizational unit scope of work mapping is exhibited in Figure 4.

Processes/ Activities	Market Analysis Dept.	Wholesales Dept.	Retail Dept.	Technical Dept.	Production Dept.	Organizational Dept. N
Activity A1	X	X				X
Activity A2	X		X			
Activity M					X	

Figure 4: Template for organizational unit scope of work mapping

Upon the completion of identifying all the activities being perform by one organizational unit, its scope of work is determined. If the sum of all organizational units' scope of work contains all the activities of all the processes that have been identified and mapped in the previous steps, it means that the researcher has done a superb job: the process mapping and process/organization structure relationship mapping are done in an appropriate manner. In other words, using both process and structure perspective, represent a control mechanism that checks whether all processes are identified and their flow through the structure is precisely depicted.

Structure of activity and workload per position analysis. Once when the processes and their precise flow through the structure are known, the research focus switches to each position in the organization individually. This level of analysis provides an understanding of micro level structure, i.e. the manner in which labor is divided into distinct tasks and then coordinated in order to achieve specified objectives. Two most commonly used techniques for analyzing activities being done and workload per each position are functional analysis and DILO (Day in the life of) analysis.

Functional analysis is based on collecting data related to the activities carried out by an employee in a specified position. The time frame for which these data are being collected may vary significantly, but it is usually a one year period. As far as data being collected concerns, they are usually as follows: (1) activity

name, (2) measurement unit, (3) time required for execution of a measurement unit, (4) number of measurement units for a designated period, (5) total workload in minutes or hours for the designated period, which may be obtained by multiplying (3) and (4). These data result in charts that show the time distribution per each activity, distribution of value added activities versus non-value added ones, existing bottlenecks in the processes, and whether a specified position requires more or less employees. Functional analysis may be done in two ways: by sending functional analysis template to an employee or employees occupying specified position in order to fill it in, or by interviewing the same employees. In each case, statements and figures in the template ought to be supported by hard evidence. Functional analysis template is shown in Figure 5.

Position/Organizational unit		**Name of an employee:**			
Number of activity	**Activity**	**Unit of measurement (UM) of the observed activity**	**Time needed for 1 UM in min**	**Workload from (start date) until (end date) in UM**	**Workload from (start date) until (end date) in min**
1					
1.1.					
1.2.					
2					
3					

Figure 5: Functional analysis template

DILO is an observational record of each activity performed by an individual during one working day or full shift including observations, quotes and comments. It provides the following information and benefits (Celerant Consulting, 2007): (1) a detailed understanding of how the activities are being performed, (2) insights into the issues and problems that arise on a day-to-day basis and how both of these are being managed, (3) distribution between value added and non-value added activities, as well as types, quantity and causes of non-value added activities, (4) understanding workload and the complete environment within which activities are being performed, (5) understanding of an organizational culture, and (6) builds credibility and relationship with employees being observed. Table 1 provides an insight into typical value added and non-value added activities.

Table 1: Typical value added and non-value added activities

Value added activities	Non-value added activities
- Working on a job - Working in a workshop - Receiving directions/coaching from supervisor - Safety required job preparation - Filling documentation into system/entering required data into computer system	- Waiting for work (no work allocated or between tasks) - Unofficial/excessive breaks (late start, over run on breaks, early finish) - Unnecessary movement - Pacing inappropriate (actual time to historical average or best demonstrated to quantify pacing) - Waiting time (for colleagues, permits, etc.) - Rework (job not completed correctly first time, repair job, extra time required, not using correct tools, etc.)

Headcount, spans of control and hierarchy analysis. These parameters are a direct consequence of an organization size. They ought to indicate whether the size and shape of the organizational structure are aligned with other organizational components.

Headcount may imply the overall remuneration costs, organization inertia/flexibility, necessary coordinating mechanisms, etc. This parameter is also a fertile ground for making various ratios that can be used in order to determine an appropriate size of some parts of the structure, as well as benchmarks against the competitors. Some of the ratios that may be taken into account are (Irwin i Cichocki, 2011): (1) number of employees in support function to total headcount, (2) number of billable employees to number of non-billable employees, (3) revenue per employee, (4) number of employees to new customer orders, (5) number of employees to number of customers, etc. The importance of having a proper headcount may not be

overstated. Having the right number of people enables an organization to get the work done in a most efficient manner.

Span of control affects the width of an organization. It is the number of employees reporting to one manager, thus making an organizational unit. Span of control refers to the amount of information coming to the manager from his direct subordinates. Contemporary organizations often have higher spans of control than was the case in the past. There are many reasons for this (Irwin & Cichocki, 2011): (1) the workforce is generally better educated, (2) managers are also better educated, (3) production technology makes it easier to apply consistent standards to work, (4) development of information and communication technology makes coordination and knowledge-sharing much easier, etc.

Hierarchy represents the height of an organization, i.e. the number of organizational levels. Hierarchy directly affects the responsiveness of an organization to the stimuli coming from its environment, as well as the P/A ratio (number of employees that directly create value to number of administrative workers). In organizations with tall structures (more organizational levels), it usually takes more time for an information to reach a relevant decision-maker, especially if he is located near the top of hierarchy and the source of information is at the bottom. This time lag causes slower response to the information, which reduces the overall responsiveness of organization. In addition, tall structures are characterized by low P/A ratio, which usually means that organization is highly bureaucratic and has high overhead costs. The following table (Table 2) provides a comparison between tall and flat structures.

Table 2: Tall and narrow versus broad and flat organizations (Irwin & Cichocki, 2011)

Organization structure shape	Advantages	Disadvantages
Tall and narrow	- Allows manager to communicate quickly with immediate staff - Allows close supervision and direct control - Feedback of ideas between immediate supervisors and staff is more effective - The fewer the staff, the lesser the management skills required	- Many levels of management mean higher cost of management staff - Large distance between top management and staff, poor executive communication and visibility - Less independence and decision authority for staff
Broad and flat	- Staff has better communication with top management - Costs less as organization employs fewer managers - Flat organizations are associated with higher level of employee morale and productivity - Encourages empowerment through delegation of authority and decision making	- Creates more supervisory responsibility for relatively few managers - Overloaded management leads to loss of control

Coordination mechanisms analysis. This analysis aims to highlight the existing coordinating mechanisms between employees, as well as their suitability. It starts by identifying liaisons between employees, which can be extracted from the process flow diagram or process/organizational structure relationship map. In the second step, prioritization of obtained liaisons is being done based on their impact on organizational performances. The list of prioritized liaisons represents the sequence in which a researcher ought to identify and analyze coordination mechanisms and their historical problems, starting from the most important liaison.

In order to analyze current coordination mechanisms and determine the gap between them and the actual requirements, it is necessary to do the following analysis for each identified liaison (Recardo, 2008):

- Importance. This is done by determining how critical each liaison is to the organization (this was done in the previous step in order to make a list of liaison priorities).
- Complexity. Greater complexity requires more sophisticated coordination mechanisms.
- Task uncertainty. The scale for assessing task uncertainty is 1 for predictable and repeatable task, while 10 is for ambiguous and unpredictable one.
- Interdependence. The scale for assessing interdependence is 1 for pooled interdependence (groups are relatively independent of each other, but contribute to the overall goals of the organization), 5 for sequential interdependence (outputs of one group become the input of the other group), and 10 for

reciprocal interdependence (certain outputs of each group become an input for the other group; collaboration needs to occur in both directions).

Figure 6 exhibits the manner in which coordination mechanisms are analyzed.

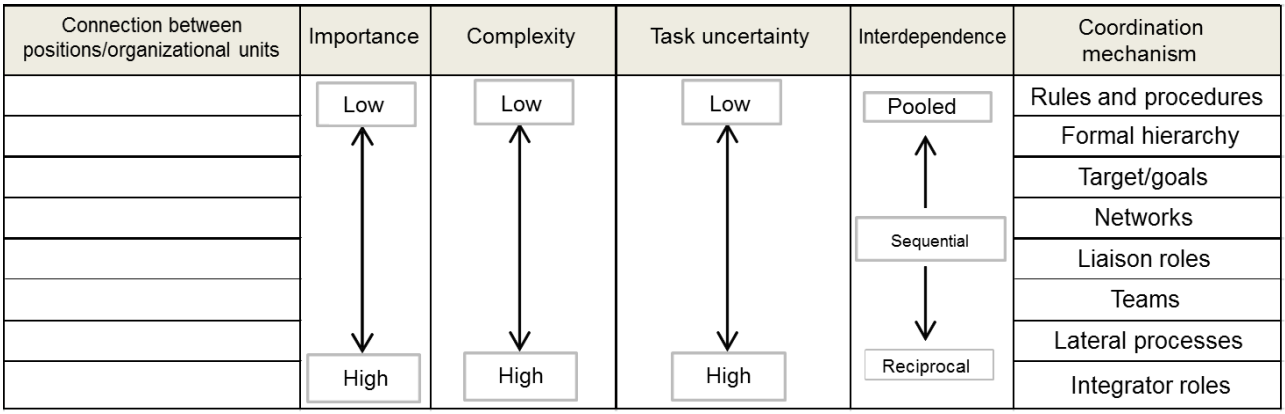

Figure 6: Coordination mechanisms identification table (Recardo, 2008)

Employee structure analysis. This analysis indicates the ability of the existing human resources within an organization to secure that on-going operations are run smoothly, and take part in the overall organizational development at the same time, in order for organization to seize new market opportunities and thrive in the long run. In other words, this analysis provides an insight into the human potential of an organization. It highlights the strengths and weaknesses in this domain, which is, without any doubt, the most important one. Indicators that explicitly or implicitly show human resources characteristics within an organization are the following: (1) age distribution, (2) qualification distribution, (3) quality of recruitment and selection process, (4) quality of training and development process, (5) reward and incentives system, (6) absenteeism, (7) employee turnover, and (8) remunerations (base salary and other monetary or non-monetary benefits that employees receive).

In addition to these, it is possible to perform a number of other analyses, while some of them may be done by a combination of some of the above. The choice of the analyses to be performed depends on the situation specifics.

3. PROCESS AND STRUCTURE DIAGNOSIS

Process and structure diagnosis is a step following the completion of analyses discussed in the previous section of this paper. After the results of each of the presented analyses are known and placed together, a researcher can start analyzing the relations between them. In the next step, all the results are being summarized (a synthesis of the obtained analysis results is being made) and again analyzed, but this time the analysis is being done in a holistic manner, for all the elements combined. Thus, the sum of these analyses results in the processes and organization structure snapshot that, after being subjected to a critical review, makes a process and structure diagnosis. In other words, process and structure diagnosis is a critical review of the state of processes and structure at a particular point of time.

Table 3: Diagnosis report example

Diagnosis parameters	Weak points	Actions to be taken	Benefits expected
Process (1... X)			
Organizational unit (1... Y)			
Position (1... Z)			
Headcount			
Spans of control			
Hierarchy			
Employee structure			

Process and structure diagnosis is a report that shows all the existing problems related to processes and structure, as well as the potential problems that may occur unless some actions are taken. After that, guidelines for actions are provided with the expected benefits. On the other hand, diagnosis may highlight positive aspects as well, depending on the desired effect of presentation. Therefore, the diagnosis report usually shows weaknesses (sometimes even strengths), actions to be taken, and benefits expected as a

result of these actions. The manner in which it will be presented may be customized to best fit the purpose. An example of the diagnosis report is exhibited in Table 3.

Process and structure diagnosis report is a starting point for process and organization structure design, i.e. for the first step in this process, which is the development of design principles and metrics. Diagnosis report broadly defines a domain in which alternative process and structure designs ought to be found. In other words, diagnosis report provides guidelines for making specific design decisions.

4. CONCLUSION

Process and organization structure play a very important role in creating a competitive advantage of an organization. On the other hand, since these two components cannot be observed and analyzed isolated from the other organizational components (e.g. strategy, human resources, organizational culture, etc.), but only through a network of complex interactions with them, it is quite clear that process and organization structure design efforts depend on these other components, but also have a profound effect on them. Therefore, it can be concluded that tracking down processes and structure is a very complex matter that does not consist of a simple series of sequentially related steps leading up to a predetermined goal. Process and organization structure design is much more than that. It is a process with logical sequence of decisions and actions that ought to be followed, but it also involves a great deal of intuition when it comes to searching for available solutions determined by the dynamic environment and internal factors specific to each organization.

What further complicates this process is the fact that there is no ideal solution for the processes and organization structure. It requires constant comparison between positive and negative traits of each solution and making a compromise. The aim is to achieve the closest approximation to an optimal solution as possible taking into account all the circumstances. However, a typical problem that arises while making a decision about the solution to be implemented is the lack of a proper feedback. This is due to the fact that effects of process and organization design typically have a delayed effect, which means that the results of chosen solution may be evaluated only after certain period of time passes from the full implementation of new processes and structure. This is usually measured in months or even years.

Even though authors are hoping that this paper presents a solid methodological foundation suitable for practitioners in order to develop their plans for tracking down processes and structures in various organizations, some limitations it suffers from are recognized. First, this paper does not provide all the techniques and tools available to the practitioner while performing process and organization structure analyses. However, the reader ought to keep in mind the complexity of this process and the limited length of this paper. Second, process and organization structure methodology presented in this paper is aiming at large and perhaps some medium-sized organizations. As such, it can be applied to small organizations, but with certain adjustments being made, which are not discussed in this paper. Finally, methodology presented here ought to be incrementally adapted to the circumstances specific for each organization. The manner in which the methodology ought to be modified is not the topic of this paper.

One general recommendation for practitioners can be extracted from this paper. It concerns general awareness about the importance of the topic presented here. Therefore, it is essential to communicate with the managers in all kinds of organizations about the importance of gaining an in-depth knowledge about the processes and organization structure. They ought to realize that this knowledge will enable them to continually improve the manner in which their organizations operate, which will affect strengthening of their competitive position in the market. Managers also need to know that tracking down processes and structure is not a one-time action, but rather a permanent process of monitoring the changes in the environment and other organizational components, as well as their effects on processes and structure. Only if they keep on tracking processes and structure inside of their organizations, they will enable them to continually increase effectiveness and efficiency of its operations, thus providing them at least a chance to thrive in this age of technological and market discontinuity.

REFERENCES

Burke, W. W. & Litwin, G. H. (1992). A causal model of organizational performance and change. Journal of Management, 18(3), 523-545.

Celerant Consulting (2007). Day in the life of study (DILO) Reference Guide. Celerant Consulting.

Chandler, A. D. (1962). Strategy and structure. Cambridge, MA: M.I.T Press.

Ciborra, C. U. (1996). The platform organization: Recombining strategies, structures, and surprises. Organization Science, 7(2), 103-118.

Davenport, T. H. (1994). Managing in the new world of process. Productivity & Management Review, 18(2), 133-147.

Galbraith, J. R. (1973). Designing complex organizations. Reading, MA: Addison-Wesley.

Galbraith, J. R. (1995). Designing organizations: An executive briefing on strategy, structure, and process. San Francisco, CA: Jossey-Bass.

Galbraith, J. R. (1998). Linking customers and products: Organizing for product and customer focus. In Mohrman, S. A., Galbraith, J. R., Lawler, E. E. & Associates. Tomorrow's organization. San Francisco, CA: Jossey Bass, 51-75.

Greiner, L. E. (1972). Evolution and revolution as organization grow: A company's past has clues for management that are critical to future success. Harvard Business Review, 16(3), 45-67.

Hammer, M. & Champy, J. (1993). Reengineering the corporation: A manifesto for business revolution. NY: Harper Business.

Irwin, C. & Cichocki, P. (2011). Organization design: A guide to building effective organizations. London, UK: Kogan Page.

Janićijević, N. (2010). Business processes in organizational diagnosis. Management, 15(2), 85-106.

Kates, A. & Galbraith, J. R. (2007). Designing your organisation using the Star Model to solve five critical design challenges. San Francisco, CA: Jossey-Bass.

Khandwalla, P. (1973). Viable and effective organizational designs of firms. Academy of Management Journal, 16(3), 481-495.

Lawrence, P. R. & Lorsch, J. W. (1967). Organization and environment. Homewood, Ill: Richard D. Irwin.

Mintzberg, H. (1979). The structuring of organizations. Englewood Cliffs, NJ: Prentice-Hall.

Mintzberg, H. (1983). Structure in fives: Designing effective organizations. Englewood Cliffs, NJ: Prentice-Hall.

Morgan, G. (1990). Images of organization. San Francisco, CA: Sage.

Nadler, D. A. & Tushman, M. L. (1980). A model for diagnosing organizational behavior. Organizational Dynamics, 9(2), 35-51.

Pascale, R. T. & Athos, A. G. (1981). The art of Japanese management. NY: Simon & Schuster.

Peters, T. J. & Waterman, R. H. (1982). In search of excellence: Lessons from America's best-run companies. NY: Harper & Row.

Porter, M. (1985). Competitive advantage. NY: Free Press.

Recardo, R. J. (2008). Organization design: A practical methodology and toolkit. Amherst, MA: HRD Press.

Stanford, N. (2007). Guide to organisation design: Creating high-performing and adaptable enterprises. London, UK: Profile Books.

Stefanović, I., Milovanov, B. & Momčilović, M. (2013). Metodološki okvir integralnog dizajniranja organizacione strukture. Kvalitet i izvrsnost, 2(3-4), 73-81.

Stefanović, I., Prokić, S. & Vujović S. (2012). The organizational environment dimensions revisited: Analysis of the contemporary context. Transformations in Business & Economics, 11(1), 124-138.

Weisbord, M. R. (1976). Organizational diagnosis: Six places to look for trouble with or without a theory. Group & Organization Management, 1(4), 430-447.

ROUTINES, CAPABILITIES, AND ABSORPTIVE CAPACITY INTERPLAY: A REVIEW AND RECONCEPTUALIZATION

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Abstract: *Researchers have often used constructs such as routines, operational capability, dynamic capability, absorptive capacity, etc., to explain various organizational phenomena, especially a competitive advantage of firms. As a consequence of their frequent use in different contexts, these constructs have become extremely broad and blurred, thus making a void in strategic management literature. In this paper we attempt to bring a sense of holistic perspective on these constructs by briefly reviewing the current state of the research and presenting a conceptual model that provides an explanation for the causal relationships between them. Authors hope that findings in this paper may serve as a foundation for other research endeavours related to the topic of how firms achieve competitive advantage and thrive in their environments.*

Keywords*: absorptive capacity, dynamic capability, operational capability, routines, inertia.*

1. INTRODUCTION

Field of strategic management is primarily concerned with the question of how firms develop strategies and thrive in their respective environments. In this quest, strategic management has developed theories and concepts that examine the environment and look inside the firm (Herrmann, 2005). Its goal is to explain underlying mechanisms and depict actions that ought to help firms in satisfying the needs of its stakeholders and outpacing the competition.

In the past few decades, the focus of the research has been partially shifted toward some specific internal aspects of firms, such as routines (Nelson and Winter, 1982; Cohen et al., 1996; Zollo and Winter, 2002; Feldman and Pentland, 2003; Becker, 2004), operational capability (Amit and Shoemaker, 1993; Winter, 2000; Schreyögg and Kliesch-Eberl, 2007; Helfat and Winter, 2011), dynamic capability (Teece et al., 1997; Gilbert, 2006; Schreyögg & Kliesch-Eberl, 2007; Helfat and Winter, 2011), absorptive capacity (Cohen and Levinthal, 1990; Kim, 1997a; 1997b; Van den Bosch et al., 1999; Zahra and George, 2002), etc., in order to explain the creation and retention of their competitive advantage. Even though these constructs were initially used to explain different aspects of organizational dynamics and competitiveness, in time they started to become extremely broad and less concise, as a consequence of their frequent use in different contexts. These days, the field of strategic management lacks clear understanding and differentiation between these constructs, as well as clear linkages joining them.

The identified gap in the strategic management literature has been the rationale for writing this paper. The effort was undertaken in order to precisely define these constructs based on literature review, make a clear boundary between them, and finally, since all of them are inseparable from the field of strategic management, make a clear connection between them. Thus the two primary goals of this paper are: (i) to review the most influential papers in strategy management literature in order to crystallize the meaning of the following constructs - routine, operational capability, dynamic capability, and absorptive capacity; and (ii) to reconceptualise their connections by integrating them into a conceptual model extracted from a literature review.

2. CONCEPTUAL FRAMEWORK

For a firm to be successful in the contemporary environment, it must maintain continuity of its on-going operations, while fostering innovations and change at the same time. Continuity and change come together when stability, hierarchy, specialization, formalization and centralization are coupled with attributes such as speed, flexibility and responsiveness (Graetz & Smith, 2008). In order to achieve a competitive advantage and growth, a firm must be capable to continuously reconfigure its resources and capabilities in order to adapt to changes in the environment (Argyris, 1996), but without

compromising the stability of its operations. This is especially true in a situation in which the management of a firm ought to pay attention to a much larger number of variables in the environment and their dynamics than was the case before (Stefanovic et al., 2011; 2012).

The ability to change continuously while keeping the efficiency is a core capability of successful firms, especially in the highly competitive, high-velocity oligopolies in which many contemporary firms compete (Brown and Eisenhardt, 1997). In other words, "a system has to develop boundaries, identities, procedures, practices, and competencies that bring about institutionalizing effects (replicability, inertia, selectivity, etc.) likely to damage the system"s adaptability and flexibility. Responding to those inevitable tendencies (trade-offs), an organization has to find ways to handle this risk of inherent dysfunctional flips and rigidity" (Schreyögg and Sydow, 2010, p. 1258).

In this paper we provide a review and propose a reconceptualization of several constructs that represent antecedents of competitive advantage of firms by achieving efficiency through stability and continuity, and at the same time, effectiveness through instability and adaptability.

2.1. Routines

"As companies grow, they develop structures and systems to handle the increased complexity of the work. These structures and systems are interlinked so that proposed changes become more difficult, more costly, and require more time to implement, especially if they are more than small, incremental modifications. This result in structural inertia – a resistance to change rooted in the size, complexity, and interdependence in the organization"s structures, systems, procedures, and processes... Quite different and significantly more pervasive than structural inertia is the cultural inertia that comes from age and success. As organizations get older, part of their learning is embedded in the shared expectations about how things are to be done. These are sometimes seen in the informal norms, values, social networks, and in myths, stories, and heroes that have evolved over time. The more successful an organization has been, the more institutionalized or ingrained these norms, values and lessons become. The more institutionalized these norms, values, and stories are, the greater the cultural inertia – the greater the organizational complacency and arrogance" (Tushman and O"Reilly, 1996, p. 18).

In order to discuss the concept of routines, we will adopt the approach of Nelson and Winter (1982), who begin their analysis of routines from the notion of skill, which they define as "… a capability for a smooth sequence of coordinated behaviour that is ordinarily effective relative to its objectives, given the context in which it normally occurs" (p. 73). Skill is a basic trait that determines the quality of work performed and things to be done. As far as routine concerns, although the term has been in circulation for decades, we are just beginning to understand its nature (Pentland and Feldman, 2005). Routine represents a general way of doing things, that is, a stable pattern of behaviour that characterizes organizational reaction to a specific internal or external stimulus (Zollo and Winter, 2002).

Historically, the term „routines" clearly referred to reccurent interaction patterns, that is, collective recurrent activity patterns (Becker, 2004). It is "an executable capability for repeated performance in some context that has been learned by an organization" (Cohen et al., 1996, p. 683). In a revision of the extent literature, Becker (2004) identified the following characteristics associated to the routine construct: (1) patterns, (2) recurrence, (3) collective nature, (4) realm of consciousness (mindlessness vs. effortful accomplishment), (5) processual nature, (6) context-dependence, embeddedness and specificity, (7) path dependence and (8) triggered.

When viewed from a distance, any particular organizational routine can exhibit a great deal of continuity over time, which leads some theorists to emphasize their role in organizational inertia and stability (Nelson and Winter, 1982). This stability-providing effect of routines is important for organizational learning, as well as for organizational efficiency increase. However, sometimes the stability-providing effect of routines does develop into a pathology. Repetition of specific activities takes place, even though there are no obvious evidence of benefits for this kind of behaviour. In other words, routines may lead to inertia (Becker, 2004).

Gilbert (2005) argues that two basic types of inertia are resource and routine rigidity. Resource rigidity stems from resource dependency, i.e. blinders created by resource dependence, and incumbent reinvestment incentives, i.e. a desire to preserve market power. Resource dependency means that

firm"s external resource providers, i.e. capital markets and customer markets, shape and constrain its internal decision-making process (c.f., Pfeffer and Salancik, 1978). Incumbent reinvestment incentives are found to exist in situations in which firms cannot acquire new technology, and therefore they increase investments in their current market positions (Gilbert & Newberry, 1982). On the other hand, routine rigidity may influence inflexibility of firm routines as well. In this view, routines are seen as repeated patterns of response that become reinforced through repeated use. Routines are self-reinforcing by nature and are not built to change. Gilbert (2005) explains that both resource and routine rigidity constrain adaptation, but they have different underlying causal mechanisms. "Data show that resource rigidity stems from unwillingness to invest, while routine rigidity stems from an inability to change the patterns and logic that underlie those investments. The first relates to the motivation to respond, the second to the structure of that response... By analogy, resource rigidity is concerned with movement along a line, while routine rigidity deals with the trajectory of the line... Threat decreases resource rigidity but increases routine rigidity" (Gilbert, 2005, p. 757). One of his main findings is that the response to discontinuous change in environment requires more than just commitment of resources. The underlying organizational routines that use those resources must also adapt accordingly. Therefore:

Proposition 1: *Resources and routines, if not questioned and re-examined periodically, have a tendency to become rigid due to the force of inertia.*

Having this in mind, the question that practically imposes itself is whether routines exhibit only continuity and repetition, or there is some other trait invisible when viewed from distance. Closer observation of routines reveals their different kind of nature, the one that is opposite to continuity and repetition. Viewed up close, routines change. They change continuously and endogenously, which leads various academics to emphasize their role in flexibility and change (Pentland and Reuter, 1994). In response to these apparently contradictory empirical findings, Pentland and Feldman (2005) argue that routines are continuously emerging systems with internal structures and dynamics. The internal structure of a routine can produce a wide range of different outcomes on the continuum between „very stable" and „constantly changing", depending on circumstances.

The stability and instability of routines are both desirable. This presents a paradox that continually challenges organizations to balance the two objectives (Poole and Van de Ven, 1989). Anand et al. (2012) argue that routines go through alternating cycles of intended stability in terms of adherence to the established procedures, and intended instability in terms of improvisation and change in these procedures. In other words, operational routines go through regular phases of renewal through organizational learning. In the absence of a renewal, adherence to routines tends to decay, leading to a state of higher entropy over time. The preceding arguments suggest the following proposition:

Proposition 2: *The greater the extent to which firms foster organizational learning, the greater the likelihood they will establish empirically proven routines that will be subjected to renewal as circumstances dictate.*

2.2. Organizational (operational) capability

The capabilities refer to a firm"s capacity to deploy and coordinate different resources, usually in combination, using organizational processes, to affect a desired end (Amit and Shoemaker, 1993). Hence, resource and capability represent two different conceptual levels. A firm's resources at a given time could be defined as those (tangible and intangible) assets which are tied semipermanently to the firm (Wernefelt, 1984). On the other hand, capabilities are focused on the combination and linking of resources, that is, capability represents a distinctive and superior way of allocating resources (Schreyögg and Kliesch-Eberl, 2007), and each firm gradually develops its approach to selecting and using specific resources (Schreyögg and Kliesch-Eberl, 2007), which is why it is also called organizational capability, or even operational capability. All these terms are treated as synonyms in this paper.

Organizational capability may also be regarded as a firm"s capacity to perform a specific activity or interrelated set of activities in a reliable and at least minimally satisfactory manner (Helfat and Winter, 2011). "Operational capability enables a firm to perform an activity on an on-going basis using more or less the same techniques on the same scale to support existing products and services for the same customer population." (Helfat and Winter, 2011, p. 1244) According to Winter (2000), an organizational capability is "a high level routine (or collection of routines) that, together with its

implementing input flows, confers upon an organization‟s management a set of decision options for producing significant outputs of a particular type" (p. 983). Hence:

Proposition 3: *Firms that incorporate appropriate routines on the selected resources during their operations will have a greater chance to create more effective organizational (operational) capabilities.*

As already implied in the section covering routines, organizational capabilities may fall into trap of becoming needless routines if their underlying logic is not subjected to continuous re-examination and evaluation. "Any capability therefore contains an inherent risk, that is, the risk of rigidity and helplessness in the face of fundamentally changing conditions. As a consequence, organizations are confronted with a dilemma: on the one side, they have to develop reliable patterns of selecting and linking resources in order to attain superior performance and competitive advantages and on the other side this endeavour constitutes – at least in volatile markets – a considerable risk of becoming locked into exactly these capabilities" (Schreyögg and Kliesch-Eberl, 2007, p. 919). Based on the aforementioned:

Proposition 4: *Organizational (operational) capabilities, if not questioned and re-examined periodically, have a tendency to become rigid due to the force of inertia.*

An organizational capability is the result of an organizational learning process (Schreyögg and Kliesch-Eberl, 2007). Organization learning is a form of informational updating through which decision makers develop an understanding of relationships between organization actions and outcomes (Levitt and March, 1988). Thus, the factors that define an organization‟s capabilities evolve over time: they start with resources, then move to processes and values, and finally end with culture (Christensen and Overdorf, 2000). Seen through these lenses, it is not surprising that creating outstanding organizational capability has a synergistic effect, i.e., it enables the company as a whole to be more valuable than the sum of its parts (Brockbank and Ulrich, 2009). Therefore:

Proposition 5: *The greater the extent to which firms foster organizational learning, the greater the likelihood they will establish adequate organizational (operational) capabilities.*

2.3. Dynamic capability

In an environment where technological, regulatory, and competitive conditions are subjected to rapid change, persistence in the same operating routines quickly becomes hazardous. If the change is not only rapid but also unpredictable and variable in direction, operational capabilities and even the higher-order learning approaches will need to be updated repeatedly. Failure to do so turns core competencies into core rigidities (Leonard-Barton, 1992). Thus, established organizational capabilities ought to be changed as quickly and frequently as environment changes. In other words, a firm must adapt its operational capabilities fast enough in order to cope with the environment dynamics.

Firm‟s ability to thrive over time lies in its ability to integrate and build upon its current competencies while simultaneously developing fundamentally new capabilities. This is called a „dynamic capability‟. According to Teece et al. (1997), dynamic capabilities may be regarded as "the firm‟s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (p. 516). In other words, organizations must develop dynamic capabilities in order to survive in the contemporary environment.

Dynamic capabilities are those that promote a seemingly radical change in how a firm makes a living (Helfat and Winter, 2011) on the basis of its existing (operational) capabilities. They refer to the capacity to renew competencies (Teece et al.,, 1997). When change in the environment is discontinuous, residual fit usually remains between the already established firm‟s capabilities and some portion of the environment, which means that established capabilities as well as new ones must coexist for some period of time. This is what dynamic capabilities really mean: moving from one competency configuration to another, and maintaining multiple competencies that address inconsistent contexts simultaneously (Gilbert, 2006). "Dynamic capabilities in this sense build different types of capabilities, which amount to experiential, improvisational, and highly fragile processes of reconfiguration, integration, and acquisition of resources. They make use of real-time information, simultaneously explore multiple alternatives, rely on quickly created new knowledge, are governed by very few simple rules, do not get stored in the organizational memory, and thus do not produce

predictable outcomes. Their strength no longer flows from architecture but rather from its ability to continuously produce new constellations and solutions" (Schreyögg & Kliesch-Eberl, 2007, p. 919). The foregoing literature review suggests the following proposition:

Proposition 6: *The greater the extent to which firms develop various organizational (operational) capabilities, no matter whether in a successive or simultaneous manner, the greater dynamic capabilities they possess.*

Thus, an organization"s dynamic capabilities depend on simultaneously exploiting current technologies and resources to secure efficiency benefits and creating variation through exploratory innovation. Maintaining an appropriate balance between exploitation and exploration is critical for firm survival and prosperity (March, 1991; Teece et al., 1997). This is not to say that dynamic capabilities are supposed to replace operational capabilities, but rather that, as Graetz and Smith (2008) argue, the key characteristic of duality thinking that organizations must achieve if they are to exploit and explore, is the bidirectional partnership between continuity (efficiency through operational capabilities) and change (flexibility and responsiveness through dynamic capabilities).

Therefore, aligning organizations to simultaneous exploitation and exploration is a task of dynamic, rather than static alignment (Raisch and Birkinshaw, 2008), and the firm"s capability to manage this alignment is called organizational ambidexterity (Duncan, 1976; March, 1991). Even though organizations need both types of capabilities (exploration and exploitation), organizational ambidexterity can be viewed as an organization-level dynamic capability (Jansen et al., 2009), but only if management can repeatedly and intentionally orchestrate firm assets and resources (O"Reilly and Tushman, 2007). "As a dynamic capability, ambidexterity embodies a complex set of routines including decentralization, differentiation, targeted integration, and the ability of senior leadership to orchestrate the complex trade-offs that the simultaneous pursuit of exploration and exploitation requires. Developing these dynamic capabilities is a central task of executive leadership" (O"Reilly & Tushman, 2011, p. 6).

Cao et al. (2009) have shown that ambidexterity is fostered by close interrelations between existing and new knowledge. They argue that synergistic effect can be achieved by allowing existing resources to be more fully employed to acquire new capabilities, while at the same time permitting new knowledge to be more fully integrated into the existing pool of resources. Therefore, since organizational ambidexterity is a dynamic capability, it can be concluded that dynamic capabilities must be developed through learning. Zollo and Winter (2002) focused on organizational learning as a source of dynamic capability, which they defined as "a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness" (p. 340). They argue that dynamic capabilities emerge from the co-evolution of tacit experience accumulation processes with explicit knowledge articulation and codification activities. It thus follows:

Proposition 7: *The greater the extent to which firms foster organizational learning, the greater the likelihood they will establish dynamic capabilities.*

2.4. Absorptive capacity

An absorptive capacity is the ability of a firm to identify, assimilate and apply useful external knowledge (Cohen and Levinthal, 1990). It can also be acknowledged as the capacity to learn and solve problems (Kim, 1997a; 1997b). In order to identify, assimilate and exploit new knowledge, a firm must possess prior related knowledge. The prior knowledge allows assimilation of new knowledge only if some portion of it is closely related to the new knowledge (Cohen and Levinthal, 1990). An absorptive capacity tends to confine a firm to operate in a specific technological domain (Cohen and Levinthal, 1990), which may eventually lead to the pattern of inertia (Nelson and Winter, 1982). Hence, two propositions follow:

Proposition 8: *The greater the extent to which firms foster organizational learning, the greater the likelihood they will have effective absorptive capacity.*

Proposition 9: *Absorptive capacity, if not questioned and re-examined periodically, has a tendency to become rigid due to the force of inertia.*

"Absorptive capacity is more likely to be developed and maintained as a byproduct of routine activity when the knowledge domain that the firm wishes to exploit is closely related to its current knowledge base. When, however, a firm wishes to acquire and use knowledge that is unrelated to its ongoing activity, then the firm must dedicate effort exclusively to creating absorptive capacity (i.e., absorptive capacity is not a byproduct)." (Cohen and Levinthal, 1990, pp. 149-150) Creative utilization of new knowledge will be permitted if some part of the prior knowledge is fairly diverse, although still related (Cohen and Levinthal, 1990).

Van den Bosch et al. (1999) argued that Cohen and Levinthal"s (1990) implicit feedback loop (absorptive capacity→ learning → new absorptive capacity) is mediated by the environment in which the firm competes and its success in coping with it. Firms facing stable or turbulent environments tend to organize themselves differently and emphasize different ways of combining knowledge (Lane et al., 2002).

On the other side, Zahra and George (2002) have established a conceptual link between absorptive capacity, organizational (operational) capability and dynamic capability by defining absorptive capacity as "a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability." (p. 186) According to them, acquisition, assimilation, transformation and exploitation are organizational capabilities that build on each other to yield absorptive capacity. In this way, absorptive capacity may actually be seen as a dynamic capability that enable firms to create and deploy the knowledge necessary to build other organizational capabilities, that is, production, marketing, sales, etc. (Zahra and George, 2002). Therefore, two propositions are extracted from the foregoing claims:

Proposition 10: *Absorptive capability is a dynamic capability*.

Proposition 11: *The greater the absorptive capacity/dynamic capabilities that firms possess, the greater the possibility they will develop various organizational (operational) capabilities.*

Based on a thematic analysis of the literature, Lane et al. (2002) found that organizational learning and absorptive capacity coevolve with each influencing the other. However, they concluded that little attention has been given to the implications of exploitative versus exploratory learning for absorptive capacity development. Thus, Lane et al. (2006) suggested a more detailed definition of absorptive capacity as a firm"s ability to utilize externally held knowledge through three sequential processes: (1) recognizing and understanding potentially valuable new knowledge outside the firm through exploratory learning, (2) assimilating valuable new knowledge through transformative learning, and (3) using the assimilated knowledge to create new knowledge and commercial outputs through exploitative learning. Hence:

Proposition 12: *The greater the extent to which firms have established absorptive capacity/dynamic capabilities, the greater the likelihood they will foster organizational learning.*

3. CONCEPTUAL MODEL

The propositions extracted from the literature review of the constructs in this paper determine connections between them, thus making a conceptual model depicted in Figure 1.

The first trait of the proposed model that ought to be emphasized is the relationship between dynamic capabilities and absorptive capacity. The literature review began by considering them as two separate constructs, but ended with the premise of them actually being one construct. The second obvious trait of the model is positioning of operational capabilities as a central construct inextricably intertwined with all the other constructs.

Resources and routines, as well as operational and dynamic capabilities, if not questioned and re-examined periodically, have a tendency to become rigid due to the force of inertia. The explanation for this statement lies in the velocity of the contemporary environment in which majority of firms operate (Stefanovic et al, 2012). In the ever-changing environment, sustainable competitive advantage is a thing of the past. Contemporary environment has shifted the focus towards the temporary competitive advantage (D"Aveni et al, 2010), because the true sustainable competitive advantage is rare and declining in duration (Ruefli and Wiggins, 2002). Long-term survival ought to be embedded in new

variations, internal selection that correctly reflects external selection pressures and top management"s capacity for recognizing and retaining viable strategic initiatives (Burgelman, 1994).

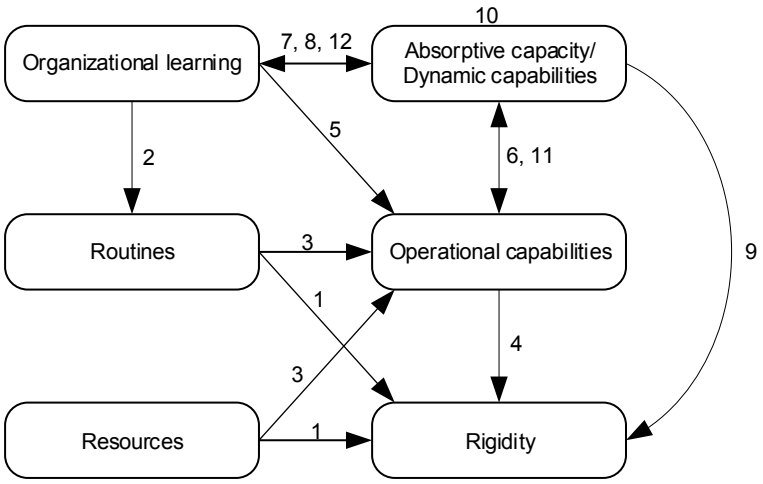

Figure 1: Conceptual model of routines, capabilities, and absorptive capacity interplay

In other words, firms ought to engage in the process of continuous organizational learning in order to cope with the changes and surprises arising from the environment. Fostering organizational learning within firms increases the likelihood of establishing empirically proven routines that will be subjected to renewal as circumstances dictate. Firms that learn how to incorporate these routines on the selected resources during their operations will have a greater chance to create more effective operational capabilities suitable for the specific situation. Therefore, widespread organizational learning increases the likelihood of creating adequate operational capabilities, but also plays an important role in establishing dynamic capabilities/absorptive capacity. Nevertheless, there is also a direct causal relationship between operational and dynamic capabilities. Thus, the greater the extent to which firms develop various operational capabilities, no matter whether in a successive or simultaneous manner, the greater dynamic capabilities they possess. Finally, the greater the extent to which firms have established dynamic capabilities/absorptive capacity, the greater the likelihood they will foster organizational learning and develop needed operational capabilities.

4. CONCLUSION

The constructs of routines, operational capabilities and dynamic capabilities/absorptive capacity have been applied to a wide variety of phenomena in recent years. Their growing appeal is a reflection of their versatility, but this versatility carries the risk of a lack of clarity in meaning and differentiation between these constructs, as well as clear linkages joining them. In this paper, we attempt to bring a sense of holistic perspective by briefly reviewing the current state of the research and highlighting what is known about the topic. After that, the conceptual model is provided based on the propositions extracted from the literature review of the constructs.

Even though this paper provides a reconceptualization of causal relationships between routines, operational capabilities and dynamic capabilities/absorptive capacity, and may present a small contribution to the holistic perspective on how firms achieve competitive advantage and thrive in their respective environments, authors are fully aware of its limitations. First and foremost, this paper presents a theoretical review and reconceptualization based on this review. In other words, the conceptual model presented in this paper has no direct empirical confirmation. It is simply a synthesis of various research papers, which is why its approval in an empirical setting is needed. Second limitation concerns the scope of the literature reviewed. Even though some of the most influential articles on the topics of interest are covered, and they share practically the same underlying logic, maybe some less-known articles would indicate other aspect of the gap in the strategic management literature we are trying to bridge. Thus, a review that covers a broader scope of articles covering these topics is needed.

We hope that this paper encourages future research on the dimensions, causal relationships linking them and contributions of the constructs. It is reassuring that researchers in diverse organizational disciplines have recognized the explanatory power of routines, operational capabilities as well as

dynamic capabilities/absorptive capacity, and we hope that their future uses of this concept will show greater recognition of its multiple dimensions and their links to create and sustain a competitive advantage of firms.

REFERENCES

Amit, R., & Schoemaker, P. (1993). Strategic assets and organizational rent. Strategic Management Journal, 14 (1), 33-46.

Anand, G., Gray, J., & Siemsen, E. (2012). Decay, shock and renewal: Operational routines and process eentropy in the pharmaceutical industry. Organization Science, 23(6), 1700-1716.

Argyris, N. (1996). Evidence on the role of firm capabilities in vertical integration decisions. Strategic Management Journal, 17 (1), 129-150.

Becker, M. (2004). Organizational routines: A review of the literature. Industrial and Corporate Change, 13 (4), 643-677.

Brockbank, W., & Ulrich, D. (2009). The context of talent. TMTC Journal of Management, July, 33-37.

Brown, S. L., & Eisenhardt, K. M. (1997). The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organizations. Administrative Science Quarterly, 42(1), 1-34.

Burgelman, R. A. (1994). Fading memories: A process theory of strategic business exit in dynamic environments. Administrative Science Quarterly, 39(1), 24-56.

Cao, Q., Gedajlovic, E. R., & Zhang, H. (2009). Unpacking organizational ambidexterity: Dimensions, contingencies, and synergistic effects. Organization Science, 20(4), 781-796.

Christensen, C. M., & Overdorf, M. (2000). Meeting the challenge of disruptive change. Harvard Business Review, 78 (2), 66-76.

Cohen, M. D., Burkhart, R., Dosi, G., Egidi, M., Marengo, L., Warglien, M., & Winter, S. (1996). Routines and other recurring patterns of organizations: Contemporary research issues. Industrial and Corporate Change, 5(3), 653-698.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. Administrative Science Quarterly, 35(1), 128-152.

D"Aveni, R. A., Dagnino, G. B., & Smith, K. G. (2010). The age of temporary advantage. Strategic Management Journal, 31, 1371-1385.

Duncan, R. (1976). The ambidextrous organization: Designing dual structures for innovation. In: Kilman, R., & Pondy, L. (eds.). The management of organizational design. NY: North Holland, 167-188.

Feldman, M. S., & Pentland, B. T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. Administrative Science Quarterly, 48, 94-118.

Gilbert, C. G. (2005). Unbundling the structure of inertia: Resource versus routine rigidity. Academy of Management Journal, 48(5), 741-763.

Gilbert, C. G. (2006). Change in the presence of residual fit: Can competing frames coexist? Organization Science, 17(1), 150-167.

Gilbert, R. J., & Newberry, D. M. (1982). Preemptive patentnig and the persistence of monopoly. American Economic Review, 72, 514-526.

Graetz, F., & Smith, A. C. T. (2008). The role of dualities in arbitrating continuity and change in forms of organizing. Internationl Journal of Management Reviews, 10(3), 265-280.

Helfat, C. E., & Winter, S. G. (2011). Untangling dynamic and operational capabilities: Strategy for the (n)ever-changing world. Strategic Management Journal, 32, 1243-1250.

Herrmann, P. (2005). Evolution of strategic management: The need for new dominant designs. International Journal of Management Reviews, 7(2), 111-130.

Jansen, J. J. P., Tempelaar, M. P., van den Bosch, F. A. J., & Volberda, H. W. (2009). Structural differentiation and ambidexterity: The mediating role of integration mechanisms. Organization Science, 20(4), 797-811.

Kim, L. (1997a). The dynamics of Samsung"s technological learning in semiconductors. California Management Review, 39(3), 86-100.

Kim, L (1997b). From imitation to innovation: The dynamics of Korea"s technological learning. Cambridge, MA: Harvard Business School Press.

Lane, P. J., Pathak, S., & Koka, B. R. (2002), A thematic analysis and critical assessment of absorptive capacity research. Academy of Management meeting, Denver. BPS Best Paper Proceedings.

Lane, P. J., Koka B. R., & Pathak, S. (2006). The reification of absorptive capacity: A critical review and rejuvenation of the construct. Academy of Management Review, 31(4), 833–863.

Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. Strategic Management Journal, 13, 111-125.
Levitt, B., & March, J. (1988). Organizational learning. Annual Review of Sociology, 14, 319-340.
March, J. G. (1991). Exploration and exploitation in organizational learning. Organization Science, 2(1), 71-87.
Nelson, R. R.; & Winter, S. G. (1982). An evolutionary theory of economic change. Cambridge, MA: Harvard University Press.
O"Reilly III, C. A., & Tushman, M. L. (2007). Ambidexterity as a dynamic capability: Resolving the innovator"s dilemma. Cambridge, MA: Harvard Business School.
O"Reilly III, C. A., & Tushman, M. L. (2011). Organizational ambidexterity in action: How managers explore and exploit. California Management Review, 53(4), 5-22.
Pentland, B., & Feldman, M. (2005). Organizational routines as a unit of analysis. Industrial and Corporate Change, 14(5), 793-815.
Pentland, B., & Rueter, H. (1994). Organizational routines as grammars of action. Administrative Science Quarterly, 39, 484-510.
Pfeffer, J., & Salancik, G. R. (1978). The external control of organizations. New York: Harper & Row.
Poole, M. S., & Van de Ven, A. H. (1989). Using paradox to build management and organization theories. Academy of Management Review, 14(4), 562-578.
Raisch, S., & Birkinshaw, J. (2008). Organizational ambidexterity: Antecedents, outcomes, and moderators. Journal of Management, 34(3), 375-409.
Ruefli, T. W., & Wiggins, R. R. (2002). Industry, corporate, and segment effects and business performance: A non-parametric approach. Strategic Management Journal, 24(9), 861-879.
Schreyögg, G., & Kliesch-Eberl, M. (2007). How dynamic can organizational capabilities be? Towards a dual-process model of capability dynamization. Strategic Management Journal, 28, 913-933.
Schreyögg, G., & Sydow, J. (2010). Organizing for fluidity? Dilemmas of new organizational forms. Organization Science, 21(6), 1251-1262.
Stefanovic, I., Prokic, S., & Vujovic, S. (2012). The organizational environment dimensions revisited: Analysis of the contemporary context. Transformations in Business & Economics, 11(1), 124-138.
Stefanovic, I., Prokic S., & Vukosavljevic, D. (2011). The response to the changing landscape of tomorrow: Reconfigurable organizations. African Journal of Business Management, 5(35), 13344-13351.
Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic Management Journal, 18(7), 509-533.
Tushman, M. L., & O"Reilly, C. A. III (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. California Management Review, 38(4), 8-30.
Van den Bosch, F.A.J., Volberda, H.W., & de Boer, M. (1999). Coevolution of firm absorptive capacity and knowledge environment: Organizational forms and combinative capabilities. Organization Science, 10, 551-568.
Wernefelt, B. (1984). A resource-based view of the firm. Strategic Management Journal, 5(2), 171-180.
Winter, S. G. (2000). The satisficing principle in capability learning. Strategic Management Journal, 21: 981-996.
Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. Academy of Management Review, 27(2), 185-203.
Zollo, M., & Winter, S. G. (2002). Deliberate learning and the evolution of dynamic capabilities. Organization Science, 13(3), 339-351.

DEVELOPMENT OF PROCESS MODEL OF ENTERPRISE ORGANIZATION

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Abstract: *This paper examines the emergence and development of process model of the enterprise. Here are given the early contributions of authors who have indicated the occurrence of the process model. Basic theoretical models are given, ranging from Deming`s flowchart and Porter's value chain model over Davenport`s model, horizontal organizations: Rumler and Branch, John Byrns and Ostroff, to the reengineering of Hammer and Harmons organizational models and processes. In particular, a model of quality management systems and model thin horizontal structures are shown. Based on them, the basic model of process organized company is given and its main characteristics are described.*

Keywords: *model, process, development, structure, horizontal organization*

1. INTRODUCTION

Process approach to the organization of companies that emerged at the end of the twentieth century is not at the same time brought the establishment of a general process model of the enterprise. Some authors in their papers describe their models, but none of them was good enough to become generally accepted - universal (general). Each of them contained the individual "process" elements but was not universal, and today there is no single model that would be in the science of the organization ranked next to well-known model of organizational structure: functional, multidivisional, project and matrix, but there are more, originating from a variety of authors and institutions. Such a single model can be reached by a critical analysis of the known models and by the results of process approach researches published so far, and the integration of the knowledge thus obtained.

2. THE START OF THE DEVELOPMENT OF PROCESS MODEL

The process model has a long course of development, which began in the early years of the twentieth century, and its fundamental shaping was achieved in the nineties. In a period of about 80 years, a number of practitioners and scholars have contributed to the emergence and development of the process model.

Gant created Gantt chart at the beginning of the twentieth century - a graphical way to view the flow of production through a series of horizontal segments, showing the duration of the manufacturing operations and their relationship. By these diagrams Gant became unconsciously the originator of the process model.

Fifty years later the Network planning was designed - graphical and quantitative methods for the analysis of complex enterprise, consisting of a large number of interconnected horizontal activities. Two techniques were developed: 1) CPM (Critical Path Method), and 2) PERT (Program Evaluation and Review Technique). Although they were methods of planning and management, they paved the way for the arrival of process model by the horizontal propagation of events.

A significant shift towards a process model was brought by the emergence of the theory of the system - the system approach of the mid-twentieth century, as it has begun studying a whole composed of parts - as a whole system. The system is defined as a set of related elements (entities) and their properties, integrated relationships between themselves and these properties. (Berrtalanffy, 1951.) Is a graphic system shown as a box with a horizontal structure - general qualitatively defined and relatively stable ranking of relationships between elements of the system - subsystem and horizontal inputs and outputs. Each system can be seen as part of the - a subsystem of a higher system, and it can also have its subsystems.

A significant contribution to the research enterprise as a system given by the 60s of XX century, Forrester, who was a pioneer of industrial dynamics - a mathematical approach to the study of the forces at work in the company and moving to one of his causes. To study the dynamics of the industry, it is used for simulation, which is specially developed methodology graphical and mathematical modelling of the functioning of the company as a whole, consisting of horizontal associated elements of state and change of state elements.

According to Forrester, the business system is a complex organization and functioning of the various states and flows controlled flashback coupled circuits. In his operation on the target-oriented, and only operation is the result of the incorporation of various activities. Business system is a subsystem of broader and more complex systems, and participates in the exchange of goods, energy, information, etc., the transformation of the lower usability in more, their exchange and consumption. Specific environment and structure of parts of the system as well as their mutual coupling significantly affect the behavior and performance achieved. (Forrester, 1963, by Rajkov, 1977.)

All these results have created a solid theoretical framework and some practical experience on which several authors in the second half of the twentieth century, published his models to generate a process approach.

3. PREVIOUS THEORETICAL MODELS

3.1. Deming Flowchart

One of the first process model given by Deming, even in 1950 at the commencement of his famous lectures in Japan. The model shown on figure 1, he used to explain to Japanese managers the interplay of individual parts of the system quality. Deming described it as "a network of independent components that work together to achieve the objectives of the system".

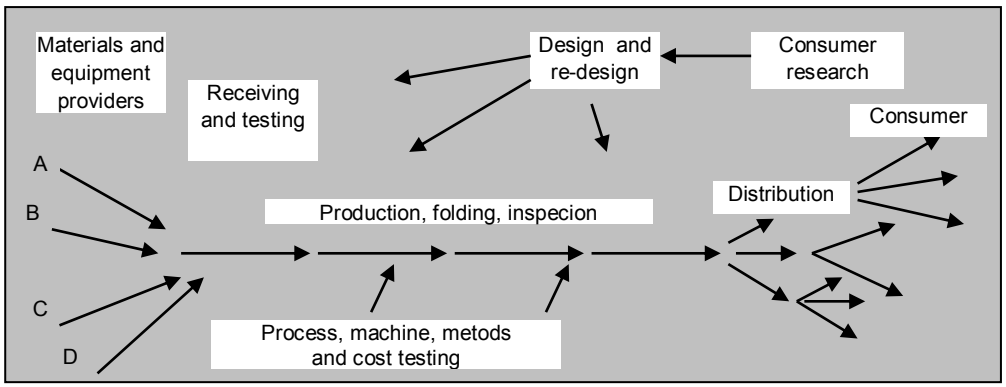

Figure 1: Production shown as a system (Deming, 1996.)

Deming has already used Flowchart - graphical display system components in a horizontal range of activities necessary for the creation and distribution of products.

3.2. Porter`s model of the chain of values

For further development of the process model, the fundamental importance of the Port`s value chain model, (published in 1985.), which contributes to the achievement of competitive advantage. "Competitive advantage can not be understood if the company is not seen as a whole. For analysis of the sources of competitive advantage, it is necessary systematic examination of all activities performed by firms, and their interactions. Every company has a set of activities that are performed in order to design, manufacture, marketing, delivery and support of its products. All of these activities are shown on figure 2 value chain of each company consists of nine generic categories of activities that are characteristic way related to each other." (Porter, 2007).

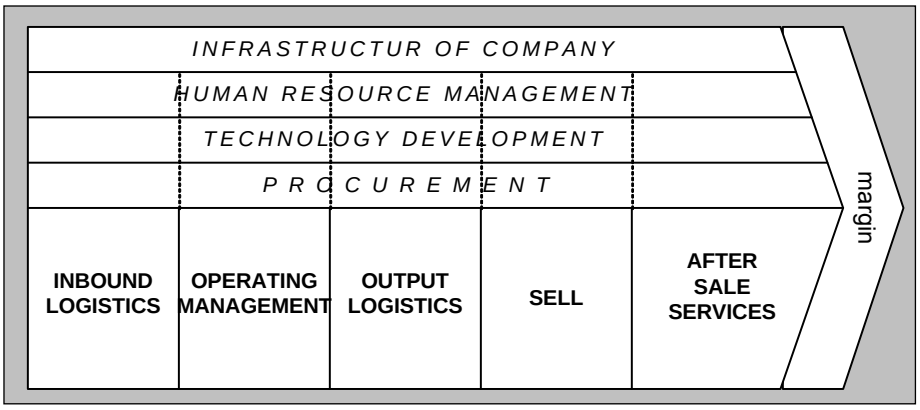

Figure 2: Porter's value chain (Adapted from Porter, 2007.)

Porter then viewed the company as a whole (process), which consists of two groups of horizontal activities (sub-processes): 1. PRIMARY - contribute to the creation of new values of the company through five generic activities: Inbound logistics, Operations, Output logistics, Sales and Service After Sales and Service and 2. *AUXILIARY*, which provide basic support, but also to each other, by providing: Inputs, Technology, Human resources and Other functions at the firm level.

3.3. Horizontal organization Rumler and Brache

Rumler and Brache (Rummler, Brache, 1990). assume that organizations behave as adaptive processing systems, which convert various input resources into outputs of goods and services, which supply the market. These organizations are based on, to processes for, structures, measures, rewards, and resources.

People within a working, functional silos, focus on what is best for a given function, often to the detriment of other functions. Rumler and Brache among the first propose the organization of activities, structures, measures and rewards, around horizontal processes.

3.4. Horizontal organization John Byrne

Byrne in 1993. popularized the term "Horizontal organization" and gave the definition of the model oriented towards business processes. Horizontal organization is described as the removal of both functional as well as the hierarchical boundaries. They all work together, within multidisciplinary teams, conducting key processes such as product development.

Byrne described horizontal organization model which contains the following elements:
1. A company is built on about three to five key processes, not tasks, with specific goals and each executive process is given to the "owner of process".
2. Hierarchy is flattened, shallow. Supervision (supervision) is reduced, fragmented tasks are combined, work that brings value was eliminated, the number of activities of the process is reduced to a minimum the number of teams in the implementation process is as small as possible.
3. Teams manage everything. The teams are the main building blocks of the masonry, with limited supervision, because they themselves manage them. They are responsible for the executive measurable goals.
4. Contacts with suppliers and customers are direct.
5. All employees are informed and trained.
6. Customer satisfaction, rather than a capital increase or profitability is a primary driver, and performance measures. Profit will come and capital will grow, if the customers are satisfied.
7. Performance team is rewarded. The review and payment, reward effects, the results of the whole team and not just the individual. (Byrne, 1993.)

3.5. Davenport's model of integrated company

Davenport (Davenport, 1993.) was among the first focused on the improvement and process improvement in this regard stressed the crucial importance of information technology. Model integration of an enterprise (figure 3), which was established as part of the improvement of its processes, can be considered as the first practically usable process model company. However, it is quite a general view of the processes in the company, and Davenport has not focused his attention to its further improvement. Still visible is its horizontal flow, the main processes and their relationship and taking into account the customers and retailers. Unusual is the unification Engineering and Marketing.

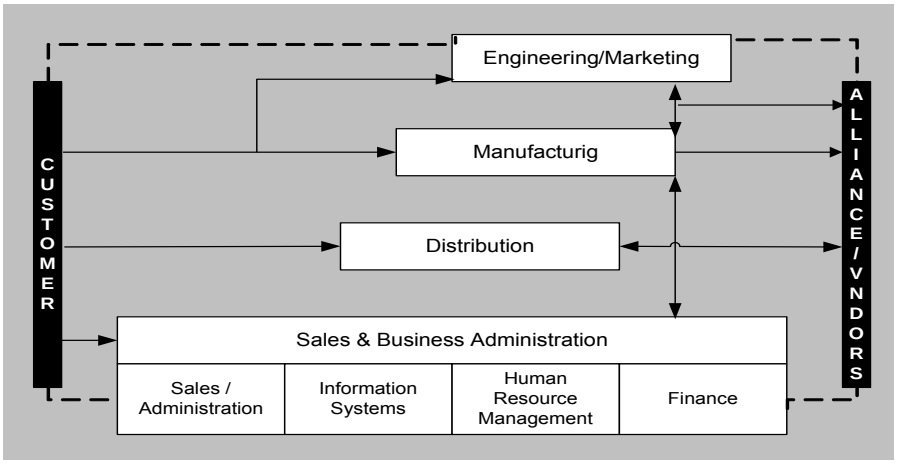

Figure 3: Davenport`s model integration off enterprises (Adapted from Davenport, 1993)

3.6. Horizontal organization Frank Ostroff

Ostroff 1999. offers the first viable concept map the horizontal arrangements under which explains what the horizontal organization, what it looks like, why it is important, as it leads to performance improvement, where appropriate, to introduce and how to develop. He explained the twelve primary key principles for the formation of horizontal organization. The five principles relate to:
1. organizing around basic cross-functional process, not about the tasks or functions;
2. setting process owner or manager who will take responsibility for the main process;
3. the formation of teams, not individuals, as the foundation of organizational design and performance;
4. reducing hierarchy by eliminating jobs that do not create value;
5. integration with customers and suppliers.
The other seven principles relate to institutional changes:
6. allowing employees to make decisions important to the team's performance;
7. use of information technology to assist people to reach performance goals and deliver proper value to the customer;
8. highlight multiple competencies and train people to solve problems and work productively in cross-functional areas within the new organization;
9. promote multiple skills, abilities, creative thinking and flexible response to the new challenges that arise in business performing teams;
10. teaching people trained primarily in specific functions or departments to work in partnership with others;
11. measuring target output process performance such as customer satisfaction, employee satisfaction financial contributions;
12. building a corporate culture of openness, cooperation and collaboration, which focuses on continuous improvement of performance and evaluate accountability, well-being and empowerment of employees. (Ostroff, 1999.)

With these principles Ostroff gave a graphical representation of the model, but it only shows the position of teams within the classical vertical structure and not widely usable.

3.7. Process reengineering by Hammer and Champy

A decisive contribution to the implementation of the process approach in practice achieved reengineering processes since 2001. firmly suggested Hammer and Champy. "It is no longer necessary or desirable to companies organize their work around the division of labor Adam Smith. Jobs oriented task in today's world, customers, competition and change the date. Instead, companies must be organized around business processes." (Hammer, Champy, 2004). According to them, it means the next ten changes in the company:
1) Work units change - from functional departments to process teams.
2) Jobs change - from simple tasks to multidimensional work.
3) The role of the people is changing - from controlled to authorized decision-making.
4) Shall be prepared for the job - the practice of education.
5) The focus of enforcement measures and compensation shifts - from financial results.
6) Changes to the criteria for promotion - from the productivity capabilities.
7) Values change - from patronizing the creative.
8) Managers change - from supervisors become coaches.
9) Changes to organizational structure - from hierarchical to flat.
10) The Executive Directors are changing - from the counter points to the leader.

These changes represent the essence of reengineering, which is described as follows: "Reengineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvement in contemporary critical success criteria such as cost, quality, service and speed." (Hammer, Champy, 2004.)

3.8. Harmon`s model of organization and process

Harmon (Harmon, 2003) says we should leave the organizational chart because under it we do not know which organizational unit is responsible for a process. He used the name of an organization chart which shows the three main processes: R&D, Sales and Marketing, Manufacturing and Order Fulfillment group and Auxiliary processes. Each of these processes consists of several sub-processes, and the processes are divided into activities. To view the process Harmon uses rectangles with rounded corners to distinguish the organizational units (departments) showing by rectangles with normal angles. View the processes of enterprises with the help of an organization chart is important because "department don`t produce profits; value chains and processes produce profits." Therefore, "organizations need to focus on the flows and relationships that actually add value and produce product for customers." (Harmon, 2003.)

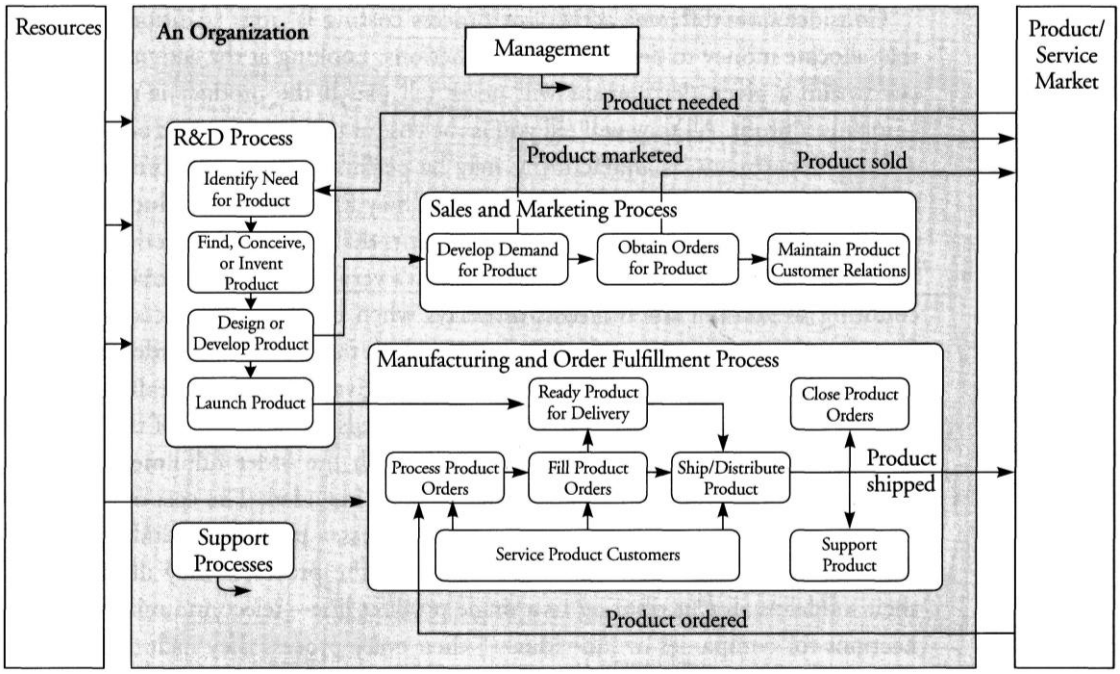

Figure 4: Harmon`s organization chart (Harmon, 2003) (On basis General Elseivier permission)

3.9. Model of anatomical structure of the business system

A group of autors at FOS developed a model of anatomical structure of the business system (Radović, 2008.) with four processes: Research and Development, Production, Business and Management, which consists of ten subsystems: 1) The basic activity, 2) Marketing, 3) Supply, 4) Sale, 5) Economics, 6) Finance, 7) Personnel, 8) Legal-normative, 9) Control) and 10) Development. For this model a detailed process approach of the 12 steps was developed, among them a central place occupies 5. Identification and classification process. This approach - engineering process is carried out in a number of organizations.

4. QUALITY MANAGEMENT MODEL

ISO 9000 published in 1984. developed rapidly, so that the version of the year 2000. was based on the process approach. For an organization to function effectively, it must determine the number of related activities and to carry out their management. Activities or groups of activities, using resources, and managed in order to enable the transformation of inputs into outputs, can be considered as a process. Often the output element from one process directly forms the input element to the next. Application of processes within an organization, together with the identification and interaction of these processes, and the management of them, to obtain the desired results, it can be called a "process approach".

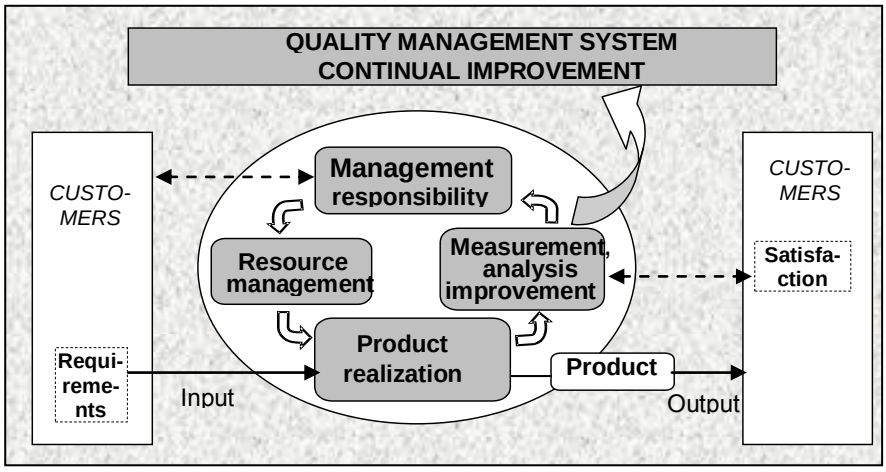

Figure 5: Model of quality management system based on processes (Adapted from SRPS ISO 9000:2005)

Model quality management system based on processes (Figure 5) shows that customers play a significant role in defining requirements as inputs and monitor their satisfaction which is determined by how the

organization meets their requirements. The model is fully consistent with systems theory, a control uses a feedback mechanism, which consists of the measurement and analysis of data collected for the purpose of continuous improvement.

5. MODEL THIN HORIZONTAL PROCESS STRUCTURE

The idea of tanks - flattened horizontal structure was quickly accepted as a way of achieving a process approach in organizations. It particularly applies to the logistic and operational aspects of business. One of the models of tanks is shown on figure 6.

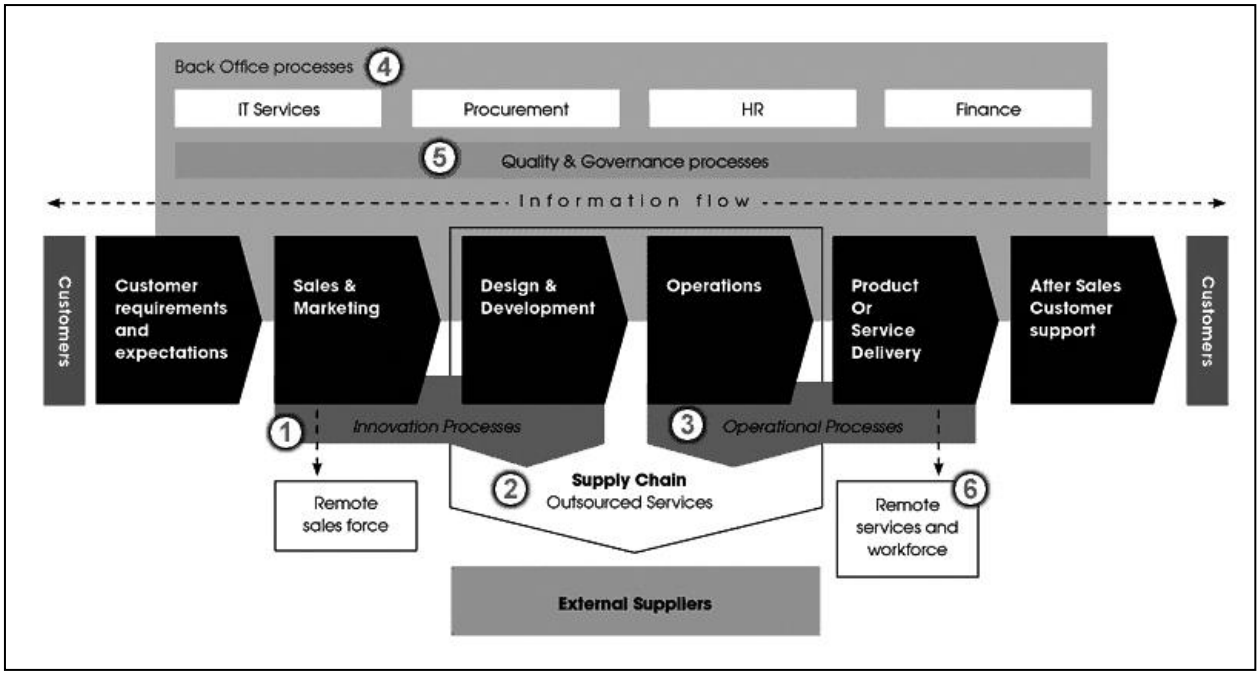

Figure 6: Model thin horizontal process structure (With Lean Business Thinking permission)

In this model, it was pointed out that there are six key process groups:
1. Innovation Processes - Development processes usually involve transforming customer's requirements and information along the value stream.
2. Lean Supply Chain Development - It is important to recognize that outsourcing can provide lean levers for improvement.
3. Lean Operations - Sales, Procurement and Manufacturing.
4. Lean Back Office - Within your organization there are a series of non customer facing, but business critical processes.
5. Quality Lean - Lean techniques signpost a different role for the Quality organization.
6. Service - Lean thinking is directly applicable to service industries. It is important for service delivery teams to have a clear understanding of the characteristics of service (value) that the customer cares about.
Company Lean Business Thinking using this model as a starting point in the acknowledgments of consulting services for process improvement.

6. BASIC MODEL OF PROCESS ORGANIZED COMPANY

Based on the characteristics previously described models can form a general - a universal model, which can be used as a starting point in the application process approach in each company. How it is used as a basis for the design process on the folder might be called the basic process model of enterprises, and its essential one feature are:
1) The model assumes that the company operates in an environment with market principles of business, making sure there is the process of marketing management (MM) and customer relationship management (CRM) through which establishes relationships with customers that defines their requirements and monitor the achievement of satisfaction.
2) The model also implies that the main objective of business enterprise economic efficiency - profit making, which is why there is a process of financial management (FM).
3) The products and services of the company is in the process of devising their own research and development (R&D), but are used and the results of R&D and others.

4) The company's activity is achieved in the process of operations management (OM), supported by the process of supply chain management (SCM).
5) Needed quality of products, services and business processes is realized by QM and appropriate integrated management system standards: quality, environmental protection and employee safety.
6) People are creative factor in business and management, and they can engage in teamwork - teams and managing established through the owner of the process, which is under the process of human resource management (HRM).
7) The structure of the model is made by the listed horizontally oriented processes, which are shown by arrows, and their informational links that are indicated by dashed lines, which establishes an IT process (IP). It is organized as an information system ERP type and should provide support to the management and processing teams and achieve integration process.
8) Top management in collaboration with the owners determine the strategic framework - vision, mission, objectives, strategies and policies.

The elements of the process model of enterprises and their relationship are shown on figure 7. As you can see, the display processes and sub-processes using the horizontal arrow, which reflects the nature of the process: the horizontal orientation of the flow of converting inputs into outputs.

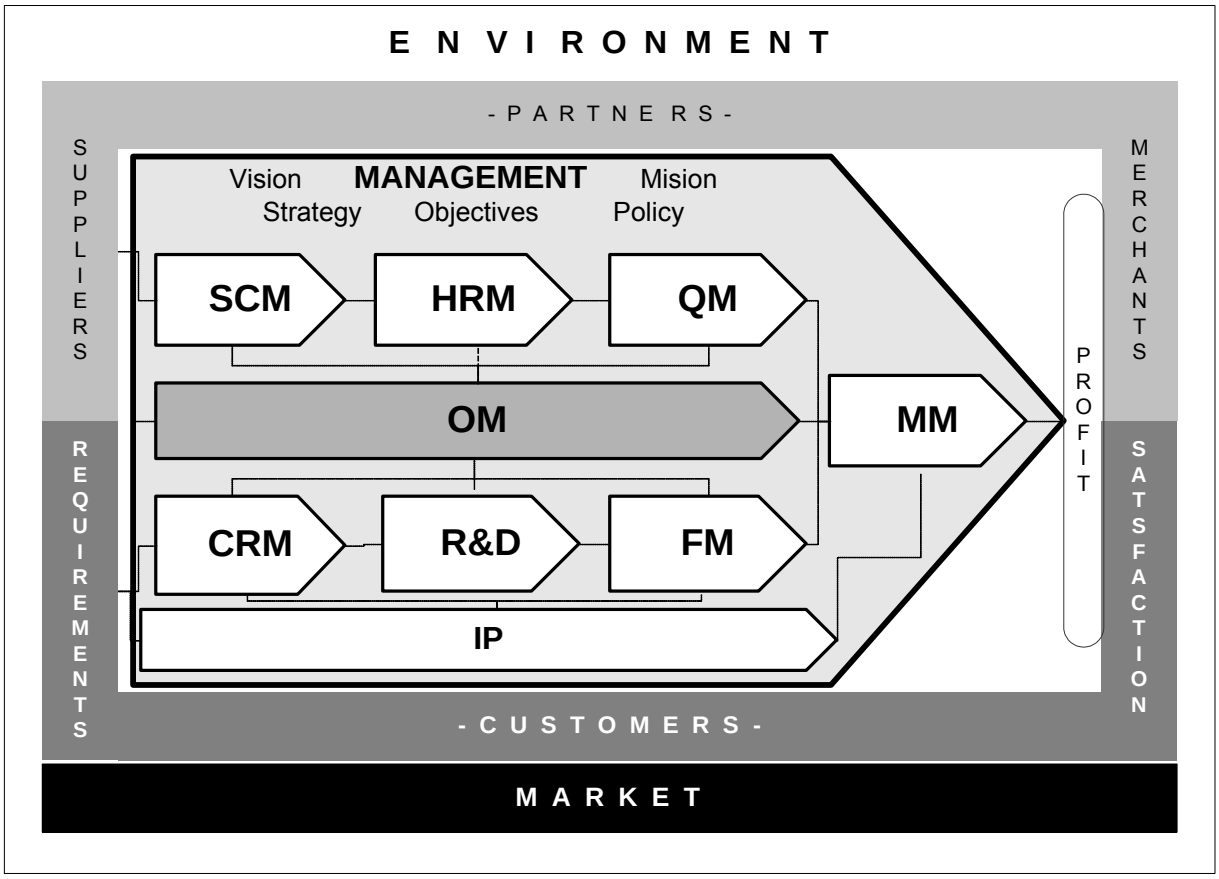

Figure 7: The basic model of a process of organized enterprises

Dashed lines connecting subprocesses indicate that the model involves multiple interconnectivity process. In the model is clearly visible role of top management to integrate processes and direct corporate performance by defining a framework of business factors. The model clearly shows that the final users are the main reason for the company's operations, the good organization of its processes, realized profit, operating in partnership with its suppliers and distributors.

7. MAP OF PROCESSES AND ITS CREATION AND PRESENTATION

These models reflect the views of their authors by the process approach. When implementing these models in practice for any particular company it is needed to create a process map, which describes in detail a process organization. To view maps of the process there are many different methods (standard) and software tools such as Method Integrated Definition (IDEF), Workflow Management (WfM), Unified Modeling Language (UML), Business Process Modeling Notation (BPMN), Business Process Modeling Language

(BPML) and so on. (Comparative analysis of the most important methods - standards have been published in: Ryan,K.L.Ko, Stephen,S.G.Lee, Eng Wah Lee (2009) and Recker,J., Indulska,M., Rosemann,M., Green, P., (2009). It is important to note that the process creates a special folder for each company, and that the process model is unique for all companies, except that adapts to each individual case.It is also important to distinguish between the process model as a general view of the processes in the company from a folder process that gives a detailed view.

8. CONCLUSION

The process model of the company has evolved over several decades of the twentieth century. A significant contribution to its development was given by several authors, for which there are several models. Analytical approach separates their main features, and it is given in their graphical representation. Due to the complex nature of the process approach integrating a feature of all of these models can come to one basic process model that clearly and unambiguously determines the way of the company. It is general enough to be applied to all companies and specific enough to be clearly different from other models of organizational structure. Further, the proposed model includes all the processes that exist in modern enterprises. Therefore, when working on the implementation of the process approach in every enterprise it can be used as a starting point for understanding the processes of the company and determine its process structure. Then it should be used as the basis for creating detailed maps of its processes using a variety of methods, standards and procedures to identify, describe and improve process.

REFERENCES

Berrtalanffy, L, (1951.), General System Theory A New Approach to the Unity of Science, Human Biology, XII.

Byrne, A, J, (1993.), The Horizontal Corporation. Retrived from http://www.businessweek.com/stories/1993-12-19/the-horizontal-corporation (21. march 2014.)

Davenport, H. T, (1993.), Process Innovation – Reengineering Work trough Information Technology, Harvard Business School Press, Boston, Massachusetts.

Deming, W. E, (1996.), Kako izaći iz krize, Grmeč, Beograd.

Filipović, J, Đurić, M, (2010.), Sistem menadžmenta kvaliteta, FON, Beograd.

Forrester, J, Industrial Dinamics, M.I.T. Press, Boston Mass., 1993, prema (Rajkov, 1977.)

Hammer, M, Champy, J, (2004.), Reinženjering tvrtke – manifest za poslovnu revoluciju, MATE, Zagreb.

Harmon, P, (2003.), Business Change, Morgan Kaufmann Publishers, San Francisko.

Harrington, H. J, Esseling, K.C. E, Nimwegen Van, H, (1997.), Business Process Improvement Workbook, McGrow-Hill, New York.

Harrington, H. J, (2012.), Streamlined Process Improvement, McGrow-Hill, New York.

Jaško, O, Čudanov, M, Jevtić, M, Krivokapić, J, (2013.), Osnovi organizacije i menadžmenta, FON, Beograd.

McCormack, P. K, Jonson, C. W, (2000.), Business Process Orientation, CRC Press, Florida.

Ostroff, F, (1999.), The horizontal organization, Oxford University Pres, New York.

Porter, E. M, (2007.) Konkurentska prednost, Asee, Novi Sad.

Radović, M. M, Karapandžić, Z. S, (2005.), Inženjering Procesa, Fakultet organizacionih nauka, Beograd.

Radović, M. M, (2008.), Projektovanje proizvodnih sistema, FON, Beograd.

Rajkov, M, (1977.), Teorija sistema, Privredno finansijski vodič, Beograd.

Recker, J., Indulska, M., Rosemann, M., Green, P., (2009.), Business Process Modeling - A Comparative Analysis, Journal of the Association for Information Systems, Volume 10, Issue 4, pp. 333-363, April 2009.

Rentzhog, O, (2000.), Temelji preduzeća sutrašnjice – Procesima usmerena poslovna filozofija, Prometej, Novi Sad.

Rummler,G, Brache, A, (1990.), Improving Performance: How To Manage the White Space on the Organization Chart, Jossey-Bass, San Francisco, C.A.

Ryan K.L. Ko, Stephen S.G. Lee, Eng Wah Lee, (2009.), Business process management (BPM) standards: a survey, Business Process Management Journal, Vol. 15 No. 5, 2009, pp. 744-791, Emerald Group Publishing Limited

Smith, H, Fingar, P, (2003.), Business Proces management, Meghan-Kiffer Press, Tampa, Florida.

SRPS ISO 9000:2005 Sistemi menadžmenta kvalitetom – Osnove i rečnik, IZS, Beograd, 2005.

Lean Business Enterprise Process Model, Retrived from http://www.leanbusinessthinking.com/applications (20. april 2014.)

RELATIONSHIP BETWEEN BUSINESS ENVIRONMENT AND ENTREPRENEURIAL ACTIVITIES

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Abstract: *This paper will present causal relationship between entrepreneurial ventures and the business environment in which such activities are initiated. Academic research in this direction emerged in last few decades, and they point to the undoubted importance of this topic for economic development at the national and global level. Many authors have indicated the complexity of relations and interactions between entrepreneurship and the environment, and have emphasized the importance of certain factors that simultaneously represent potentials and threats for these businesses. Also, although it is clear that the environment influences the encouragement of entrepreneurship and its success, the influence in the other direction should not be neglected, since these ventures largely affect the business environment, especially if they are numerous and significant for other companies.*

Keywords*: Entrepreneurship, environment, Porter's structural analysis, Population ecology theory, Resource dependence theory*

1. INTRODUCTION

Although entrepreneurship has its roots in changes and development of the society, it has become a subject of studies only in the last few decades (Fayolle, 2008). For a long time it has been held that entrepreneurship is not something that should be paid attention on in academic circles. However, we witness the fact that the modern economy is actually based on entrepreneurial ventures in different stages of development of the societies. Special attention was devoted to this concept during the last decade of the twentieth century, as evidenced by many indicators such as number of researchers involved in these issues, number of published scientific papers with the topics related to entrepreneurship, number of scientific papers with this problem presented, and so on. In many countries, especially in Europe, entrepreneurship provides solutions for many economic problems, and improves national economies.

Entrepreneurship can be, and often is motivated by the situation observed on some specific market, but this relation can be observed in the opposite direction, and then we can say that entrepreneurship in some way creates a market or its activities. This paper will present the relationship between entrepreneurship and the business environment, regarding the changes that occur in the environment as a result of the existence or non-existence of entrepreneurial consciousness and activities. In developed countries, entrepreneurship is usually on an extremely high level, and therefore allows the economies of these countries to develop much faster than it is the case in developing countries. This, however, does not mean that encouraging entrepreneurship is an easy task, but the fact is that it is necessary to work on it, because that opens up new possibilities, provides space for innovation, and, in the end increases degree of competition, leading to the various qualitative and quantitative benefits for many participants on the relevant market.

2. OVERVIEW OF ENTREPRENEURSHIP THROUGH STRUCTURAL ANALYSIS

Terms "*entrepreneur*" and "*entrepreneurship*" in different societies have different interpretations. Thus, in the United States entrepreneur is a person who runs his *own*, *new* and *small business* (Drucker, 2007). However, this should be considered with caution, since it is assumed that not every new business is an entrepreneurial venture. In Germany these terms are associated with the concepts of power and property, so entrepreneur (*Unternehmer*) is considered to be the one who owns, but at the same time runs his business. In each case, regardless of whether it is a new business, or an own business, or a combination of both of these conditions, the importance of innovation is usually emphasized (Drucker, 1984).

Although there are different points of view, generally, none of them denies the claim that entrepreneurship is based on economic and social foundations of the community in which it occurs and persists. Also, entrepreneurship is almost always associated with a risk, especially when it is related to some kind of innovation. Indeed, the practice shows that many entrepreneurial ventures have ended infamously, and it is believed that the main causes for this outcome are actually the entrepreneurs themselves, that is those of them who start such businesses, but are unaware of what is engaging, so they are not prepared for

challenges that are in front of them. This especially applies to the activities that are closely related to high technology, for example. Consequently, we might say that entrepreneurship involves a combination of creativity, planning, and risk-taking (Kuratko, 2013).

The market position of the company depends on a number of factors. Also, the market itself is created and developed in accordance with the appearance and operations of new subjects. This means that there is a strong causal relationship among all these elements. That way enterprises affect the business environment in which they survive and develop.

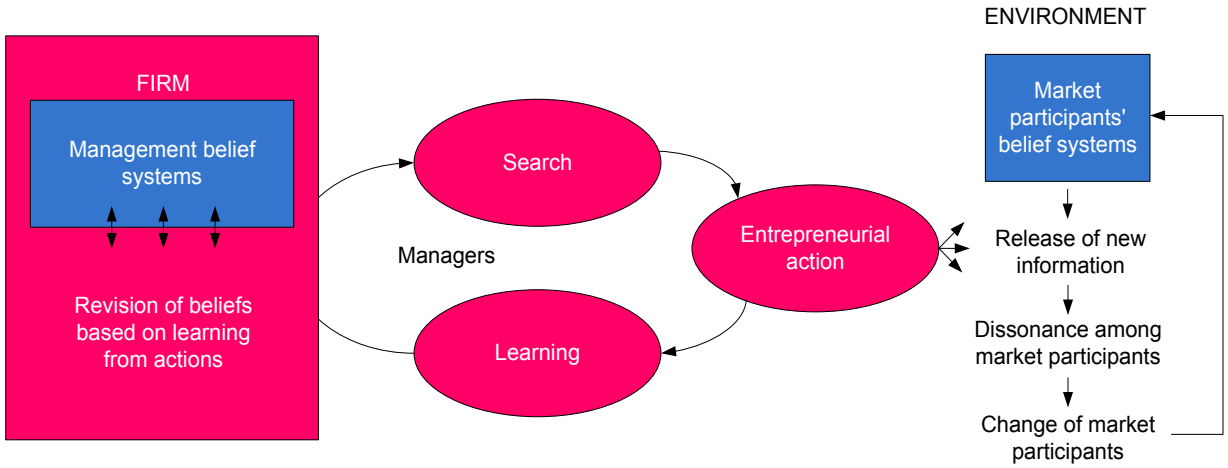

Figure 1: Entrepreneurial perspective on the firm-environment relationship (Smith & Cao, 2007)

Many studies have been conducted in order to analyze the complexity of these relationships. It is clear that in the first step environment imposes certain restrictions, but also provides certain opportunities for the individual enterprise. An important role is often played by the strategy that the company uses. Strategy can be seen as an integrative result of all the other aspects of the organization, so it needs to include internal aspects of the structure, procedures, people, culture, as well as all environmental processes (Jaško et al., 2013a).

Michael Porter notes that not all industries offer equal opportunities for the sustainable profitability, and not all organizations use equally the opportunities offered by the industries (Porter, 2008). He believes that enterprises through a selection of strategy clearly affect the improvement or worsening of their positions in the industry.

As a basis for the analysis of the environment, Porter suggests a structural analysis, which emphasizes five basic factors that describe the attractiveness of an industry:

1. Threat of New Entrants
2. Rivalry Among Existing Competitors
3. Bargaining Power of Buyers
4. Bargaining Power of Suppliers
5. Threat of Substitute Products or Services

The threat of new entrants in an industry is one of the key indicators of competitiveness. From the standpoint of individual enterprises, higher barriers for entry reduce the threat of new competition and ensure the position of existing companies. This means that the threat of new entrants depend on barriers to entry and the reactions of existing companies who expect this new company (Jaško et al., 2013b).

Rivalry among existing competitors involves various forms of price competition, the struggle for better promotion, bigger and better after-sales service, and includes a number of competitors that determine the degree of concentration, degree of product differentiation and barriers to entry.

Bargaining power of buyers means that the stronger buyer is in a better position to influence the reduction of prices, higher quality of products and services, and thus contribute to the achievement of profitability of the industry. Buyers are stronger and their impact on producers is higher in case where they are concentrated, when they have large individual purchases, when they possess a lot of information about products or services, when there are substitutes for the main product and when products or services are not differentiated.

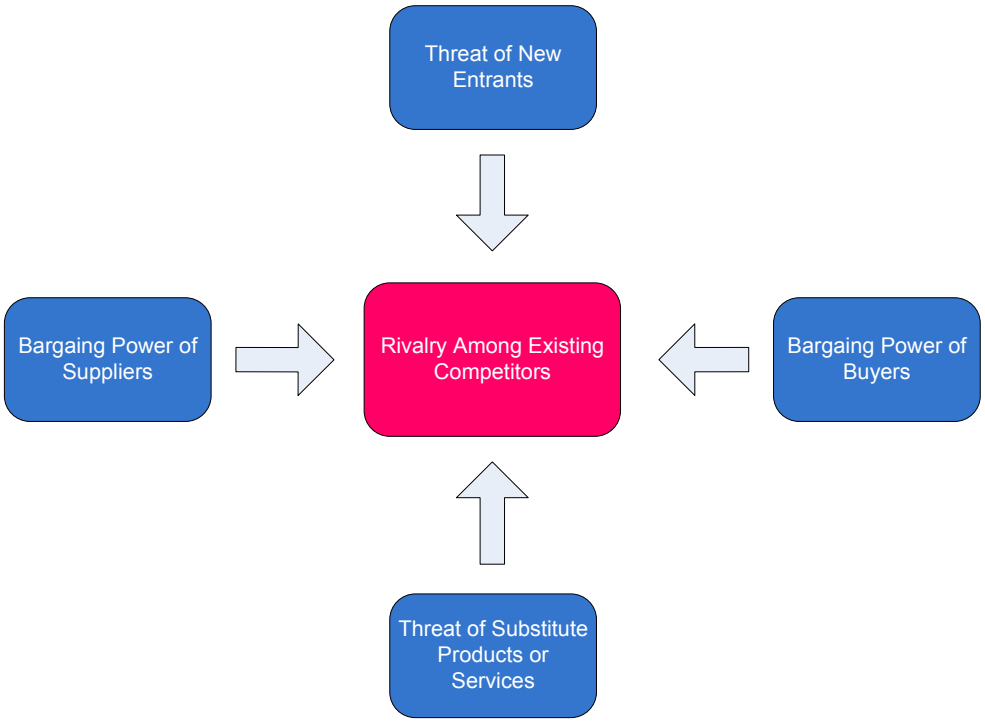

Figure 2: The five competitive forces that shape strategy (Porter, 2008)

Suppliers may also affect business results through the influence on the price, terms of sale, the quality and availability of the required raw materials. They are stronger and their bargaining power is greater in cases where there are no substitutes for the necessary inputs, when these inputs are important for the production of a specific product, when there are only a few suppliers of necessary inputs, when there are more buyers of its product, etc. Otherwise, the supplier is in a position to protect his only customer through reasonable prices and good quality.

The existence of substitute product significantly affects the demand for a particular product. Its sale is restricted in case where consumers can buy a similar product, the product of the same quality, or the product that has the same utility value. Danger of substitutes is higher when there is no exclusive consumer loyalty to the original product. An enterprise can minimize the risk of substitutes through good-differentiation of its products or if it achieves significant cost advantages over competitors (which will make the price of its products more attractive to the customer).

If Porter's considerations are observed through the prism of entrepreneurship, then we can come to conclusions that clearly show the importance of entrepreneurship in creating the image of the business environment. In fact, each of these factors significantly defines the entrepreneurial potential in a particular area or in a particular industry, but also depends on the existing entrepreneurial structure. Let us consider the example of manufacturers of certain components or semi-finished products. They are stronger if there are only few of them, so they have excellent position that allows them to dictate the terms of dealing with other business entities. On the other hand, manufacturers in the next phase of process want to acquire these necessary resources at better conditions. Accordingly, they are willing to somehow motivate entrepreneurs to start up businesses of common interest, in order to provide what they need at a lower price than the one that is already offered. The similar story is with the products substitutes. Often, it is practically impossible to obtain a specific product (component, semi-finished product) or the product is simply not acceptable from the point of the spending power of the local population. In this situation entrepreneurial spirit comes to the fore, and this is the chance for these producers that make a product that has similar characteristics and meet same needs, but is more accessible than "the original one".

However, the lack of entrepreneurial initiatives can scare potential foreign investors. Generally speaking, in developing countries production is significantly cheaper than in developed countries, and therefore the world's major companies often try to relocate at least part of their production in order to reduce their own costs. That way, through contracts with local companies, they switch production on potentially more profitable base. This trend is especially prevalent since the beginning of twenty-first century, in various industries. Besides the benefits for these companies, a chance is seen by the local governments, but also by the manufacturers or suppliers of parts and components that should be incorporated in the final products.

Global companies are counting on these local entrepreneurs, because they hope to get what they need at a lower price than it would have been if production is located somewhere else. Of course, the proper quality must be achieved, because these companies cannot afford to make final products of poor quality due to the lower cost, since it would affect their credibility, and that is the last thing they want to happen.

3. MODERN APPROACHES TO THE RELATIONS BETWEEN BUSINESS ENVIRONMENT AND ORGANIZATIONS

The importance of entrepreneurship in the contemporary business environment can be seen in different ways. One of the important concepts that follows the creation and development of new business is the *Population ecology theory*. This concept was created some forty years ago. Hannan and Freeman noted that during the observation of mutual influence and interaction with the environment it is much easier to group and classify organizations in certain categories (Grundstén, 2004). Those organizations are observed as organisms in the process of natural selection, and therefore special attention should be paid to the birth of the organizations, their growth and development, and death. Authors believe that the behaviour and results depend on several factors associated with a particular organization, and these factors are (Hannan & Freeman, 1993):

- niche width,
- inertia and change,
- density dependence,
- age dependence,
- resource partitioning.

Although this concept initially was not focused on entrepreneurial ventures, it is spotted its great applicability in this context over time. Accordingly, Aldrich believes that the theory of entrepreneurial behaviour should (Grundstén, 2004):

1. pay more attention to the capacities provided by the environment;
2. notice the importance of other organizations that are part of the environment that affects the new company;
3. consider interdependence of organizations;
4. take into account the sequence of events associated with organizational foundings;
5. pay special attention to the unique strategies used by companies that are specialized in different industries or populations in the early years of life;
6. work together in teams to build longitudinal community-based samples of organizational populations; and
7. develop comprehensive studies of entrepreneurial behaviour over time.

In the context of taking entrepreneurial action, the emphasis will be placed on the market niche that organizations occupy. Organizations are actually founded due to entrepreneurial initiatives, appearance or creation of new consumer needs, changes in market conditions, government regulations, but there is a great variation in their population. If the niche is relatively new, a number of organizations will collapse in the selection process, because they are not compatible with the environment. Those that survive will make a relatively stable population, with very similar characteristics. Once stabilized, this population will have a relatively stable structure due to internal and external constraints (Jaško et al., 2013a).

According to this theory, the organizations arise ("are born") and disappear ("die") depending on the density of the population in a particular niche. If the niche has a small number of organizations, it gives a strong impulse for entrepreneurial activity and the establishment of new organizations, and reduces the likelihood that the organization will go bankrupt. On the other hand, if the niche has too many organizations, high rivalry will increase the probability of organization bankruptcy, and reduce the attractiveness of the branches for the establishment of new organizations. Dynamics of organizational populations within a niche occurs in the manner that was presented on the previous picture.

The practical application of the population ecology theory is reflected in the observation of organizations considering them as specialists or generalists. Organizations generalists focus on a broad niche - they offer a wide range of products and services and meet the needs of many different groups in the market. Specialists focus on a smaller number of products and services, and meet needs of a small number of groups or even just a group of clients (who still numerically may include a large number of members). Depending on the ambition and the capacity of the entrepreneur, his new ventures will be directed precisely to one of these two categories.

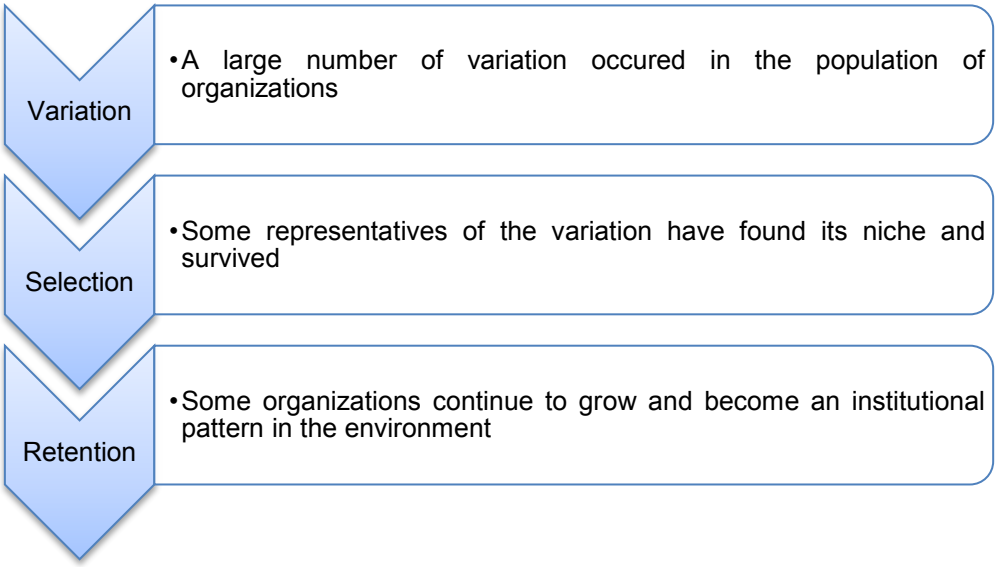

Figure 3: Dynamics of organizational forms in population ecology (Jaško et al., 2013a)

Certainly, one cannot say that one type is better or worse than the other - it depends on a number of factors, but it is possible to make some conclusions that are based on practice and logical judgment. Thus, specialists are generally more capable in business in the narrow area in which their operations coincide with companies generalists because they react faster, they are more flexible and better adapted to the specific conditions of these market segments. However, they are still more sensitive on changes in business environment because they do not have the sufficient size and business insurance in case that the environment negatively affects them. If specialists have problems in their performing, there is no some other activity that can compensate their efforts. On the other hand, generalists have a wider area in which they operate, which makes them some way protected from changes in the environment, and that reduces the risk of their existence. Demand in some areas may decline, but it is unlikely that the combined problems arise in all businesses, because these segments are substantially different. Specialists do not have that kind of security. In accordance with that, generalists can perform partitioning of resources. They can strategically allocate resources from one segment to another, and therefore provide more stable capital flows and cash flows compared to generalists.

If we look at the width of these niches, we can conclude that the broad niches are more appropriate for generalists, while narrow niches are more suited to companies specialists, because they better achieve their advantages in such environments respectively. Changes in niches also affect the chosen strategy of organizations. If the environment is stable, specialists have the advantage. However, if there is a change in the environment, the nature of that change should be considered. Rapid changes favour organizations generalists, since they have enough resources to survive and adapt to the new environment. On the other hand, changes which do not come up with major quakes favour specialists because they are generally faster and they better adapt to new conditions. Since these changes do not carry too much of quakes, they do not need any significant resources in order to survive.

Thus, the theory of population ecology is one new way to explain the organizational dynamics. Many phenomena, such as creation and deterioration of small organizations, structural similarity of organizations in similar environments, dynamics of disappearance and changes in organizations are explained by this approach. However, the disadvantage of this theory is that it looks at the environment as the only significant impact on the organization, ignoring the internal factors, and sees the choice of strategy with the positioning in organizational niches as the only factor of success, but that does not have fully justification in the environment. Therefore, it is advisable to take into account other relevant factors, or combine the theory with additional approaches.

Another concept that discusses this issue is the *Resource dependence theory*. According to this theory, as the name might suggest, organizations depend on the availability of certain resources, and as such, in many situations they need to interact with other market participants in order to provide them. In this way, they become dependent on the environment (Grundstén, 2004). The authors of this theory, Pfeffer and Salancik believe that it is necessary to focus on the interaction of the basic six dimensions, which are (Pfeffer & Salancik, 2003):

1. Concentration - the degree of dispersion of power and authority in the environment;

2. Munificence - the availability of critical resources;
3. Interconnectedness - the number and types of relations between the participating organizations;
4. Conflict - disagreement regarding the objectives:
5. Interdependence - the degree to which one organization influences the other;
6. Environmental uncertainty - the impossibility to predict future accurately.

These elements interact in a specific manner, which is presented by the next scheme:

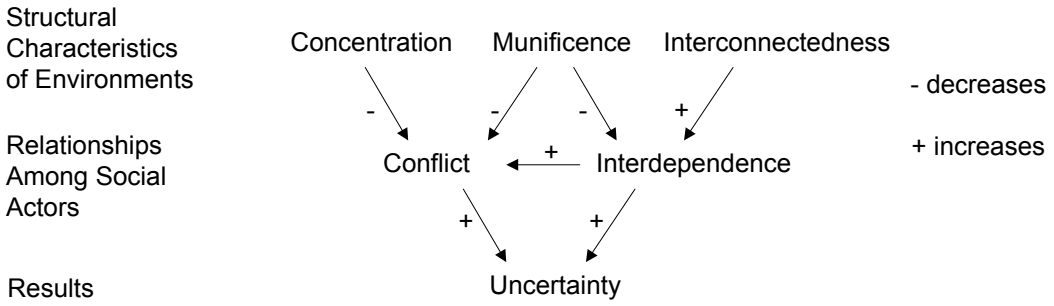

Figure 4: Relationships among dimensions of organizational environments (Grundstén, 2004)

Similar to the population ecology theory, it is possible to make conclusions concerning the relationship between environment and entrepreneurship. It is clear that the availability of resources has large positive impact on the establishment of new businesses, but it is not the only factor that should be taken into consideration. Since these relationships are extremely complex, it is necessary to observe all these elements in interaction in order to gain an objective picture of the potentials for taking entrepreneurial activities. These two theories still differ to some extent, mainly due to the fact that the population ecology theory holds that organizations are reactive and passive, and believes that they will survive if the environment allows them to, while according to the resource dependence theory, organizations are active, able to fight for their position every time the environment changes. These differences are presented in the following table:

Table 1: Two frameworks for entrepreneurial environments (Grundstén, 2004)

Population ecology theory	Resource dependence theory
Acts of the entrepreneur are predominantly deterministic.	Acts of the entrepreneur are primarily volitional.
The entrepreneur's choice are predicated and molded by the industry.	The entrepreneur makes strategic choices to secure the best transactions with the environment.
The environment is a set of influences which selectively permit some ventures to survive.	The environment is a pool of resources which the entrepreneur selects and acquires to establish his venture.
The entrepreneur is an exponent of environment and an instrument of economic development.	The entrepreneur masters fate and makes strategic choices to minimize threats and exploit opportunities.

Regardless the fact that these approaches observe organizations and entrepreneurs from different aspects, there is no doubt that both concepts have their foundation in practice, and that, as such, they have great significance. All authors who have considered this issue agree that there is a mutual causal relationship between organizations and environment, but that in each case the relation is specific and based on a number of factors. Therefore conclusions regarding this relationship can only generalize and represent a broader view of the problem that is a cornerstone, but cannot be precise guidance for behaviour in specific situations.

4. CONCLUSION

Although entrepreneurship is one of the bases of economic development and has undeniable role and importance throughout history, academic researches concerning this issue appeared in the last couple of decades. These researches warn that entrepreneurship is not something that can be planned to the end, and that the success of these efforts depends on many factors, both internal and external. The impacts of these factors manifest different on different markets, so many ventures failed although they had strong financial or technological support. The reason for failure often lies in the fact that these jobs are taken in inadequate business environment. Considerations of relevant authors who have studied this issue have confirmed that there are some environmental factors that simply encourage entrepreneurial activity. However, they believe that it is not possible to find a pattern of behaviour that will guarantee success. Many of them actually observe entrepreneurship as an art, due to the lack of such a pattern that would surely lead to success or avoid failure, at least.

Considering the specificity of entrepreneurial ventures and their dependence on the specific conditions and situations, each one of them should be considered separately in one particular context. Although the environment provides the potentials for success, it also imposes restrictions, so all these factors should be carefully considered and their interaction should be examined, in order to gain previously set goals. In accordance with that, special attention should be paid to the relationships with other participants, especially if they are big or strong, because they affect, directly or indirectly, the results of all these ventures.

The organization will focus on specific market segments and try to make success. In doing so, due to the dynamism and instability of the environment, it should be remembered that once established mode of behaviour is something that might be changed, since the organization must continuously follow possible changes in the environment. In accordance with that, given the fact that in most cases these changes come as a result of actions of other participants or the occurrence of certain objective circumstances, it is necessary to adapt them in order to make further development possible. That way, by changing themselves, organizations are also changing their business environment, in continuously repeated iterations. Some of them will be in a position to influence these changes more than others, and that will bring them a competitive advantage.

REFERENCES

Drucker, P. F. (1984). The discipline of innovation. *Harvard business review*,*63*(3), 67-72.

Drucker, P. F., & Drucker, P. F. (2007). *Innovation and entrepreneurship: Practice and principles*. Routledge.

Fayolle, A. (Ed.). (2008). *The dynamics between entrepreneurship, environment and education*. Edward Elgar Publishing.

Grundstén, H. (2004). *Entrepreneurial intentions and the entrepreneurial environment* (Doctoral dissertation, Helsinki University of Technology).

Hannan, M. T., & Freeman, J. (Eds.). (1993). *Organizational ecology*. Harvard University Press.

Jaško, O., Čudanov, M., Jevtić, M., & Krivokapić, J. (2013a). *Osnovi organizacije i menadžmenta*. FON.

Jaško, O., Čudanov, M., Jevtić, M., & Krivokapić, J. (2013b). *Projektovanje organizacije*. FON.

Kuratko, D. (2013). *Entrepreneurship: Theory, process, and practice*. Cengage Learning.

Pfeffer, J., & Salancik, G. R. (2003). *The external control of organizations: A resource dependence perspective*. Stanford University Press.

Porter, M. E. (2008). The five competitive forces that shape strategy. *Harvard business review*, *86*(1), 25-40.

Smith, K. G., & Cao, Q. (2007). An entrepreneurial perspective on the firm-environment relationship. *Strategic Entrepreneurship Journal*, *1*(3-4), 329-344.

PROTECTION OF PERSONAL DATA AND THE PRACTICES OF THE IT COMPANIES IN SERBIA

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Abstract: *The protection of personal data is an integral part of the basic human right of privacy. All data operators, including companies, need to comply with the principles of protection of personal data, in a line with positive legislation. This paper focuses on the importance of abiding by the rules on protection of personal data in the companies' operation in Serbia, especially in the business sector based on information technologies (hereinafter: IT). In addition to this, a presentation of the study on compliance of IT companies in Serbia with the regulations in the field personal data protection is given. The paper also points to the techniques through which the companies can synchronise their operation policies with the appropriate legislation.*

Key words*: Personal data, privacy, IT sector, e-commerce, internet, operators, legal framework*

1. INTRODUCTION

Personal data have become the new currency which is already used on the global market along with other goods. As shocking as this may be, the data shows that the value of personal data in 2011 was circa 315 billion Euros, with a potential growth to 1 trillion Euros until 2020 (Financial Times, 2013). Companies, among which most belong to the IT sector, because of the nature of their businesses often come in contact with personal data that they gather, process, exchange and intersect. This advantage of the IT companies entails a huge responsibility in regard to protection of personal data. Bearing in mind that protection of personal data is an aspect of the right of privacy, and an integral part of human rights in general, it is of vital importance to explore and determine which companies provide the necessary level of protection of personal data.

The first part of the paper is consisted of a review of the national and international legislation that deals with protection of personal data. In the second part, the focus is on the companies' obligations regarding the protection of human rights. In the third part there is a representation of the results of the research of the protection of personal data in 30 companies in Serbia. Finally, in the last part recommendations are given, so that companies can improve their operation in the field.

2. LEGAL FRAMEWORK FOR PROTECTION OF PERSONAL DATA IN THE NATIONAL AND INTERNATIONAL LEGISLATION

The Constitution of the Republic of Serbia ("Official Gazette of the Republic of Serbia" no. 98/2006, article 42, paragraph 2) states that the protection of personal data is regulated exclusively by a law. In this sense, a Law on personal data protection which comprehensively regulates the matter was adopted. However, as the technological development rapidly surpasses and easily bypasses the established regulations, there is already a necessity for amending the existing law in a way that it would prevent the possible violations of the right on protection of personal data.

The existing framework regulates the requirements for gathering and processing personal data, and obliges the companies which legally defined as data operators, that before processing any personal data they obtain consent from the person whose data is being processed, to inform them about the processing of the data and future changes. Basically, data operators are obliged to enable their customers to exercise their rights, to access, to a copy, to correct, modify, update or delete data (Law on personal data protection (hereinafter:LPDP), "Official Gazette of the Republic of Serbia", no. 97/2008, 104/2009 - other law, 68/2012 -,

article 3). Data operators are also obliged to report any collection of personal data to the Central register's database within the jurisdiction of the Commissioner for Data Protection (in further text: Commissioner) (LPDP, article 52)

The international legislation in this field has integrated the right of protection of personal data into the core of the basic human rights, as a segment of the right of privacy. The UN has adopted a resolution which deals with privacy and binds the member states to protect the privacy of their citizens against mass surveillance and data gathering (GAUN, 2013). In addition to this, Serbia also signed and ratified the Convention number 108 of the Council of Europe which defines the protection of people in regard to the automated personal data processing, and the additional Protocol of the Convention number 108 related to the monitoring institutions and cross border data flow. The Directive of the European Parliament and the Council of the EU 95/46/EC from 24.10.1995, deals with the protection of the citizens from the processing of personal data and freedom of movement of such data and obliges the member states to protect the basic human rights and freedoms of their citizens, emphasising their right of privacy in regard to the processing of personal data.

3. PROTECTION OF PERSONAL DATA FROM THE PERSPECTIVE OF THE BUSINESS SECTOR

The problem of personal data is multi - layered one because it's been noticed that individuals do not have a mechanism to protect their data from the continuous requests from the state organs to the companies that possess most of their users' data. To make thing worse, individuals cannot expect protection from the state organs because of the improper handling of their data by the companies. The reason for this being the lack of capacity and resources of the countries which are mandatory for effective control over the operation of the companies in this field. Additionally, the fact that the companies mostly operate in several different legal systems brings to collisions between the laws of several different instances.

Being aware of the reality, and with the aim to protect their own reputation and assure uninterrupted operation, companies have begun to adopt internal procedures for data protection, in the form of technical standards ISO 27001 and other that regulate some of the issues regarding retained and processed data (International Standardisation Organisation, 2005) as well as employing officials who would have only one specialisation i.e. providing higher level of personal data protection.

An example of good practise for establishing a "pact" between the consumers and the companies with the civil society organisations as mediators is the project titled Global Network Initiative (GNI, http://globalnetworkinitiative.org/). GNI seeks to implement a legal framework based on the internationally accepted standards that would ensure responsible operation within the IT sector, enable inclusion in the process of making self-regulatory rules and mutual exchange of ideas and experiences. This organisation has adopted the Principles for freedom of expression and privacy (GNI, 2008), Guidelines for implementation of the Principles (GNI, 2008). The members of this association in order to protect the data of their clients are taking active part in public debates on the reforms of the systems for surveillance that the states have.

4. METHODOLOGY OF RESEARCH ON THE LEVEL OF PERSONAL DATA PROTECTION BY IT BUSINESS SECTOR IN SERBIA

The first step of defining the research methodology of the IT business sector in Serbia compliance with the data protection legal framework was consisted of the process of selecting and determining a research target group with regard to the relevance in the field of data protection. In that sense, 30 IT companies were divided into three groups - cellular and landline operators, Internet providers and e-commerce companies, with 10 representatives from each group. After that, the predefined number of companies was selected. Each of them, because of the nature of their business, is in position to collect much personal data from their customers. Furthermore, in each group 5 of the companies were selected on the basis of market share significance, while other 5 were selected randomly.

In the next step, criteria that empowered the determination of the level of data protection were formed. Further explanation of the criteria will be given in the next chapter. The web pages of the selected companies were analysed with the goal to obtain relevant documents that contain answers for fulfilment of the mentioned criteria. In order to confirm the found answers, after the analyses of the obtained documents, questionnaires for the companies were prepared and distributed to all of the 30 companies with a request to provide the missing answers or verify the answers that were defined in the documents on their web sites. Qualitative legal analyses and intersection of the findings followed as well as a draft of the recommendations that could enable companies to improve their operation in regard to data protection.

It is important to notice, that this research did not deal with the question if the companies are operating in compliance with the developed criteria in practice, yet the research results are only based on the analysis of the available documents on the companies' web sites and based on the verification answers that were provided by the companies as well as on the insight to the online Central data file register that kept by the Commissioner. It should be noted that out of 30 companies only 3 replied to the questionnaires they were sent, therefore the results of the preliminary research are verified in accordance with their answers. The findings from the other companies are relying solely on the analyses of the companies' documents available online, precisely Terms of services, Privacy policies and Contracts that are companies closing with their clients.

The aim of this research, which is first of this kind in Serbia, was to indicate the activities of the in the IT sector in Serbia and provide recommendations that could improve this field of work. On the other hand, the data protection security level remained out of scope of the research, since the focus was on the analyses of the available legal documents which are enabling users to get to know the level of protection of their personal data.

5. EXPLANATION OF THE DEFINED CRITERIA - INDICATORS OF THE BUSINESS COMPLIANCE WITH THE DATA PROTECTION LEGAL FRAMEWORK

As already mentioned, the research methodology included the development of criteria i.e. indicators of the level of protection of personal data, after the legal analysis of the legal framework on data protection and based on the later. In that context, the criteria was modeled by a similar research that was conducted by the organization Electronic Frontier Foundation (EFF, https://www.eff.org/), were created. The criteria are based on whether each and every of the companies:

1. Requests a court order to access the personal data - state bodies can gain access to the personal data only on the grounds of a court order which is afterwards submitted to the companies that are obliged to act upon it. (Law on criminal procedure ("Official Gazette RS", 45/2013) - art.167. Law on Military security agency and Military intelligence agency ("Official Gazette RS", no. 17/2013)- art. 13a, Law on security-information agency ("Official Gazette RS", 111/2009), art. 13 and 14, Law on electronic communications ("Official Gazette RS", no. 60/2013 – Constitutional Court Decision), art. 126)

2. Informs the user about the request for access to personal data - the mentioned laws do not strictly bind companies to inform their user, but at the same time it is not forbidden. Therefore, companies that are protecting the privacy of their clients and their reputation should inform them about the request for access to personal data, if it is not in accordance with a court order (i.e. if the court order contains gag order).

3. Delivers the personal data when ceding the company's claim - companies are allowed to cede their claims together with the necessary personal data of their clients to third parties in accordance with the article 436 of the Law on contracts and torts ("Official Gazette of Serbia and Montenegro" no. 1/2003 – Constitutional Charter). This means that a third party that is not included in the contract can gain access to the personal data. According to the law, the client's consent for ceding the claim is not required, but must be notified.

4. Notifies the clients about data processing - pursuant to the article 15, par. 1, line 1-8 of LPDP, companies are bound to publish a Notification letter about the processing of personal data. This Notification letter must contain the following: primary information about the company, purpose of data processing (e.g. register of users, number of post-paid users), the manner in which data will be used (e.g. to inform users about new services), the identity or categories of persons who will use the data (e.g. only employees in the sector of date security) then the voluntary nature of data provision and processing and legal grounds (e.g. only on the basis of voluntary given consent) including the data subject's rights: to access, to a copy, to correct, modify, update or delete data, as well as to a stay and suspension of processing. Also, companies should notify the client about other circumstances the withholding of which from a data subject or a third party would be contrary to conscientious treatment.

5. Notifies the user of any modifications of Notification of data processing - if in any moment the company decides to modify the Notification of data processing, the company is bound to provide the user with a notification of such a modification. It is not in accordance with the Law on data protection to request from the users to inform themselves on these modifications by visiting the official website of the company (LPDP, art.15, par.6)

6. Publishes the internal acts on Privacy policy and data protection - this criteria reflects on the practice of drafting and publishing internal acts on Privacy policy and data protection that define in a comprehensive way the following issues: types of data that the company collects and for what purpose, notification of data processing and modifications of Privacy policy, means of data protection, information on ceding of claims and personal data, including the implemented procedure in regard to the request of state bodies for the access to personal data etc. This is not defined by Law, but presents good practice that should be accepted.

7. Keeps a database in the Central register in jurisdiction of the Commissioner - when collecting and processing personal data, companies are obliged to register their data sets in the Central registry according to article 52 of LPDP.

5.1. Defining the target research group - operators, internet providers (ISP), e-commerce companies

An operator is a legal entity that conducts or is authorized to conduct activities of electronic communications (Law on electronic communications, article 4, par.2). The research embraced the 5 largest and most well-known operators (Telekom Srbija, Telenor, VIP Mobile, Orion Telekom i SBB) as well as 5 companies selected randomly (Ikom, Radijus Vektor, Kopernikus, Targo Telekom i Katel Network).

Internet service providers are defined as entities that offer access to the Internet with no regard to whether it is ADSL, Dial-up, cable, etc. The selection of Internet providers was conducted based on their media and public presence (Beotelnet, Veratnet, EUnet, Beonet, Pošta net), while other 5 were selected randomly (SRBnet, Teledot, Netpro, Bluenet, Tippnet).

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The Law on electronic commerce ("Official Gazette of the Republic of Serbia", no. 95/2013) defines that commerce of goods and services online is a form of remote commerce in sense of the law that regulates commerce (article 4, par.2). According to the data of the company "Limundo" around 900 000 people shopped online in 2013. In this research, the 10 e - commerce companies were divided in two groups: the first group is comprised of companies that mediate in the trade (Limundo, Kupujem prodajem, Kupi me, Popusti), in the second group are the companies that participate actively in the e-commerce i.e. online shops (Hoću to, Planeta shop, Tehnomanija, Tako lako, Knjižara Vulkan, Non stop shop).

6. PROTECTION OF PERSONAL DATA IN IT BUSINESS SECTOR IN SERBIA RESEARCH RESULTS

It is noteworthy that 9 out of 30 companies did not pass any of the criteria: Ikom, Radijus Vektor, Kopernikus, Katel Network (operators); SRB Net, Teledot, Beotelnet, Bluenet, Netpro (ISP).

Regarding the first criteria, i.e. requesting a court order to access users' data, 10 companies in total allow access to their users' data only with a valid court order, i.e. 4 out of 10 operators (Telekom Serbia, Telenor, Orion Telekom, Targo Telekom), as well as 6 out of 10 e-commerce companies (Limundo, Kupujem Prodajem, Kupi Me, Popusti, Hoću To, Knjižara Vulkan). Not a single of the Internet providers that were part of this research requests a court order for accessing data.

In regards to the second criteria, informing users about the court order, bearing in mind that giving this information is not a legal obligation, none of the operators inform their users, neither do 9 ISP's, or e-commerce companies. Only Verat Net (Internet provider) and Limundo (e-commerce) contact their users when there is a court order for accessing their data.

The analysis of the practice of companies in which they cede their claim (that is user's debt) to third parties, the results show that 4 operators (Telenor, VIP Mobile, Orion Telekom, Targo Telekom) deal with this problematic, and this information are provided as part of the Terms of Service, which are an integral part of the user contract. None of the e-commerce companies deal with ceding, which is probably because 5 out of 10 e-commerce companies in this research, merely meditate in the sales, which implies that buyers, don't have any direct debt towards them. Three ISP's explicitly stated that they do not act in such a manner, precisely, they don't cede their claims to third parties (Tipp Net, Verat Net, EU Net).

The Notifications of data processing that were analysed as part of the fourth criterion are publicly available on the websites of 4 operators (Telenor, VIP Mobile, Orion Telekom, Targo Telekom) and only 2 ISP's (Pošta Net and Verat Net), even though that is required by law. All of the 10 e-commerce companies have publicly available Notifications on their web pages.

The Notification for data processing, which is also required by LPDP, is only actively practised by 3 operators, but their Terms of Services, which include the Notification of data processing, provide that the users shall be notified by the "authorised dealer and the official website". Only two ISP's (Pošta Net and Verat Net) act in accordance with the law, except for Pošta Net, which acts like the operators do, while only Verat Net regulates this matter in their Privacy Policy, but they also publish the changes on their website. Article 15 of the LPDP explicitly states that companies must personally notify their users about data

processing, as well as about the modifications of the Notification. Only 3 e-commerce companies act in such a way (Limundo, Planeta shop and Tehnomanija), while Nonstop Shop, Popusti and Kupi Me notify their users about the changes through their official websites.

Table 1: Protection of personal data in IT business sector in Serbia research results

Operators	Telekom Srbija	Telenor	VIP Mobile	Orion Telekom	SBB	Ikom	Radijus Vektor	Kopernikus	Targo Telekom	Katel Network
Request court order for the access to personal data	Yes	Yes		Yes					Yes	
Inform users about requests for access	No	No								
Cede claims to third parties	No	Yes	Yes	Yes					Yes	
Notify users of data processing	No	Yes	Yes	Yes					Yes	
Inform users of the modifications of the Notification of data processing	No	Yes	Yes	Yes						
Have internal privacy policies	No	Yes		No					Yes	
Registered database in the Central Registry	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No
ISP	Pošta Net	BeoNet	TippNet	SRBNet	Teledot	VeratNet	BeotelNet	BlueNet	EUnet	Netpro
Request court order for access to personal data										
Inform users about requests for access						Yes				
Cede claims to third parties			No			No			No	
Notify users of data processing	Yes					Yes				
Inform users of the modifications of the Notification of data processing	Yes	Yes				Yes				
Have internal privacy policies	Yes	Yes				Yes				
Registered database in the Central Registry	No	No	No	No	No	No	No	No	Yes	No
E-Commerce	Limundo	Kupujem prodajem	Kupime	Popusti	Non stop shop	Tako lako	Hoću to	Planeta shop	Tehnomanija	Knjižara Vulkan
Request court order for access to personal data	Yes	Yes	Yes	Yes			Yes			Yes
Inform users about requests for access	Yes									
Cede claims to third parties										
Notify users of data processing	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Inform users of the modifications to the Notification of data processing	Yes		Yes	Yes	Yes			Yes	Yes	
Have Internal privacy policy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Have a registered database in the Central Registry	Yes	No	Yes	No	No	No	No	No	No	No

When it comes to adopting and publishing internal Privacy policy acts that would comprehensively regulate the companies operations in the field of users' privacy protection, only 2 operators (Telenor and Targo

Telekom) operate in accordance with this good practice, as well as 2 ISPs (Beonet and Verat Net). Unlike them, only Tehnomanija hasn't yet published such an act, while all the other e-commerce companies have it (Limundo, Kupujem prodajem, Kupi me, Popusti, Nonstop shop, Tako lako, Hoću to, Planeta shop i Knjižara Vulkan).

With respect to the practice of registering the database in the Central Register of the Commissioner, which is defined in the seventh criterion, 6 operators have registered databases (Telekom Serbia, Telenor, VIP, Orion Telekom, SBB and Targo Telekom), and only one Internet provider (EU Net). At the same time, only 2 e-commerce companies have registered databases (Limundo and Kupi Me). In this way companies commit misdemeanour (Law on personal data protection, Article 57, Paragraph 1, Line 13) and can be fined.

7. CROSS EXAMINED RESULTS AND ANALYSIS

Based on the analysis of the published documents it can be concluded that none of the Internet providers request a court order for the access to personal data, nor do half of the operators. Furthermore, the provider EU Net clearly stated in its Terms of Services that: "...the Provider has a right to provide User's data and his misconduct to interested parties." (EUnet, 2011). Unlike operators and Internet providers, most e-commerce companies demand a court order for the access of personal data of users.

Telekom Serbia didn't have a publicly available answer to any of the developed criteria in our research. However, after we sent them questionnaire, the company replied that is has implemented the ISO 27001 standard and in that way has provided a high level of personal data protection security, adopting certain internal acts which regulate the procedures for data management. Notwithstanding this, after analysing these acts (General policy for data management security, IT security and protection for employees policy) an explicit Notification of data processing and its data modification was not found, but it's clearly stated that data is provided only with a court order. In any case, when adopting the ISO standard companies give a clear signal that personal data is, from a technical point of view, well protected.

As it has been previously stated, companies in most cases do not inform users on governmental requests to access data. However, Verat Net and Limundo do inform users about requests, with the exception that Verat Net doesn't have explicitly stated that it requests a court order to enable access to the state bodies to the personal data, which is surprising. Verat Net is the only Internet provider that has a positive answer on all other criteria and, as such, represents a good example which should be followed by other companies.

When it comes to the Notification on data processing, the content of this Notification is defined by law, and not complying with the law is financially punishable (LPDP, art. 57, par. 1, line 4). Regardless of this obligation, Internet providers do not consider that it is necessary to make this Notification available to users, so 8 providers do not have any Notification, and neither do 6 of the operators. However, the situation is different when it comes to e-commerce companies, which all but one sends the Notification whose content is fully in compliance with the aforementioned law.

A modification of the Notification of data processing is also regulated by LPDP, and it obliges companies that they inform the users about every modification personally. Out of all of the analyzed companies, only 3 (Limundo, Planeta shop and Tehnomanija) act in such a manner that they inform their users personally, while others do so through their website. Most users do not visit the official website of their operators and providers, so there is little chance that they will acquaint themselves with the modifications. Furthermore, most operators and Internet providers do not have a clear stipulation on the modifications of the Notification of data processing, but do so through the Terms of Services which include the Notification of data processing. As an example of good practice in this field we can name the company Limundo, which sends an e-mail of notification to all registered users with every modification of the Notification of data processing and publishes the new version on its webpage at least 8 days before it takes effect.

It is encouraging that almost all e-commerce companies that were a part of this research, have internal acts on privacy and personal data protection. This practice should be followed by operators and ISPs, which in most cases do not have any internal documents in regard to data collection and data processing. It is especially troubling that some of the more successful companies in this field, such as SBB and Ikom, do not have publicly available documents that regulate the matters of data collection and personal data protection of their users.

One of the interesting results of the research refers to the ceding of data to third parties in order to collect claims. Telenor, Orion Telekom, Targo Telekom and VIP Mobile envisage the possibility of ceding data to

third parties in order to collect claims. However, what concerns the most is the fact that terms that provide for such a possibility are not linked to relevant articles of the law, which oblige companies to notify users on every ceding, but that, solely by signing the contract, the users consent to the ceding of claims to third parties, and at the same time to the ceding of their personal data. Two companies do not envisage such a possibility, namely TippNet and EUnet.

This research has shown that e-commerce companies take the importance of personal data protection of users much more seriously and that 9 out of 10 issue a Notification of data processing and an published Internal privacy policy. Unfortunately, the situation is dramatically different when it comes to operators and Internet providers, who have only published Terms of Services on their websites, which in most cases does not include a Notification on data processing and a Procedure for acting in regard to requests for access to personal data. The aforementioned Terms of Service are mostly aimed at regulating the terms under which service is provided, as well as the users' obligations, and only touch upon data protection.

8. RECOMMENDATIONS FOR THE IMPROVEMENT OF THE PROTECTION OF PERSONAL DATA IN IT BUSINESS SECTOR IN SERBIA

Furthermore, on the basis of the research results, recommendations for the improvement of compliance of the companies from the IT sector with the data protection regulations will be presented. These recommendations are not directed only to the companies that were part of this research, but to the entire IT industry and those who are interested to conduct their business in this field.

First of all, companies should get acquainted with the legal framework of the Republic of Serbia, primarily the Law on personal data protection, but also the Law on electronic communications (article 126), the Law on criminal procedures (article 167), the Law on the security-information agency (article 13-14), as well as the Law on the military security agency and military intelligence agency (article 13a), that are all explicitly defining that in order to enforce any measures that tackle personal data, it is indispensable for the state bodies to obtain a court order. Therefore, only companies that are respecting these regulations and procedures can be seen as ones that plead for the privacy protection of their users, and consequently they can expect trust and loyalty of their users.

In case the court order does not contain a gag order, companies should inform user on that order. This practice was implemented only by Limundo (e-commerce company) and Verat net (Internet provider) since these companies already understand the advantage of the relationship of the mutual confidence can bring to the market.

Regarding the ceding of their claims, companies should inform their users in each case, while consent of the user is not mandatory in accordance with the article 436 of Law on contracts and torts. Based on the analysis of the available documents of the companies, this matter can be improved by sending notification to each user when his/her claim, together with their personal data, was ceded.

In order to have a legal basis to collect and process data, which is the precondition for conducting their primary activity of offering IT services, which cannot be imagined without proceeding of personal data, companies are bound to publish easily understandable and accessible Notifications of processing of the personal data, which was omitted by 17 companies included in the research. The fundament of data protection is the existence of consent for the processing and the Notification of processing of data that are both fully defined by the Law on personal data protection (article 19). Therefore, the essential recommendations for all companies is to publish online the Notification of the processing in compliance with the aforementioned Law, in shortest time possible, following the good practices of companies that were already mentioned.

Equally important is to personally inform each user on the modifications of the Notification of the processing that is also regulated by the LPDP. Only two out of 30 companies act in this manner, which clearly demonstrates ignorance of the companies. Moreover, this also indicates that our IT business sector has not yet acknowledged the advantages of relationship tailored to each user's needs. Also, it is important to build a two-way communication with the user and this presents a good possibility to do so.

Internal privacy policy documents that are publicly available present a good and easy way to inform users on companies conduct under all criteria that were developed for the purpose of this research. Largest segment of the companies that were included in the research (17) did not make this document publicly available, making it more complicated for the users to get acquainted with the data protection procedures while at the

same time often regulating these sensitive issues of data protection through unreadable and unclear Terms of service.

Bearing in mind that state bodies lack the internal capacity to fully control companies in this field, companies from the IT sector could adopt guidelines for conducting operations in this area through the process of collaboration and joint investments, following the global initiatives such as GNI, and in this manner ensure security in conducting business, and at the same time simplify the work of state bodies.

The fact that the users in Serbia will sooner or later realize that their personal data and privacy are important, as was the case in other countries, and that it is not all the same if one or the other operator provides them services and has direct control over their data. This also represents the possibility for smaller companies to prove that they care about privacy and that privacy of their users is an important market value and advantage in comparison to other “players”, as well as that they need to use these advantages.

The new EU Draft Regulation on data protection (European Union, 2013) provides higher penalties for misdemeanour- up to 2 percent of the annual global profit of the company. Since Serbia is a candidate for joining the EU, during the process of accession it will need to improve the standards on data protection to comply with this Regulation, which will also pertain to companies. What this means is that, companies, on their own or under the pressure of sanctions, will need to improve their business in this area, and in return will be able to expect more clients and higher profit.

REFERENCES

Council of Europe, *Convention no. 108 for the Protection of Individuals with regard to Automatic Processing of Personal Data*.

Council of Europe, *Additional Protocol on the Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data, regarding supervisory authorities and transborder data flows*,

European Union, 2013, Press Release: Progress on EU data protection reform now irreversible following European Parliament vote. Avaliable at: http://europa.eu/rapid/press-release_MEMO-14-186_en.htm.

United Nations General Assembly (2013) Resolution on the Right to Privacy in the Digital Age, available at: http://www.hrw.org/sites/default/files/related_material/UNGA_upload_0.pdf

How much is your personal data worth? (2013, June 12), The Financial Times. Avaliable at: http://www.ft.com/intl/cms/s/2/927ca86e-d29b-11e2-88ed-00144feab7de.html#axzz2ztQyrMfq

Global Network Initiative (2008) *Principles on Freedom of Expression and Privacy*. Available at: http://globalnetworkinitiative.org/principles/index.php

Global Network Initiative (2008) *Implementation Guidelines*. Avaliable at: http://globalnetworkinitiative.org/implementationguidelines/index.php

International Standardization Organization (2005) *ISO Standard 27001*. Available at: http://www.27000.org/iso-27001.html

Eunet (2011) *EUnetDial-in servis - Opšti uslovi*. available at: https://my.eunet.rs/support/documents/pdf_ugovori/YUnetDial_opsti.pdfhttp://globalnetworkinitiative.org/

PERFORMANCE MANAGEMENT

PERFORMANCE MANAGEMENT METHODOLOGY: INTEGRATIVE APPROACH

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Abstract: *Performance management is not a new methodology. In fact, there is no unique performance management methodology. It is an integrated concept comprised of many separated methodologies. Those individual methodologies should and must be integrated, linked and applied together, since this is the only way they can achieve its own full performance. More importantly, their integration and enhancement achieved through the performance management methodology provides the synergy that creates superior business performance as a whole. This paper will present the most important methodologies that represent an integral part of performance management methodology.*

Keywords*: performance management, methodology, performance indicators*

1. INTRODUCTION

There is no unique performance management methodology: performance management goes through the whole process of managerial planning, executing and control. Performance management is not new methodology; it is approach that tightly integrates business improvements and analytical methodologies already known to management and employees. It involves methodologies, metrics, processes, software tools and systems that manage the performance of an organization as a whole. Performance management can be seen as an umbrella concept that integrates business and financial information into unique support framework for planning and decision-making. It includes strategic mapping, balanced scorecard, managerial accounting, customer chain value, cost management, budgeting, forecasting and planning. These methodologies inspire other key solutions, such as supply chains management, risk management, human resources system management, lean management and six sigma (Cokins, 2009).

Performance management integrates methodologies and their support systems in order to provide synergy that would not exist if they would be implemented isolated one from another (Cokins, 2009). It is holistic model in which all parts must be combined and connected in order to realize organizational strategy in a sensible and coherent way (Hope & Player, 2012). The more those methodologies are integrated, unified and enriched with all kind of analyses, the more powerful performance management will be. Integrated methodologies, combined with analytics, represent a key for completing full vision of performance management framework (Cokins, 2009).

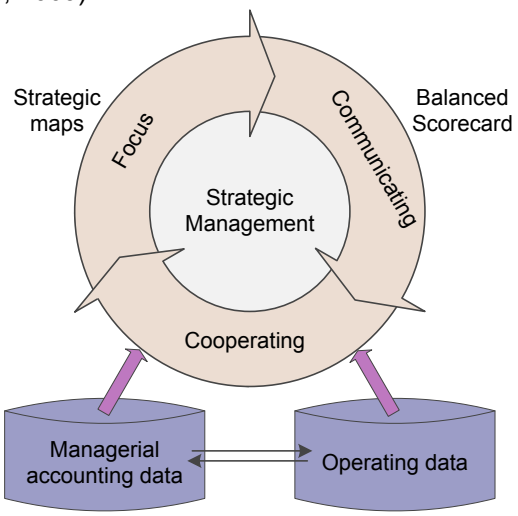

Figure 1. Performance management integrative cycle (Cokins, 2004)

The implementation of performance management is tightly connected with these managerial approaches (Hagos & Pal, 2010): Sigma Strategy, Balanced Scorecard, Activity Based Costing, Total Quality

Management, Economic Value Added (Economic Profit), Integrated Strategic Measurement, Theory of Constrains. Figure 2. illustrates independent methodologies that make performance management.

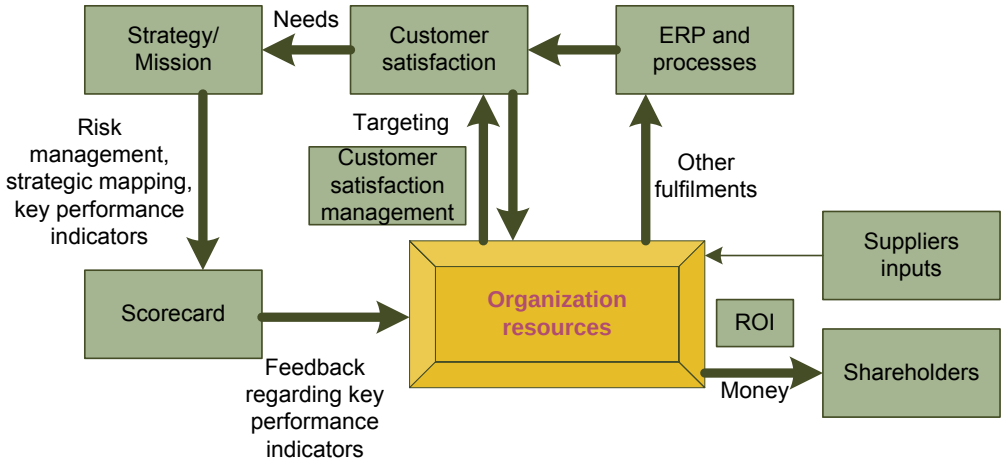

Figure 2. Linked performance management methodologies (Cokins, 2009)

Many performance management components exists for decades now, while some of them are only recently became popular. Some of these components are already partially or completely implemented in many organizations, while performance management is simply enriches them in order to be more harmonized with other components (Cokins, 2004).

2. KEY PERFORMANCE INDICATORS

Key performance indicators are key management instruments used by managers in order to understand if their organization is seeking in the right direction or is turning from the road of company progress (Marr, 2012). Key performance indicators represent results or outcomes identified as key for archiving high performance and they provide baseline for goals setting and performance measurement (Armstrong, 2009). They measure things that are of strategic importance for organization, therefore it is necessary to define strategy first and afterwards to define and link indicator to it. Key performance indicator is indicator that is really meaningful, since everything and anything can be measured. If all indicators are considered to be the key ones, than none of them will standout and get the attention it deserves (Schiff, 2008). The proper set of indicators will put the light on the performances and emphasize areas that need special attention (Marr, 2012). The number of key performance indicators depends on the type of organization, but usually organizations have six to twelve key indicators and potentially dozen others that support the key ones (Armstrong, 2009).

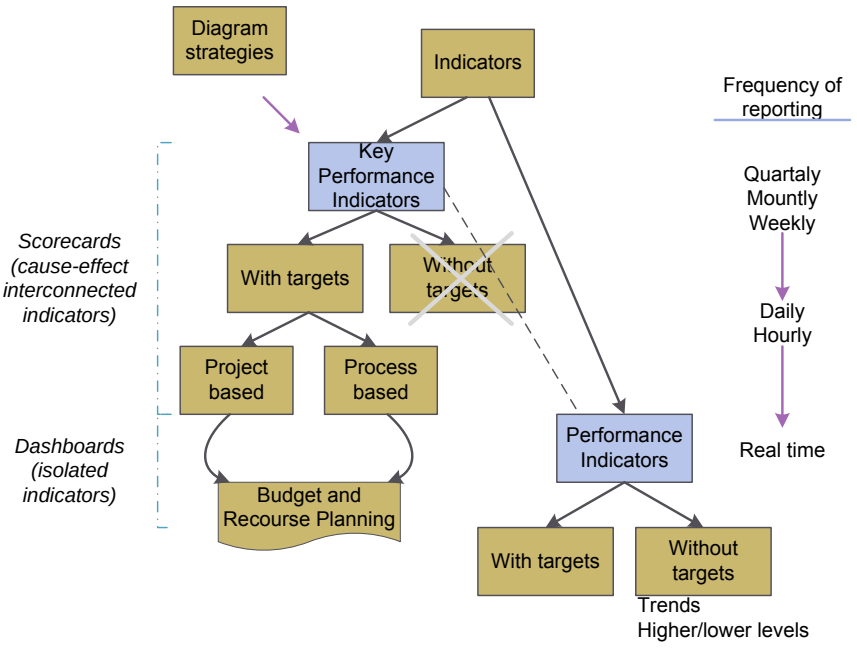

Figure 3. Key performance indicators, scorecards and dashboards (Cokins, 2009)

Sets of key performance indicators are presented on the scorecards, which report on organizational performances (Armstrong, 2009). When putting performances of scorecards, one should not be carried away

in trying to include as many indicators as possible. Unwritten rule is that it is often enough to have six to ten key performance indicators (Dagan, 2007). Integrated key performance indicator framework is shown on Figure 3. Performance frameworks, dashboards or scorecards are often in use for grouping key performance indicators into displays or reports so they can represent immediate insight into business performance (Marr, 2012).

It is important that key performance indicators provide information and answer about what company needs to know, therefore it is necessary to determine information needed and questions that need to be answered, first. Marr (2012) developed key performance questions (KPQs), where key performance question precisely says exactly what manager needs to know. In that way key performance questions represents guide for selection of meaningful indicators (Marr, 2012).

3. BALANCED SCORECARD

Balanced scorecard is widely accepted performance management methodology, and many companies use it for measuring their performances (Hagos & Pal, 2010). Balanced scorecard basically uses integral performance management in order to follow and adjust business strategy (ten Have, ten Have, & Stevens, 2003). The managers often use it for goal clarification, monitoring and structuring mechanisms for initiating interventions. These are the same steps that performance management applies, which results in using balanced scorecard as a basis for performance management activities in organization (Hagos & Pal, 2010).

Traditionally, dashboards seek to focus solely on financial performance indicators (Armstrong, 2009), while the inclusion of nonfinancial information into financial ones is become known as a balanced scorecard (Avis, 2009). The goal of balanced scorecard was to battle the tendency of focusing to short-term financial reports only, because business success needs balanced usage of financial and operational indicators (Kaplan & Norton, 1992) (Kaplan & Norton, 1996).

Organizations are trying to find a ways for observing performance indicator from the perspective of business as a whole, since they must be able to measure financial as well as nonfinancial performances (Hagos & Pal, 2010). Understanding the connection between short-term work of employer with the long-term organizational goals is a key for successful performance management. Balanced scorecard transforms the vision of an organization into understandable goals on every organizational level (Jones, 1999). Balanced scorecard is the way to present former, present and future goals with the easily understandable set of performance indicators (Horngren, Sundem, Stratton, Burgstahler, & Schatzberg, 2008). Balanced scorecard was developed to measure performance toward organizational goals, serving as an indicator of the overall organizational efficiency (Hagos & Pal, 2010).

Kaplan and Norton believe that balanced scorecard approach focuses attention on the vision and strategy, rather than control (Kaplan & Norton, 1992). They imply that this approach can help in harmonization of individual performances with overall strategy, since it motivates people to engage themselves in communication and education, goals setting process and links rewards with performance indicators (Kaplan & Norton, 1996). The original Kaplan and Norton concept asks managers to answer four basic questions, which means observing four connected perspectives (Kaplan & Norton, 1996). Beside usual financial perspective, balanced scorecard motivates managers to incorporate customer's perspective, operations and organizational innovation and learning capabilities (ten Have, ten Have, & Stevens, 2003).

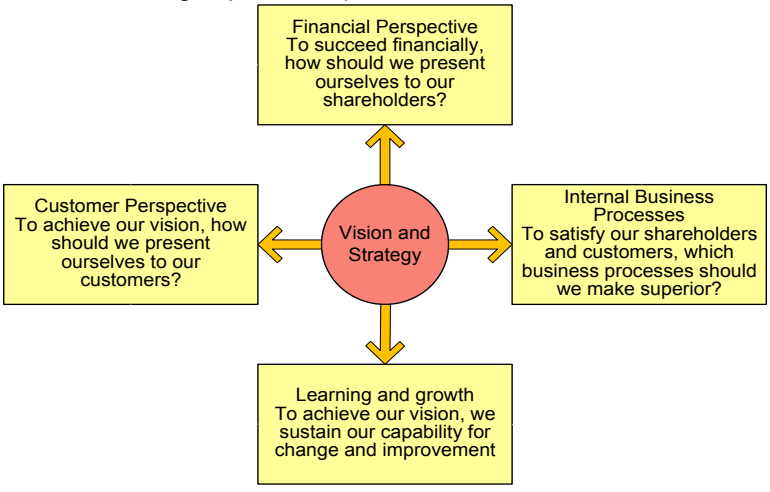

Figure 4. Four perspectives of vision and strategy conversion (Kaplan & Norton, 1996)

Balanced scorecard provides answer to four main questions (ten Have, ten Have, & Stevens, 2003):

- What is important for company shareholders?
- How do customers perceive company?
- Which internal processes can add value?
- Is company innovative and ready for the future?

The balance is a key word. Each area is equally important and each should have no more than four to five indicators. These indicators should reflect the organizational culture. (Jones, 1999). Basically, balanced scorecard is a selection of adequate indicators; if key performance indicators are wrong, than behavior, priorities and employers decisions will not be harmonized with the vision and the strategy of the organization (Cokins, 2009). Balanced scorecard indicators depend on the nature of the company (ten Have, ten Have, & Stevens, 2003). They must not be just a tool for control of behavior and evaluation of past performances, but should be the basis for management system that communicate the strategy, harmonize individuals and teams with the strategy, set long-term strategic goals, allocate short-term and long-term resources and provide feedback and learning about strategy (Armstrong, 2009).

Balanced scorecard methodology, developed by Kaplan and Norton (1996), recognized faults of focusing on short-term financial results. It improves organizational performances by moving attention from financial indicator toward nonfinancial business indicators that reflect customers, internal processes, innovation, learning and growth (Cokins, 2009). And, in return, these indicators lead to better financial results. Balanced scorecard provides insight into aggregate financial consequences of nonfinancial indicators (ten Have, ten Have, & Stevens, 2003).

It is important to stress than none individual methodology, including balanced scorecard cannot achieve results if it is not integrated with other performance management methodologies. Implementation of balanced scorecard often does not succeed in providing projected benefits purely because it is not integrated with performance management processes, especially with those used on operational level (Cokins, 2004). It is believed that 80 % of companies than do not integrate balanced scorecard with performance management methods and tools will give up on it and go back to less organized and less effective set of metrics (Leahy, 2003).

4. STRATEGIC MAPS

Strategic maps in a term of strategy are often compared to financial analysis: in the same way that financial analysis explains company's financial health, the strategic maps explain strategic health of a company. Strategic maps represent a tool that help in defining strategy and facilitate keeping organization on the right track by altering and modifying strategy if it is necessary to change that track (Cokins, 2004).

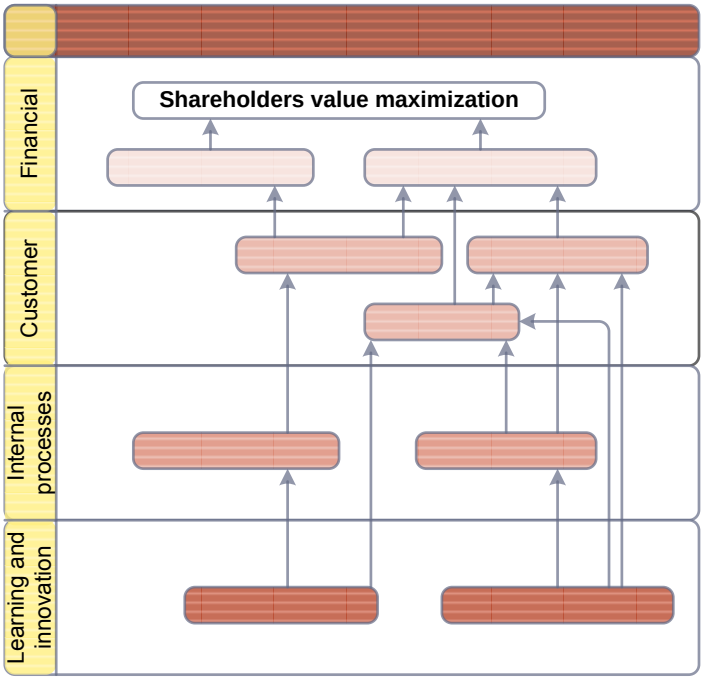

Figure 5. Generic strategic map (Cokins, 2009)

Strategic maps are actually diagrams that show logic of the way that organizations interact in creation of overall performance (Bourne, Franco, & Wilkes, 2003). These maps show connection between cause and effect by which certain improvements create desired results. They are means for description of the elements of organizational system and connections between them. In that way they become guide mark for system improvements that leads to performance improvements. Furthermore, strategic maps provide employers with clear connection between their work and overall goal and give visual insight into critical goals of organization and their relations that run organizational performances (Armstrong, 2009).

5. DASHBOARDS

Dashboards are graphical presentations designed to transfer key performance indicators from intranet systems of organization to a broader audience so that they can assimilate with them and act accordingly simply and quickly (Armstrong, 2009).

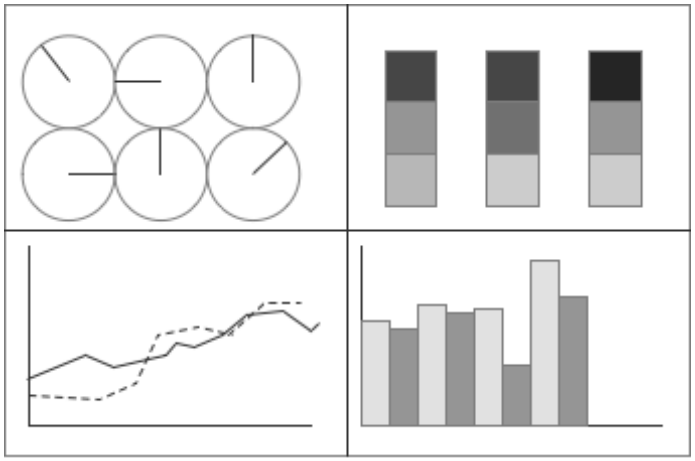

Figure 6. Examples of charts on the dashboards (Armstrong, 2009)

Dashboards can be described as “delivery vehicles” (Dover, 2004), since they make performance information available when it is needed, where it is needed (Armstrong, 2009).

Dashboards enable fast and convenient way for monitoring progress by referencing to an adequate indicator, enabling fast corrective action if it is needed (Dagan, 2007). They can be complemented by drawings, traffic lights, charts and tables, but they should not be overcrowded and in that way hide important indicators (Armstrong, 2009).

6. ACTIVITY BASED COSTING

Performance management is considerably supported with richer information provided by ABC – Activity Based Costing (Cokins, 2004). Traditional costing models allocate indirect costs according to the volume. As a result, product costs with high volume become overvalued, while products with low volume become undervalued. On the contrary, activity based costing calculates real costs of products, customers or services by adding indirect costs according to the activity performed instead of volume (ten Have, ten Have, & Stevens, 2003).

Activity based costing is not solely accounting system. Also, it is much more than accounting management information system. It shifts managerial accounting into managerial economics and represents change management tool. It is socio-technique tool and its main value is irrefutable information based on facts that can be used by employees and managers in order to build business situations and quickly recognize business opportunities and challenges (Cokins, 2004).

The principles of activity based costing must not be applied only to products, but to different distribution channels and customers. The goal is to apply direct cost to any consumer recourse. As for shared recourses, they should be tracked by using measurable drivers that reflects consumption rate instead of arbitrary cost allocation (Cokins, 2009). The starting point for activity based costing is that activities cause costs, not the products or consumers. As different products need different activities, while each of them uses different recourses in different amounts, the cost allocation must be pondered in accordance with that (ten Have, ten Have, & Stevens, 2003).

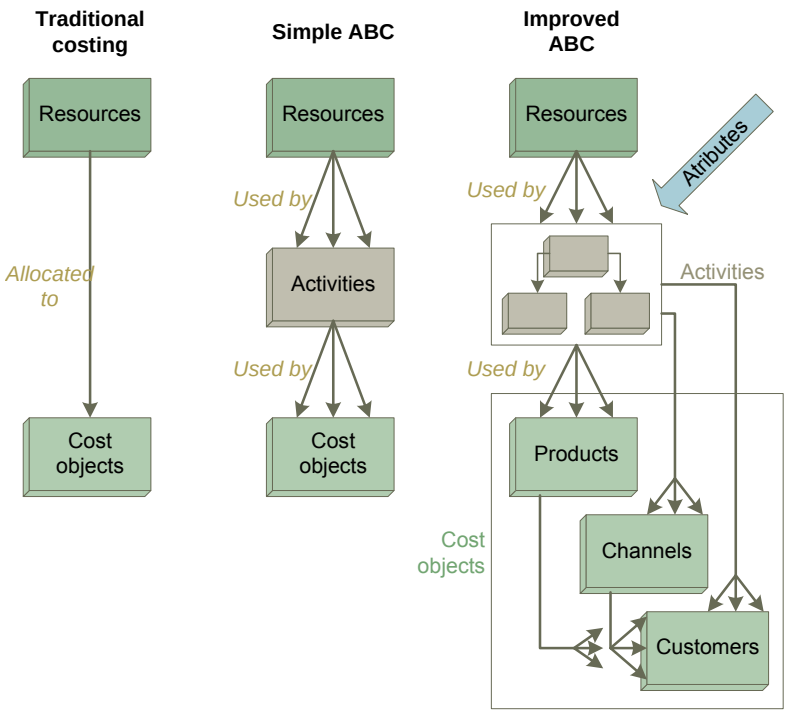

Figure 7. Comparative overview of costing systems (Cokins, 2009)

ABC analyses can be applied through following steps (ten Have, ten Have, & Stevens, 2003):

- Defining cost objects, indirect activities and recourses used for indirect activities.
- Assessing costs by indirect activity.
- Identifying cost drivers for each recourse.
- Calculating total indirect costs of product for the type of cost object.
- Dividing total costs with indirect cost volume by individual cost object.

Recently, Time-Driven Activity-Based Costing – TDABC is becoming the more advanced managerial accounting technique. When it is possible that considerable part of resources consumption exists in repetitive process, activity drivers from ABC model can be replaced with average (standard) time necessary for each activity (Kaplan & Anderson, 2004).

The difference between TDABC and ABC system in in fact that Time-Driven Activity-Based Costing is capacity sensitive and calculates standard activity cost by using standard rates. On the other hand, ABC system is not capacity sensitive and calculates activity cost of each period as real cost. Time-Driven Activity-Based Costing requires investment in measuring event times and to constantly maintain them. ABC simply requires amounts regarding activities that are exported form operational systems (Cokins, 2009).

7. ECONOMIC VALUE ADDED

Economic Value Added – EVA is a method for company's financial performance measurement (ten Have, ten Have, & Stevens, 2003) (Hann, 2011). The concept conceived in New York consulting company Stern-Stewart, assesses economic profit of a company (Marr, 2012). Economic value added measures real economic profit instead of accounting profit, that is the level in which company earnings exceeds shareholder's and creditor's rate of return, with assumption of comparative risk (Hann, 2011). Economic value added measures real profit after deducting all capital expenditures (Hagos & Pal, 2010).

Economic Value Added is unique because it focuses on measuring value, as well as performance (ten Have, ten Have, & Stevens, 2003). It measures economic profit achieved during certain period and is equal to net operative profit after tax adjusted for the price of capital employed (Elliott & Elliott, 2006). It can be calculated using following formula:

$$\textit{Economic value added} = \textit{Net operating profit after tax} - \textit{Price of capital employed after tax} \times \textit{Average capital employed} \quad (1)$$

It can be seen that economic value added measures economic profit, that is excess profit after deduction of earnings necessary for company to maintain capital and it indicates if company really created wealth. The

calculation uses net operating profit after tax (NOPAT) because it reflects profit available from operations, and not accounting profit. The other part of formula means that capital employed, which has its own price (weighted average cost of capital WACC (Marr, 2012)), should be seen as cost of maintaining capital that must be deducted in order to get economic profit (Hann, 2011). Positive economic value added means that during certain time period, value has been created (Elliott & Elliott, 2006).

Economic value added measures economic profit that exceeds expectations of investors and represents performance indicator that, by removing accounting anomalies, enables direct comparison of companies with similar risk profile (Marr, 2012). Adjustment of net operating profit after tax is performed by modification of operating profit by capitalization of some costs that should be seen as assets in economic sense, such as leasing expenses, and than deducting real cash outflows (paid tax instead of calculated tax) (Hann, 2011). Also, when calculating economic value added, research and development and training costs are investments and should be treated in that way (Marr, 2012).

Economic value added is adequate indicator for setting goals, evaluation of performance, defining bonuses, communicating with investors, capital budgeting and valuation (ten Have, ten Have, & Stevens, 2003). It can be increased by (Hagos & Pal, 2010):

- Increasing revenues,
- Minimization of operating costs,
- Production of the same products and services using less capital,
- Investing only in productive projects,
- Decreasing costs of capital.

For adequate application of economic value added four main areas can be perceived: measuring, management, motivation and state of mind, as shown in Figure (ten Have, ten Have, & Stevens, 2003).

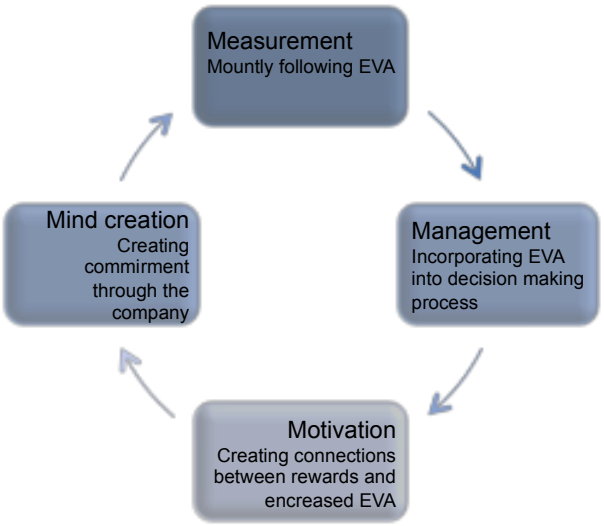

Figure 8. Key areas of EVA implementation (ten Have, ten Have, & Stevens, 2003)

The main challenge in use of economic value added is in calculation of real cost of capital, since that requires deciding about how many and which anomalies will be considered (there are over 150 of them) (ten Have, ten Have, & Stevens, 2003). Stern suggests that only the most important factors should be considered and use roughly defined cost of capital (Stern & Shiely, 2001).

The implementation of economic value added is more about cultural than financial change. Organizations must create culture where performance is more important than simply profit or loss (Marr, 2012).

8. CUSTOMER RELATION MANAGEMENT

Customers are more valuable for the company than the current sales amount. If a company can successfully identify the most valuable customers, gain them, keep them and increase its purchases, it will generate greater value than if all the customer were treated in the same way (ten Have, ten Have, & Stevens, 2003).

The key issue in customer relation management is to give to a customer perception that he or she is recognized and served immediately in a certain way through multiply integrated interface. This requires strategic management of all interactions with customers through marketing strategy customer led from outside to the inside, superior operations, systems and procedures that support customer interface and values and a customer focused culture (ten Have, ten Have, & Stevens, 2003).

Figure 9. Customer managemet piramide (ten Have, ten Have, & Stevens, 2003)

When it is defined what the potentially most valuable customers are, the company should be following next steps (ten Have, ten Have, & Stevens, 2003):

- Gathering as mush as possible relevant information about (potential) customers.
- Analysis of information with redefinition of information needs over time.
- Setting goals regarding the way in company wants to be perceived as provider of products, services or experience.
- Selection of media, systems and content of communication and interaction with customers.
- Development of engagement rules and special service packages for each customer.
- Incorporation of a customer guided culture.
- Warehousing and analysis of data about customers.
- Development of customer management system through learning.

9. CONCLUSION

Performance management is not comprised of several unconnected parts that can be improved separately from one another (Hope & Player, 2012). Individually, these methodologies cannot provide complete solution for performance management needs. The integration with fundamental processes of performance management is necessary (Hagos & Pal, 2010). There is significant interdependence between numerous methodologies and systems for improvements and therefore, change in one area can influence performance elsewhere (Cokins, 2009). Performance management system is nor linear nor sequential process. It is dynamic process that evolves over time. In order for performance management to function, it is necessary to include all of its parts. If only one part is neglected, the system will not work (Bacal, 2012).

Cokins remarkably illustrates performance management framework by comparing it with gorgeous villa, called “Performance Management Villa” (Cokins, 2009) in which all chambers are equipped with strategic maps who establish the routes given from executive teem. In each chamber information and analytical tools are provided so that people can determine the way for accomplishing strategy. Balanced scorecard instrument tables for feedback exist in each chamber so that everyone knows how well his job is done. Villa has unique information platform. People are encouraged to make decisions quickly because there is less and less time for asking superiors for answers. In this way, managers do not manage villa, they enhance it.

REFERENCES

Armstrong, M. (2009). Armstrong's Handbook of Performance Management: An Evidence-Based Guide to Delivering High Performance. London: Kogan Page Ltd.

Avis, J. (2009). CIMA official learning system, Paper P2, Performance management. Burlington, MA, USA: Elsevier.

Bacal, R. (2012). Manager's Guide to Performance Management. McGraw-Hill.

Bourne, M., Franco, M., & Wilkes, J. (2003). Corporate performance management. Measuring Business Excellence , 7 (3), 15-21.

Cokins, G. (2004). Performance Management: Finding the Missing Pieces (To Close the Intelliogence Gap). Hoboken, New Jersey: John Wiley & Sons, Inc.

Cokins, G. (2009). Performance Management: Integrating Strategy Execution, Methodologies, Risk, and Analytics. Hoboken, New Jersey: John Wiley & Sons, Inc.

Dagan, B. (2007, September). Dashboards and scorecards aid in performance management and monitoring. Natural Gas & Electricity , 23-27.

Dover, C. (2004, October). Dashboards can change your culture. Strategic Finance , 42-48.

Elliott, B., & Elliott, J. (2006). Financial Accounting, Reporting and Analysis. Harlow: Pearson Education Limited.

Hagos, T., & Pal, G. (2010). The means of analysis and evaluation for corporate performances. Annales Universitatis Apulensis Series Oeconomica , 438-449.

Hann, P. (2011, May 25). How EVA Relates to Financial Ratio Analysis. Retrieved July 16, 2012 from Bright Hub: http://www.brighthub.com/office/finance/articles/112839.aspx

Hope, J., & Player, S. (2012). Beyond Performance Management. Boston, Massachusetts: Harvard Business Review Press.

Horngren, C. T., Sundem, G. L., Stratton, W. O., Burgstahler, D., & Schatzberg, J. (2008). Introduction to Management Accounting. New York: Pearson, Prentice Hall.

Jones, P. (1999). The Performance Management Pocketbook. Alresford: Management Pocketbooks Ltd.

Kaplan, R. S., & Anderson, R. S. (2004, November). Time-Driven Activity-Based Costing. Harvard Business Review .

Kaplan, R. S., & Norton, D. P. (1992, January-February). The balanced scorecard: Measures that drive performance. Harvard Business Review , 71-79.

Kaplan, R. S., & Norton, D. P. (1996). The Balanced Scorecard: Translating Strategy into Action. Boston: Harvard Business School Press.

Kaplan, R. S., & Norton, D. P. (1996, January-February). Using the balanced scorecard as a strategic management system. Harvard Business Review , 75-85.

Leahy, T. (2003). The Balanced Scorecard Meets BPM. Business Finance (33).

Marr, B. (2012). Key Performance Indicators: The 75 measures every manager needs to know. Hampshire: Pearson Education Ltd.

Schiff, C. (2008, June). Three things you should know about dashboards. DM Review , 29.

ten Have, S., ten Have, W., & Stevens, F. (2003). Key management models: The management tools and practices that will improve your business. Harlow: Pearson Education Limited.

APPLICATION OF THE BALANCED SCORECARD IN DEFENCE PERFORMANCE MANAGEMENT

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Abstract: *Performance management in defence is very important for the process of managing the defence and is fully integrated with all of its aspects. This paper presents a system of defence performance management, and it is based on the concept of Balanced Scorecard. The solutions presented in this paper are the authors vision as a possible solution for the continuous improvement of defence performance, in terms of dynamic changes. This paper may be useful for the development of military science, as well as practical solutions for management in public sector organizations.*

Keywords*: defence system, performance, management, balanced scorecard, key indicators*

1. INTRODUCTION

Contemporary public sector organizations, as well as private sector organizations, operate and achieve their activity in different political, economic, security, social, demographic and other conditions. Dynamic changes in these conditions raise new and complex demands to organization management. Results achieved in a short period of time become obsolete and unusable. Public sector organizations are faced with the problem of constantly increasing demands of stakeholders, as well as maintaining the quality of activities for general interest.

For defence system, as a specific public sector organization, an activity of general interest is the protection of the defence interests. In this regard, the defence system develops capabilities necessary to perform basic activities. That development processes are realized with a significant role of performance management.

Performance management in defence require a lot of information about the strengths, abilities, budget, organization, etc., which should be in balance. Based on that, it is necessary to create a system of performance evaluation which will be followed through different categories of indicators - perspectives. One of the useful tools to synthetically measure organizational performance is the Balanced Scorecard.

The concept of the Balanced Scorecard allows measuring of performance through multiply perspectives, management of organizational performance and presentation of balanced scorecard. It is applied in modern organizations, but also in some countries armed forces.

Armed forces are developing their own system for defence performance management that is based on the concept of Balanced Scorecard, with respect of defence specifics. Process of defence Balanced Scorecard development is consisted of strategy map drafting, measure of key performance indicators and present results of measurements.

2. PERFORMANCE MANAGEMENT IN THE DEFENCE SYSTEM

The defence system is a subsystem of the public sector whose mission is to protect the national security and national interests. Performance management is very important for developing of defence capabilities that are necessary for protection of national security and national interests.

Performance management in the defence system is a dynamic and iterative process. On figure 1 is shown an example of a cyclic model of defence performance management.

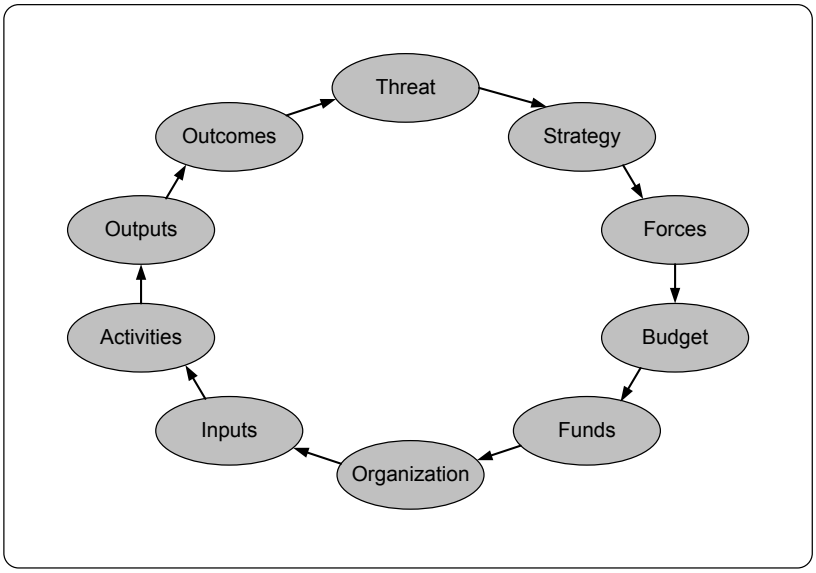

Figure 1: Model of defence performance management. (Angelis and Webb, 2009)

According to state security threats and based on an environment estimate, the government develops policy and strategy. In the next step the plan of the necessary forces development are prepared in order to implement policies and strategies. Also, it is necessary to provide adequate resources and prepare budgets for personnel, equipment, and other inputs needed to provide defence activities.

The approved budget is allocated through defence force structure and the costs types. Each defence organization provides specific inputs (staff, equipment, infrastructure, etc.) necessary to perform assigned missions and tasks. The output values are created as a result of combining inputs and activities.

Efficiency is the quality of being able to do a task successfully, without wasting reliable resources (time, money or energy). It is reflected in the „inputs activities outputs" part of the model. Rather than focusing on budgeting processes, efficiency requires understanding the outputs. Efficiency answers the question, *are we doing things right*?

Effectiveness comes from the „outputs to outcomes" part of the model. It describes how well the defence outputs performed relative to the strategies or high-level goals that the organization set out to achieve. Effectiveness also answers the question, *are we doing the right things*?

Outcomes are results, consequences, effects, or impacts of direct importance to stakeholders. Outcomes depend on the generated output and on the interaction of the output with the environment and the interpretation of stakeholders as to the success of that interaction. There are many measures, each with some utility for a particular audience and none fully measuring the „success" of the goal of providing national security (Stojkovic, Stojanovic, 2012).

It is obvious that defence performance management needs a lot of information about capabilities, budget, organization, et cetera. They must be in balance, because decisions making process based on only one type of information can have a negative impact on the defence system functioning, and probably here will be no success to provide national security and protection of national interests.

3. BALANCED SCORECARD CONCEPT

Modern organizations carry out their activities in changeable and complex conditions. Such conditions require a focus for continuous improvement of performance and implementation of strategic objectives. In this sense, many organizations devote considerable attention to performance measurement. In the process of performance measurement there are a lot of shortcomings. One of them is the foundation of the financial and material indicators.

However, such a method of measurement is not appropriate for modern organizations. In organizations there are intangible assets as employee knowledge, customer loyalty, innovative culture et cetera. The late twentieth century Kaplan and Davis Norton have created a new performance measurement system. The system, named Balanced Scorecard, is based on the performance measurement of the following perspectives: customers, internal business processes, learning and growth and financial (Figure 2).

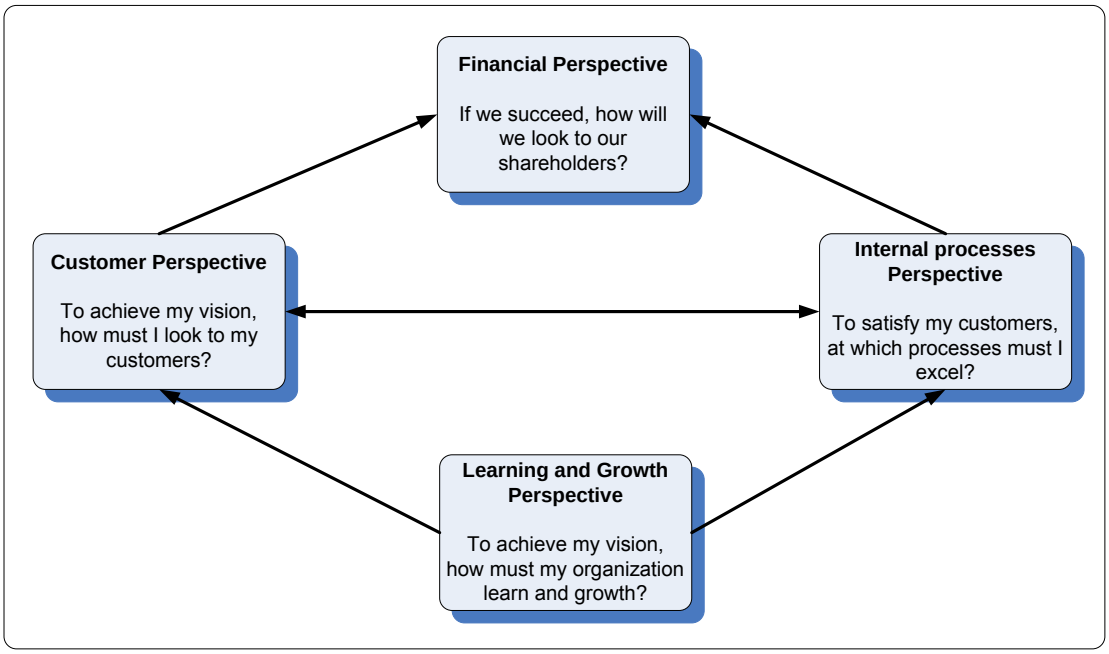

Figure 2: Perspectives of the Balanced Scorecard (Kaplan and Norton, 2001, adopted)

Essentially, the Balanced Scorecard can be viewed in three ways: communication tool, measurement system and strategic management system (Niven, 2008).

Stakeholders should to know what it needs to be done to implement the strategy. This allows the strategy map in complex conditions. The strategy map is a communication tool that shows the paths from the beginning to the end of implementation the strategy. It shows causal paths through perspectives and leads us to the implementation of strategy.

The strategy map is the basis for the development of measurement system. The Balanced Scorecard system allows an organization to translate its vision and strategies by providing a new framework — one that tells the story of the organizations strategy through the objectives of the strategy map and measures chosen to represent those objectives on the Balanced Scorecard. The strategy map and measurement system are inseparable.

The Balanced Scorecard evolved from the measurement system to the strategic management system. It harmonizes short-term activities and the strategy. The Balanced Scorecard overcomes the following obstacles: vision, people and resources. On figure 3 is shown a number of possible reasons for launching a Balanced Scorecard program.

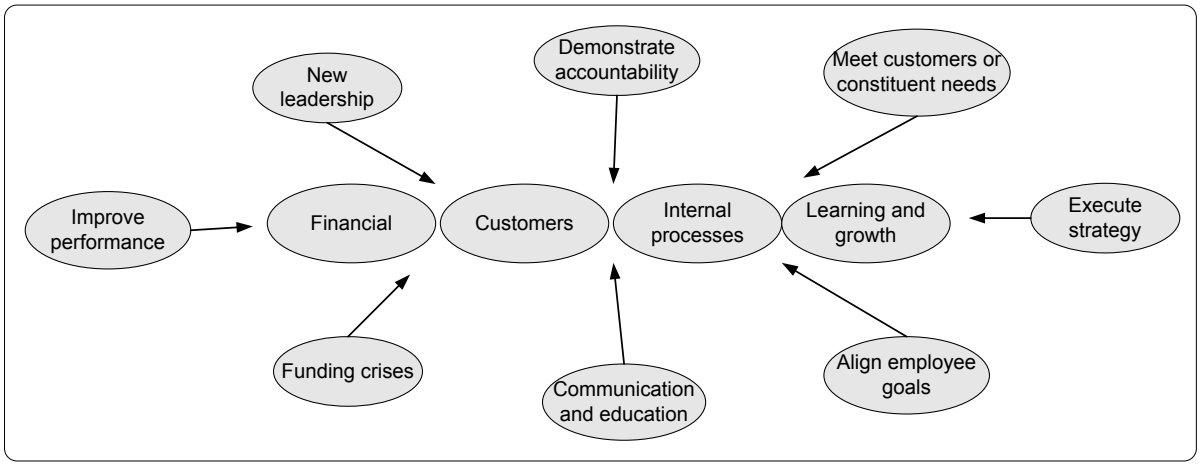

Figure 3: Arguments for BSC (Niven, 2008)

In order to realize real benefits from the Balanced Scorecard, organization should determine their specific justification for launching this implementation.

4. BALANCED SCORECARD IN DEFENCE SYSTEM

The Balanced Scorecard concept is used in modern organizations, but also in some armed forces. However, armed forces are developing their own performance management system based on the Balanced Scorecard concept, which were adopted and adjusted to the defence specifics.

The defence performance may be monitored through the following four perspectives:

- „Outcomes" provides information on the current fulfillment of tasks and the defence readiness comparing to the future challenges;
- „Resources" provides information about resources available to the defence;
- „Processes" provide information about the quality of the key processes in the defence and
- „Development" provides information about the possibility of continuous improvement and value creation of the defence.

Perspective determination and performance selection are realized in the process of defence strategy map developing (Figure 4). Due to the complexity of the defence as a system, the selection of performance is not easy. It is necessary to select the performance of which the realization of the vision and mission depends on, as well as the realization of long-term defence goals.

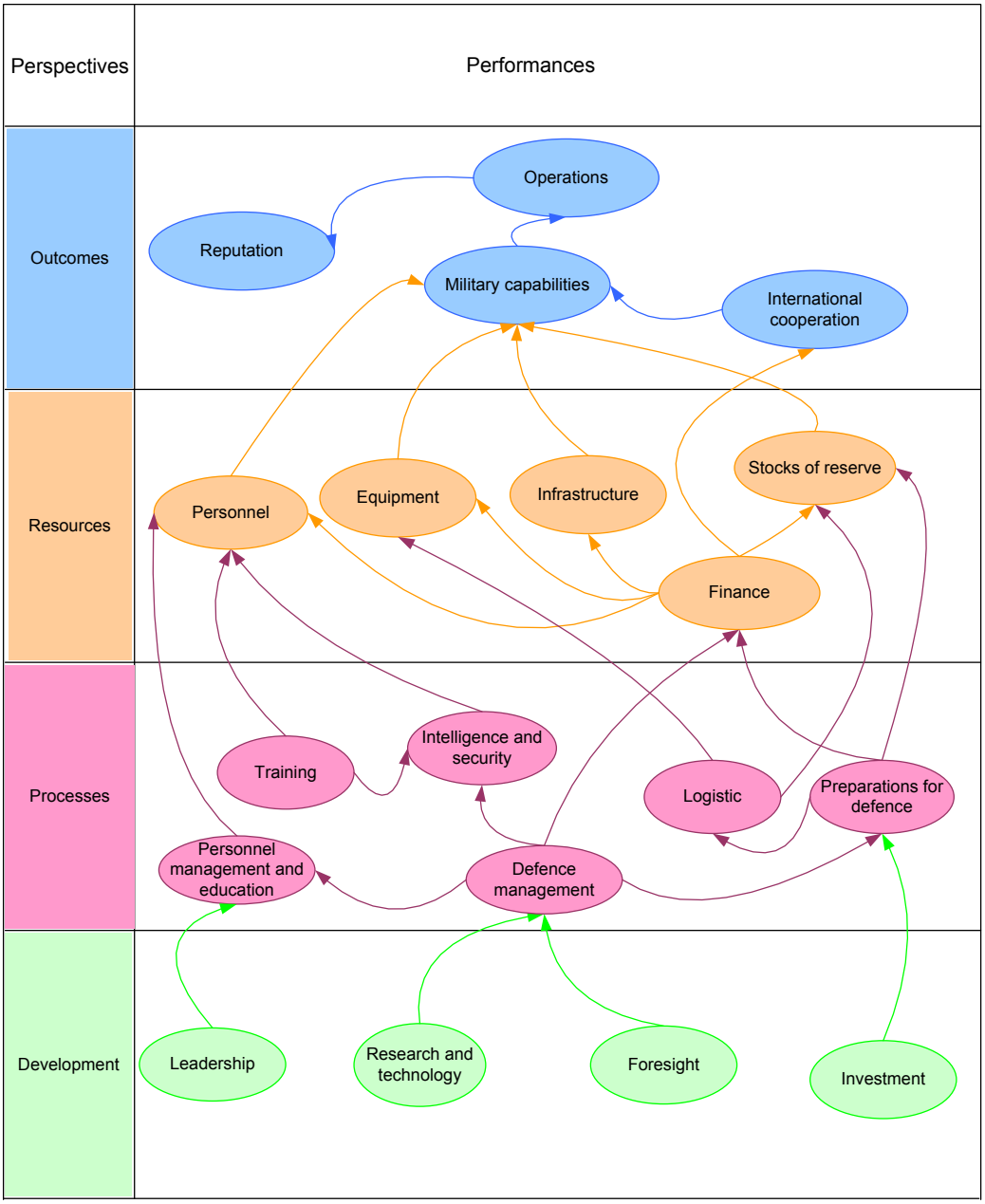

Figure 4: Defence strategy map

However, the functioning of the defence system does not depend on all performances equally. Some performances are more important, but some performances are less significant for the defence system. In this regard, in the defence system, weights for each performance within the perspectives are determined using expert choice method and software Expert Choice.

One of the main ways to obtain data on the quantity and quality of performance is their measurement. Performance measurement is the process of developing indicators for assessing specific goals and execution of measurement (Dictionary of Business and Management, Fourth edition 2006, Oxford, page 396).

There are dozens or hundreds of performance indicators to measure performance. However, it is necessary to select only the indicators that will show the real quantity and quality of performance. Performance indicators are directly related to defence objectives indicators.

The present method of measuring performance indicators allows simultaneous monitoring the implementation of the medium-term objectives and the defence performance.

Making defence strategy map and performance measure are complex processes. Due to the complexity of these processes the most expert people in the defence establishment must be engaged.

Based on the measurement results, identification of the performance shortcomings and the defence key problems are performed. The measurement results and the defence key problems are presented to the Ministry of Defence leadership, as well as proposed measures to eliminate shortcomings and resolve key issues.

In order to present the results of measurements defence dashboard are made, that graphically displays the current status and future trends of performances and perspectives (Figure 5).

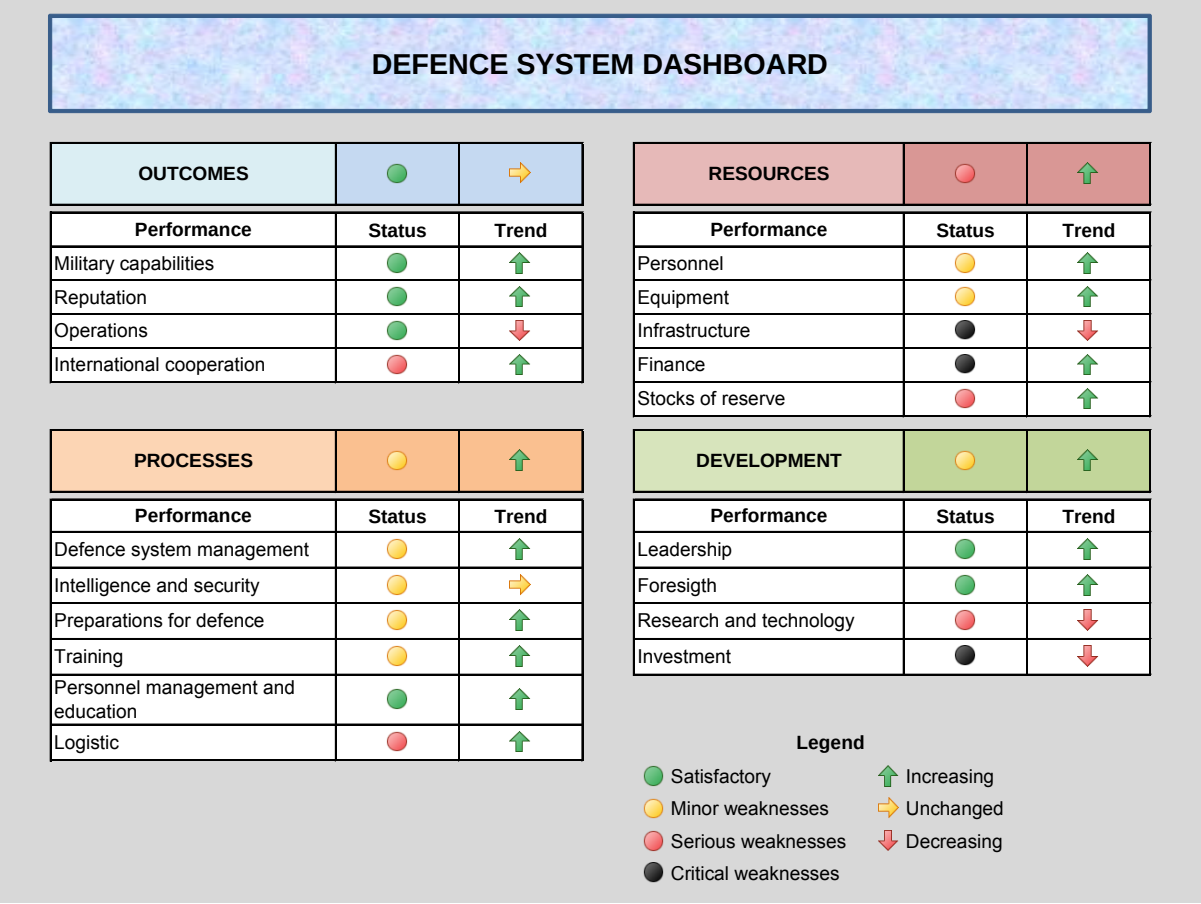

Figure 5: Defence system dashboard

Displaying the defence performance in such a way helps in understanding the entirety state of the defence, easily spotting key issues and quickly makes decisions about corrective action.

5. CONCLUSION

Performance management supports strategic planning in organizations using measurable indicators and better information enables managers to recognize success, identify problem areas and develop actions in order to provide better service to society.

The Balanced Scorecard concept enables to monitor organizational performance through more different categories of indicators. Defence performance management is based on the Balanced Scorecard concept with respect of the defence system specificities.

Appliance of the presented model of the defence performance management enables to achieve different effects:

- monitoring the performance necessary to achieve the defence system objectives;
- quick identification of key issues;
- simple and understandable presentation of the defence system state;
- defence planning based on objective indicators;
- corrective action.

The presented model may be applied in military organizations, as well as in public sector organizations. However, application of the presented model requires its adjustment in accordance the specification of the particular system.

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REFERENCES

Angelis D., Webb N. (2009), Improving Performance Measurement in Defense Organizations, Armed Forces Comptroller, Downloads: http://www.omagdigital.com/publication/?i=42492

Angelis D. C. (2005), Controlling Strategy, Management, Accounting, and Performance Measurement, Oxford University Press.

Cokins G. (2004), Performance Management–finding the missing pieces (to close the intelligence gap), John Wiley & Sons, Inc.

Dube S., Danescu D. (2011), Supplemental Guidance: Public Sector Definition, The Institute of Internal Auditors, Altamonte Springs, Retrieved from https://na.theiia.org/standards-guidance/Public%20Documents/Public%20Sector%20Definition.pdf.

Kaplan, R. S. and D. P. Norton (2001), Transforming the Balanced Scorecard from Performance Measurement to Strategic Management: Part I, Accounting Horizons, March, pp. 87-104.

Mašić B (2009), Strategijski menadžment, University Singidunum.

Niven P. (2008), Balanced scorecard step-by-step for government and nonprofit agencies - 2nd edition, John Wiley & Sons, Inc.

Smith M. (2005), Performance Measurement and Management, Sage Publications.

Stojković D., Stojanović D. (2012), Strategic defence performance management, Proceedings SYMORG.

Taticchi P. (2010), Business Performance Measurement and Management, New Contexts, Themes and Challenges, Springer.

ROLE OF TRANSFER PRICING IN BUSINESS OF MULTINATIONAL COMPANIES

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Abstract: *In recent times, the role of transfer pricing has become especially important in complex holding companies on an international level. Due to the trade between the parent company and subsidiaries located in different countries, the tax implications of transfer pricing is expressive. Therefore, the harmonization of relations between multinational companies and governments of some countries is becoming increasingly important issue. In this regard, the paper will discuss the role of transfer pricing in multinational companies, as well as their influence on the governments of the host countries. Bearing this in mind, the main objective of this paper consists in analyzing the importance of transfer pricing in order successfully manage the multinational companies performance. By adequate application of theoretical concepts and chosen research methods, the work is expected to extend domestic writings in this field and to introduce our economic publicity with the role of transfer pricing in the operations of multinational companies.*

Key words*: transfer pricing, multinational companies, tax implication*

1.INTRODUCTION

The last decade of the twentieth century was marked by increasing globalization and internalization of international business. In terms of trans-nationalization of most economies in the world, multinational companies have become the central organizers of economic activity and the main actors in shaping the international division of labor. They achieve this role through foreign direct investment, and a number of non-equity arrangements with the enterprises in the host country.

Transfer price is the cash basis for quantifying the internal transfer of products / services. It is determined for an adequate and fair determination of participation of each participant in this transfer and measurement of its effectiveness. The specificity of transfer pricing in relation to the external market price is reflected in the fact that they condition performance of the unit that buys and units that sells intermediate product / service, but also the company as a whole.

Transfer pricing has become one of the most important elements in the operations of multinational companies. Internal transfer is a potentially serious and complex economic phenomenon in relation to the external exchange of products / services, that is performed relatively without a problem due to the effects of market rules.

The role of transfer pricing in the creation of tax benefits for multinational companies became more pronounced. The ultimate effect of the tax consequences of the profit of multinational companies significantly exceed the effect of other factors, such as reduced risk of monetary disturbances, keeping the preferred dividend policy or achieve competitive advantage through finding cheap capital.

2. THE GROWING IMPORTANCE OF MULTINATIONAL COMPANIES IN THE WORLD ECONOMY

The term multinational corporation was first used in 1960. The term was apparently “coined by David E. Lilienthal, director of Tennessee Valley Authority under President Roosevelt and the Atomic Energy Commission during the Truman... His report at the Carnegie Institute of Technology from the 1960s, hich was then published in Development and Resources Corporation has a title: The Multinational Corporation. The title was then taken over by Business Week in a separate report of Multinational Companies in the issue of April 20 in 1963” (Svetličić, 1986). In fact, it seems that the multinational corporations occurred with the use of the term that indicate the feature which can by no means be considered new. However, “the features can not bear with the names they receive, but they form through a long process, filled with contradictions and struggles of various factors, which ultimately lead to the prevalence of certain characteristics. And this may be expressing something qualitatively new in relation to the old features or just be a new form” (Svetličić, 1986).

Multinational companies are very difficult to define, given that among them there are many differences observed in terms of form and concentration of ownership, the volume of capital and scope of operations, geographic dispersion of activities, degree of differentiation and integration, the structure of the internal organization and management system. The lack of a comprehensive definition of multinational companies is probably the result of applying a number of criteria that cannot be avoided during the time of their definition. With this in mind, the literature can meet various definitions of multinational companies.

Dunning defines a multinational company as a company that undertakes foreign direct investment (FDI) and owns or has the right of control over the activities of more than one country. According to this definition, a multinational company has two characteristics. First, they coordinate production between a numbers of different companies and internalize this coordination problem within a single organizational structure. Second, a significant part of economic transactions associated with this coordination activity is achieved outside of the national economy. According to these characteristics multinational companies are different than other companies. On the one hand, a large number of companies control and coordinate production between the various companies and while many other companies have taken economic transactions across borders. On the other hand, multinational companies are the only companies that coordinate and internalize their economic activities beyond the borders of the national economy.

Hood and Young point as important elements of the multinational companies following (Svetličić, 1986):

- direct investments (unlike previous portfolio investments),
- transmission resources in the package,
- property ownership abroad that bring income in various countries.

According to the management criteria, it is believed that a multinational company is that whose control central has a multinational character, i.e. the management of a given multinational companies (the leadership includes representatives of all branches of multinational companies) is multinational.

Numerous and different views of given phenomena suggest that comprehensive definition of multinational corporations must include the following elements: multinational corporations represent the major economic organizations that only part of its activities performed outside of the national economy and to this end establish affiliates abroad, their central administration is in the hands of citizens of the exporting capital country and ownership structure of the corporation may, but need not have a multinational character.

It must be recognized that difficulties in the precise definition of multinational companies, as the dominant actors in shaping global economic trends in the contemporary conditions, represent a reflection of their complexity and the fact that they are in fact “mixed formations, because on the one hand, they are a reflection of the competition, and on the other, negation of the competition, a reflection of the concentration and centralization of capital and state intervention. These companies are polyvalent, and national and transnational (multinational), and market and anti-market, they are factor of the development of the productive forces, but also the limiting factor of this development, they are a factor of the integration also and disintegration of the world market and the national economies” (Svetličić, 1986).

However, "in the broadest sense of the word multinational company we can be defined as a company that produces goods and sells its services in more than one country. In the strict sense of the word, multinational company can be defined as a company that, through foreign direct investments, controls and manages affiliates in foreign countries” (Held et al., 2001).

Specific features of multinational companies are reflected in the large geographical coverage, significant organizational interdependence and capabilities of coherent integration of activities implemented in different countries. In terms of revenues, profits, capital and resources, these companies represent the true giants, and their economic power is often greater than the potential and performance of many countries.

Their great power based on the enormous size and activities on a global scale, especially in the social influence that stems from it; internationalization of all phases of operations; centralization of decision-making; monopoly control of the world's raw materials and energy; as well as the great potential of scientific and technical development, including the ability to attract and engage a number of scientific staff from around the world. Thus, MNC’s are still the most important factor in the world economy, which controls more than 70 % of world trade and 80% of the world's financial potential. The most dynamic sectors of the economy are broadly transnational and have an interest in maintaining an open international economic system. The expansion of MNC’s has led to the growing integration of the world economy in which their business is increasingly limited by national boundaries, so that the factors of production and goods to move freely, which allows for the reproduction cycle of global capital freely fertilization.

It is characteristic that, for example, the Japanese company „Toyota" one-third of the total production generates from its 25 companies located in America, Europe and Asia. Exports about 45 % of its production realized in Japan. Through its regional network of Asian imports diesel engines from Thailand, the Philippines transformers, heaters, etc. from Malaysia. American company „IBM" in the field of information technology, 41 % of its sales realized in the North American market, 30 % in Europe and 9 % in Asia. „Canon" is realized 30 % of its production in North America, 29 % in Europe and 37 % in Asia. For companies that have a relatively small domestic market, such as the giant Dutch electronics industry „Philips" or Swiss food colossus of industry „something", it is crucial exit out of the national market and the expansion of its activities on the planet. For this reason, MNC's locate their center of activity everywhere that can realize the most effective combination of technology, capital and labor to produce the most profitable and launch their products. They are trying to infiltrate in the periphery of the world economy, the interest of the city to spatially decentralized production operations, seeking more profits and lower wages. As a consequence, the emergence of transnational unwieldy empire whose business scope often exceeds the gross national product of many countries.

On the basis of the content of MNC is a strategy that foreign investment is being made, rather than in the form of the loan capital in the form of capital and entrepreneurial business to be managed mainly from the country of origin of the company. Foreign direct investment in modern developmental stages functions as a key development factors and the international trade and technological progress have become the main mechanism for the global economy. Common modes of transmission activities of MNC's in other countries, in addition to FDI as the most important ways as: exports of goods, sales of licenses, portfolio investments, joint ventures, contractual arrangements and know-how. In such circumstances, the companies strive to become a global, primarily due to the inclusion in the global market of material goods and services, to oppose competition in the domestic market, hedging and cost per unit of product. In addition, the development of productive forces, as a result of the scientific and technical revolution, led to the fact that in some industries it is impossible to organize the production of which would be profitable, if it only works for the national market. To be effective, corporations seek to ensure good market position, increasingly insist on quality, technological innovation, with particular attention to attach a global strategy and development. In the struggle for dominance in the market, they are not shy to use various non-economic, even illegal activity, that they an effective and fast way to provide global dominance.

Power, available knowledge and accumulated experience of multinational companies are coming to full expression in situations where they use favorable conditions and comparative advantages offered by a specific geographical location and when they integrate these separate locations in the multinational network of research and development, production and sales, and marketing (Milićević, 2003).

In the circumstances of a complex organizational structure, instability of exchange rate movements and possible political upheaval in the host countries, companies has as tasks-coordination, control, resource allocation, performance measurement and currency management becomes more complex.

3. TRANSFER PRICING - A FORM OF MULTINATIONAL COMPANIES POWER EXPRESSION

Power of multinational companies is not expressed only through competitive advantages in a number of countries in the world. These companies have a significant influence on the government of the host countries. The power derives from their ability to influence the macroeconomic policies of local governments and set up rules to suit themselves. The most obvious example of the expression of this type can represent transfer prices.

As for the group at the international level, the transfer of goods and services between the parent company and subsidiaries is carried out by transfer pricing. Thus, for example, if the parent company that manufactures equipment and subsidiaries installes that equipment in another country, transfer pricing implies a level of profit and tax profit of parent company and subsidiaries. Established equipment transfer pricing imply in this case the cost of the branch of subsidiaries and at the same time the income of the parent. That is, regardless of how they are formed, transfer prices significantly affect the profitability of each entity within the complex group. Transfer prices affect the decision making process of the input and output. These decisions directly affect profits, rates of return on investment as well as on taxation in the case of complex organizations at the international level.

Transfers of products and services among subsidiaries that are located in different countries represent a very important segment of the multinationals. In support of this conclusion is the fact that internal transfers between subsidiaries account for between 30 and 50% of the total annual income of multinational companies. The prices at which these transfers take place based either on cost or estimated market prices

for the products or services that are subject to internal trade. In both cases, these prices are considered administrative or management cost, given that they do not provide the economic value of internal transfers. Accordingly, the transfer price can be a significant source of multinational companies' benefits as the central management successfully manages them (Radebaugh & Gray, 1997).

If transfer prices are implemented incorrectly, a company increases its exposure to double taxation, penalties, and high legal costs. This results in an increase in the total cost of ownership as a short term money saving decision may finally cause an overall higher cost. Thus, the increased total cost of ownership makes the corporation less profitable. Transfer pricing was found to be an important part of maximizing operating performance (Kumar & Sosnoski, 2011).

Transfer pricing at multinational groups level have multiple effects. They directly affect the amount of business results of the group members in the supply chain. For multinational companies with global supply chains, increased awareness of transfer pricing–related issues is leading to the acknowledgments that changes in an operational structure often demand appropriate changes to the tax and legal structure to align business models (Balachandran et al., 2010). This result has a different level of corporate taxation and taxation of distributed profit of group members in different countries. By the transfer pricing, profit is transferred from countries with high tax rates in countries with lower tax rates. They directly influence the increase in profits in countries with lower rates of income tax. On the other hand, transfer price may have a control part. Thus, or example, if the parent wants to receive dividends from its subsidiaries, which is not possible because of legal restrictions, then the parent will artificially increase their profits and reduce profit of subsidiaries.

Therefore, the main benefit, which could result in the effective management of transfer pricing is reflected in minimizing global tax liabilities, reducing the risk of monetary disturbances, maintaining desirable dividend policy, finding cheap capital, and the like. Tax consequences arising out of the utilization of different transfer prices can be easily quantified, and the final effects of the profit of multinational companies significantly beyond the effects of other factors. Transfer pricing is the movement of money from one country to another. Almost correctly, it can save a company millions of dollars, if not done accurately, transfer pricing can place global companies at considerable risk for audits, interest and penalties, even result in double or triple taxation (Tully, 2012).

Tax legislation and tax incentives vary from country to country and range of moves performed by multinational companies in order to achieve tax savings very large . In the period since 1980 till 1990 in the U.S. there was a big expansion of multinational companies whose asset value almost tripled and climbed up to the amount of 1.8 trillion dollars, while the amount of taxes paid in the same period hardly changed. Than 36,800 foreign companies, more than half did not report any taxable income. U.S. Treasury Department has estimated that 36 multinational companies in this period to avoid paying more than 100 billion dollars in taxes, of which two-thirds related to Japanese companies. Particularly outstanding was the example of Toyota, which was accused that by excessively high transfer prices of cars and parts in the U.S. carried out the transfer of profits in Japan, where tax rates were much lower. Later the company still paid the entire trillion dollar tax.

In order that such cases would not be repeated in the early 90s, many countries have begun to incorporate into their tax legislation the different ways of calculating of transfer pricing for multinational companies that do business with them. A large number of multinational companies in the world has imposed the need to address the problem of calculating transfer prices at the global level in what they include and organizations such as *The Organisation for Economic Co-operation and Development - OECD* and *United Nations - UN*, and the final solution was a principle "arm's - length transaction," which included the recognition of transfer prices, for internal deliveries between the parent company and the foreign subsidiary, on level comparable prices applicable to unrelated entities. This means that the tax base includes the difference between this particular transfer pricing and internal established transfer prices. When transfer prices do not reflect market relations and the arm's-length principle, can lead to distortion in terms of tax liabilities of related entities and the tax revenues of the host countries. Therefore, the profit of related entities can be corrected to the extent necessary to correct such distortions and ensure the application of the principle of arm's length. OECD member countries are considered that appropriate alignment is achieved by establishing requirements for commercial and financial relations between unrelated entities in comparable transactions under comparable conditions (OECD Guidelines, 2010).

Although this approach limits the possiblility for transfer prices manipulation, it is difficult to apply. The problem is that the transfer prices are essentially administrative cost, and used for evaluation of internal financial flows that cannot be traced through the flow of goods or services. Even in situations where the primary cost of unfinished products can be accurately defined, there is always the opportunity to "discover" a

new service whose cost accounting system recognizes. Thus, expenditures on behalf of mutual advisory services, insurance services, general management, research and development, phone calls, loans, and others, can still be included in the calculation as costs by choice. Moreover, in many countries a firm's legal structure and ownership structure define respective accounting requirements. For instance, disclosure requirements may vary with factors such as size, number of owners, liability regimes, and so forth (Martini et al., 2012).

Multinational companies have the ability to easily and quickly reallocate their profits, and that the governments of the countries puts at a disadvantage. By threat of closure of their factory, and thus by the loss of jobs for many people, by a bad image of the host country to other investors as well as by weakening of political support for elected governments of these countries by the local population, multinational companies are pressuring the government policies of host countries.

For these reasons, many countries are introducing benign procedure for the control of transfer pricing of multinational companies. In order to keep or attract large companies, they offer a number of tax benefits, benefits in the area of production, such as cheap or free land for the construction of production facilities, subsidies and financial assistance in times of crisis in order to maintain or increase employment.

4.CONCLUSION

Multinational companies provide a powerful process of international integration and the emergence of the global economy, whose essence is the realization of national interests and economic expansion, primarily to home countries. Power, available knowledge and accumulated experience of multinational companies are coming to full expression in situations where they use favorable conditions and comparative advantages offered by a specific geographical location and when integrate these separate locations in the multinational network of research and development, production and sales, and marketing.

Transfer prices are an important instrument for planning and controlling of business performance at the level of multinational companies. The effect of transfer pricing is best seen in terms of a high degree of independence of the organizational units of businesses. Recently, by transfer pricing profits is transferred from countries with higher tax rates in countries with lower tax rates. Law in developed countries successfully discover such an effect of transfer pricing at the level of individual complex groups and, therefore, possess adequate tax regulations.

Financial flows and income distribution of multinationals must be controlled by the governments of the host countries. On the other hand, starting with the economic and political power of multinational companies, local governments must sometimes directly intervene by way of tax incentives or through benefits in production.

We conclude that the alignment of the relationship between multinationals and the governments of certain countries is associated with the distribution of wealth and the control of production. This relationship is much more than a successful creation of tax legislation.

REFERENCES

Balachandran, K., Li, S. & Wang, T. (2010). The Role of Transfer-Pricing Schemes in Coordinated Supply Chains. Journal of accounting, auditing & finance 25(july), 375-404.

Held, D., McGrew, A., Goldblat D. & Perraton. J. (2001). Global Transformations: Politics, Economics and Culture. Cambridge, UK: Polity Press.

http://unctad.org/Sections/dite_dir/docs/WIR2013/WIR13_webtab28.xls (15.03.2014).

Kumar, S. & Sosnoski, M. (2011). Decision framework for the analysis and selection of appropriate transfer pricing for a resilient global SME manufacturing operation – a business case. International Journal of Production Research, 49(18), 5431–5448. DOI: 10.1080/00207543.2011.563835.

Martini, J., Niemann, R. & Simons, D. (2012). Transfer Pricing or Formula Apportionment? Tax-Induced Distortions of Multinationals' Investment and Production Decisions. Contemporary Accounting Research, 29(4), 1060–1086. doi:10.1111/j.1911-3846.2012.01140.x.

Milićević, V. (2003). Strategijsko upravljačko računovodstvo. Beograd: Ekonomski fakultet.

Radebaugh, L. & Gray, S. (1997). International Accounting And Multinational Enterprises, New York: John Wiley.

Smernice OECD za primenu pravila o transfernim cenama za multinacionalna preduzeća i poreske uprave. (2010). Retrieved from http://www.stats.govt.nz

Svetličić, M. (1986). Zlatne niti transnacionalnih preduzeća. Beograd: Ekonomika.

Tully, B. (2012). Transfer Pricing Strategies and the Impact on Organizations. FinancialExecutive (july/august), 34-37.Retrieved from www.financialexecutives.org.

TOWARDS A FRAMEWORK FOR ENHANCING R&D INDICATORS OF OECD COUNTRIES

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Abstract: *Expenditure on research and development (R&D) is one of the most widely used measures of innovation inputs. Governments in modern economies devote much attention to enhancing productivity and emphasizing its drivers such as investment in R&D. So far, there are no existing frameworks that perform ranking based on R&D. The aim of our paper is to present an I-distance methodology that gives a new perspective on the measurement of R&D. In addition, we aim to compare it to the list of the OECD countries by R&D expenditure, and to point out improvements that our methodology provides. As a case study we analyzed a dataset of 41 OECD countries, with the latest available data of 2013. One of the contributions lies in the application of an I-distance method which can easily integrate R&D variables with different measurement units into one composite indicator. Using the I-distance method, the obtained results suggest that following indicators are very significant for ranking countries: GERD as a percentage of GDP, Business Enterprise Expenditure on R&D as a percentage of GDP, Percentage of GERD financed by industry and GERD per capita population. In addition, applying the I-distance method we were able to overcome the problems concerning the aggregation of composite indicator that uses presumably biased weighting factors. Moreover, our approach could be a foundation for an appropriate framework of R&D ranking countries which would be unbiased i.e. independent from subjectively formed weighting factors.*

Keywords*: research and development (R&D), I-distance method, ranking of countries, OECD countries*

1. INTRODUCTION

As a branch of economics that focuses on improving the economies of developing countries, development economics considers how to promote economic growth in such countries by improving factors like health, education, working conditions, domestic and international policies and market conditions (Cracolici et al.2010) It examines both macroeconomic and microeconomic factors relating to the structure of a developing economy and how that economy can create effective domestic and international growth. It seeks to determine how poor countries can be transformed into prosperous ones (UNDP 2008). Strategies for transforming a developing economy tend to be unique, because the social and political background of countries can vary dramatically (Petrosillo et al.2013). Today, more than ever before, innovation, enterprise and intellectual assets drive economic growth and increase standards of living (D'Acci 2011). Innovation is instrumental in creating new jobs, providing higher incomes, offering investment opportunities, solving social problems, curing disease, safeguarding the environment, and protecting our security. To help achieve these objectives, governments must create appropriate incentives for continued growth in innovation and technology development and embrace sound policies for assuring broad social diffusion and access to key scientific and technological advances that enable us, as Newton first observed, *~~to~~ stand on the shoulders of geniuses*" (Business and Industry Advisory Committee to the OECD, CREATIVITY, INNOVATION AND ECONOMIC GROWTH IN THE 21st CENTURY).

It is not uncommon that the countries refer to the best rank in one criterion, while the other criteria (which are also important) are below average. In order to enhance and improve ranking and conclusion we focused on the application of the composite index (Amdt et al.2013; Guttorp and Kim 2013; Saisana et al.2011). Composite indicators as tools to compare country performance are increasingly common (Saisana and Tarantola 2002; Saisana and D'Hombres 2008). Simplistically a composite indicator synthesizes the information included in a selected set of indicators and variables (Paruolo et al.2013) The output of a composite indicator is a set of scores indicating the relative performance of a country within a set of countries (Brügermann and Patil 2011). A composite is thus a measure of similarity (Saltelli 2007; Paruolo et al.2013). The main virtue of composite indicators is their usefulness for policy analysis in that they can summarise complex and sometimes elusive issues in wide ranging fields, e.g., environment, economy, society or technological development. Composites often seem easier to interpret than finding a common trend in many separate indicators and have proven useful in benchmarking country performance.

There are many problems we experience when applying composite indicators (Diener and Suh 1997;Moffat 2000). Some of them are: imputation of missing data, multivariate analysis, normalization, weighting and aggregation, uncertainty and sensitivity analysis. For each of them methods how to overcome it (Dobbie and Dail 2012; Soo 2013;Tarantola and Saltelli 2007) are applicable. We will explain those three we find most important for this work. First problem is with data selection and missing data - the most common problem at all. Indicators should be selected on the basis of their analytical soundness, measurability, country coverage, relevance to the phenomenon being measured and relationship to each other. The use of proxy variables should be considered when data are scarce. Imputation of missing data is needed in order to provide a complete dataset (e.g. by means of single or multiple imputation). Consideration should be given to different approaches for imputing missing values (Handbook on constructing composite indicators: methodology and user guide). For example extreme values should be examined as they can become unintended benchmarks. Multivariate analysis is an exploratory analysis which should investigate the overall structure of the indicators, assess the suitability of the data set and explain the methodological choices, e.g. weighting, aggregation. Another most common problem with getting one dimensional variable by observing more dimensions is normalization. Normalization should be carried out to render the variables comparables well as indicators. Attention needs to be paid to extreme values and skewed data, because they may influence subsequent steps in the process of building a composite indicator.

The aim of our paper is to present an I-distance methodology that holds a new perspective on the measurement of R&D. In addition, we aim to compare it to the list of OECD countries by Expenditure on R&D (% of GDP) available from the World Bank data, and to point out improvements that our methodology provides. We will try to discuss several topics. We will incorporate expenditure R&D indicators into the evaluation framework of countries (OECD Factbook 2013). A simple definition of R&D intensity is *"the ratio of expenditures by a firm on research and development to the firm's sales".* Generally speaking, R&D is the main driver of innovation, and R&D expenditure and intensity are two of the key indicators used to monitor resources devoted to science and technology worldwide (Economic Glossary). R&D intensity for a country is defined as the R&D expenditure as a percentage of Gross Domestic Product (GDP) (Eurostat). The main aggregate used for international comparisons is gross domestic expenditure on R&D (GERD). This consists of the total expenditure (current and capital) on R&D carried out by all resident companies, research institutes, university and government labour (OECD Factbook 2013). The GERD is an indicator of science and technology (S&T) activities; it is appropriately used as a summary of R&D activities and the basic flow of funds (Griffith, R., Huergo, E., Mairesse, J., P, B., : Innovation and productivity across four European countries).

The aim of this work is to provide a framework for introducing the necessity of evaluating countries by composite indicators. Our paper will employ a statistical I-distance method which can easily overcome the problem of subjectively chosen weighting factors. In addition, it can integrate variables with different measurement units into one value which is thereafter considered as a rank of a certain country. Besides the analyze of influence of each one indicator , we will compare the results of I-distance method with other method and we were able to provide detailed data on how each observed indicator contributes to the final rank and point out the crucial indicators of countries. In addition, we compared ranks obtained by I-distance method with ranks based on the Expenditure R&D (% of GDP).

2. METHODOLOGY

The common case with different ranking methods is that their bias and subjectivity can affect the measurements and evaluation to a great extent. This problem can be somewhat overcome by the use of the I-distance method, a metric distance in an n-dimensional space, which has recently made a significant breakthrough (Jeremic et al. 2011a; Radojicic and Jeremic 2012; Jeremic et al. 2012; Dobrota et al. 2012). It was originally defined by Ivanovic (Ivanovic 1977), who devised this method to rank countries according to their level of development based on several indicators, where the main issue was how to use all of them in order to calculate a single synthetic indicator, which will afterwards represent the rank.

For a selected set of variables $X^T = X_1, X_2, \ldots X_k$ chosen to characterize the entities, the I-distance between the two entities and $e_r = x_{1r}, x_{2r}, \ldots x_{kr}$ and $e_s = x_{1s}, x_{2s}, \ldots x_{ks}$ is defined as

$$D(r,s) = \sum_{i=1}^{k} \frac{\left| d_i \;\; r,s \right|}{\sigma_i} \prod_{j=1}^{i-1} 1 - r_{ji.12\ldots j-1} \qquad (1)$$

where $d_i(r,s)$ is the distance between the values of variable X_i for e_r and e_s, e.g. the discriminate effect,

$$d_i(r,s) = x_{ir} - x_{is} \quad i \in \{1, \dots k\} \tag{2}$$

σ_i the standard deviation of X_i, and $r_{ji.12\dots j-1}$ is a partial coefficient of the correlation between X_i and X_j, $j < i$ (Radojicic et al. 2012; Jeremic et al. 2013).

To overcome the problem of negative coefficient of partial correlation, which can occur when it is not possible to achieve the same direction of variables, it is suitable to use the square I-distance (Jeremic et al. 2011b). It is given as:

$$D^2(r,s) = \sum_{i=1}^{k} \frac{d_i^2(r,s)}{\sigma_i^2} \prod_{j=1}^{i-1} 1 - r_{ji.12\dots j-1}^2 \tag{3}$$

The I-distance measurement is based on calculating the mutual distances between the entities being processed, whereupon they are compared to one another so as to create a rank (Seke et al. 2013). It is necessary to fix one entity as a reference in the observed set using the I-distance methodology. The ranking of entities in the set is based on the calculated distance from the referent entity (Jovanovic et al. 2012).

3. ANALYSYS – CASE STUDY

The results of the I-distance method, as well as a comparison of the I-distance and the Expenditure R&D (% of GDP) ranking, are presented in Table 1. A total of 41 countries have been included in the analysis. As can be seen from Table 1, Korea, Japan and Switzerland are the countries that top the I-distance method list. Korea, which comes in first for the I-distance method, takes third place in the Expenditure R&D rank, and, while Israel tops the Expenditure R&D rank, it takes eighth place in the I-distance rankings. A very interesting finding is that several countries show major oscillations in ranks methods, far more than other countries.

Table 1: I^2-distance rank, Expenditure R&D rank and Rank change

Country	I^2-distance	Rank I^2-Distance	Expenditure R&D (% of GDP)	Rank Expenditure R&D	Change
Korea	31,986	1	3,74	3	-2
Japan	29,848	2	3,36	6	-4
Switzerland	26,621	3	3,37	4	-1
United States	25,419	4	2,77	10	-6
Finland	25,309	5	3,78	2	3
Denmark	23,513	6	3,09	7	-1
Sweden	23,318	7	3,37	5	2
Israel	22,704	8	4,39	1	7
Chinese Taipei	19,486	9	1,84	19	-10
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
Russia	1,654	39	1,12	33	6
Romania	1,562	40	0,48	39	1
Mexico	1,529	41	0,46	40	1

For the past six years, the R&D funding for the top ten countries have remained mostly the same. There has been dramatic change however, in the extent of globalization involved in research, as well as shifts in the way funds are spent. While 2013 R&D investment growth was minimal in the U.S. and Europe, growth in most Asian countries, especially China continued. Asian R&D investment growth rates are expected to return to their pre 2013 levels in 2014 and 2015. The exception to this outlook may be Japan, which is more correlated with trends in the U.S. and Europe than with neighbouring Asian countries (Grueber and Studt 2013). Thus, implementing this concept in the I-distance framework is of great significance, because the results confirmed this order and such predictions.

As has been previously implied, one of the main objectives this paper is to present the relevance of R&D indicators. Namely, the I-distance method uses ten indicators and places them into a specific order of importance. This allows for a better understanding of the ranking results of the I-distance method, as well as for a better comprehension of the differences between the I-distance and Expenditure R&D ranking. In that, it is essential to establish an order of importance for the indicators since it provides an answer to the question: "What *are the variables that are the most relevant for measuring the R&D level of countries?*" Accordingly, a Pearson correlation coefficient of each variable with the I-distance value has been calculated as to determine the significance of input variables. These correlations are presented in Table 2.

Table 2: Variable importance as measured by correlation with I-distance

Variables	Correlation with I-distance
GERD as a percentage of GDP	0,869
Business Enterprise Expenditure on R&D (BERD) as a percentage of GDP	0,828
GERD per capita population (current PPP $)	0,712
Percentage of GERD financed by industry	0,588
Basic research expenditure as a percentage of GDP	0,536
Total researchers per thousand total employment	0,480
Total R&D personnel per thousand total employment	0,466
Higher Education Expenditure on R&D (HERD) as a percentage of GDP	0,398
Number of patent applications to the PCT (priority year)	0,254
Higher Education researchers as a percentage of national total	0,168

The results show that the first three variables are significantly correlated to the I-distance measurement values. According to the results of our research, the most significant variable for determining R&D level appears to be *GERD as a percentage of GDP*, where r =0,869, p<0,001. Very high relevant positions are taken by the three important variables: *GERD as a percentage of GDP, Business Enterprise Expenditure on R&D (BERD) as a percentage of GDP, GERD per capita population*. It is essential for lower-ranked countries to improve these most significant R&D indicators in order to improve their overall position in the ranking process.

The most important indicator in composite index, which is used to enhancing R&D indicators of OECD countries, is *GERD as a percentage of GDP*, with r^2=0,869 (p<0,01). In addition, *Business Enterprise Expenditure on R&D (BERD) as a percentage of GDP* have an almost identical contribution to the composite index, with r^2=0,828 (p<0,01). It should also be noted that *GERD per capita population (current PPP $)* plays a significant role in composite index, with r^2= 0,712 (p<0,01) (Isljamovic et al.2013).

Table 3: Overview of the most significant R&D indicators for the top 4 high placed countries and other 4 with the highest change in rank

Country	GERD as a percentage of GDP	BERD as a percentage of GDP	GERD per capita population
Korea	4,36	3,09	1307,77
Japan	3,34	2,61	1190,44
Switzerland	2,87	2,17	1364,96
United States	2,79	1,95	1443,13
Israel	4,20	3,54	1231,44
Chinese Taipei	3,07	2,28	1178,06
Russia	1,12	0,65	264,61
Slovakia	0,82	0,34	212,77

Table 3. presents the results of the three most significant indicators for the first four countries and those that have had the greatest change in rank respectively. We have previously seen that in the first place is situated Korea. Progress of two positions is explained by the fact that Korea has the best results for the three most important variables which leads to the first place in the I-distance ranking. Second place belongs to Japan. By achieving 2,61% *BERD as a percentage of GDP*, as one of the key indicators, Japan has progressed for

four places. As Japan is one of the leading economic powers, this result is not so surprising. Good results by all indicators, without major oscillations bring Switzerland in third place. This represents an improvement of one position. A very interesting progress from ten to fourth place achieved United States. Although there is an average *BERD as a percentage of GDP* for that position, what stands out and leads to a high position is the most accomplished *GERD per capita population* of 1443,13. In I-distance ranking Korea, Switzerland and Finland have kept a place in the top five countries. The most significant decline was recorded by Israel, having fallen from first to eighth position. Although it has good results in key indicators, very bad *Percentage of GERD financed by industry* has proven to be crucial stumbling point. By observing the poor ranking of countries, we noticed two great progresses of China and Slovakia for nine and ten position respectively. As you can see in the table 3, the reason for this rise of Chinese Taipei is located in very good results in all major indicators, while other indicators have larger oscillations. From all observed, we concluded that the use of I-distance method realized a more reliable ranking, since including far more R&D indicators than previous methodologies This has helped to clear up image, which countries such as Chinese Taipei and Slovakia have taken a much greater position than they previously had. We have noted that in addition to Finland, Switzerland and Korea which took the top five countries, have found also Japan and United States, although they had previously significant the lower positions. All other countries have had a slight change in the ranks.

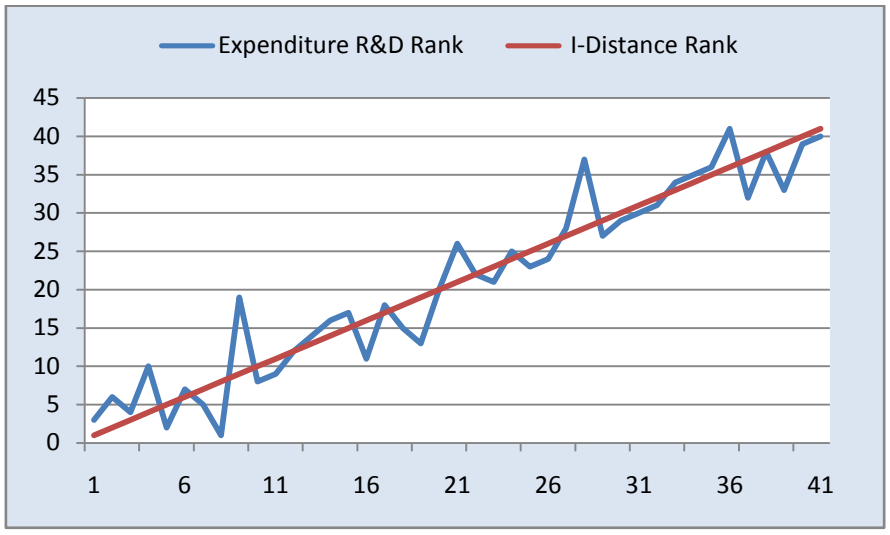

Figure 1: I-distance ranks and Expenditure R&D ranks

What we can see on the Figure 1. is the existence of several peaks, which are located below the red line, representing I-distance rank. These peaks represent Expenditure R&D rank, regarding a decline in the number of ranking positions to the I-distance rank. With the other hand we have two peaks one at the beginning which is a ascent Chinese Taipei from the 19th to the 9th position and another Slovak Republic from 37th to 28th position. However, the chart provides a better look at the relationship I-distance rank and Expenditure R&D rank.

4. CONCLUSION

Broadly speaking, innovation has become foundation for human progress. In today's world, ~~"~~We owe our existence to innovation. We owe our prosperity to innovation… We owe our future to innovation… Innovation isn't a fad—it's the real deal, the only deal. Our future no less than our past depends on innovation." (Hamel 2012)

So, a common indicator used to measure R&D investments across countries is represented by GERD: Gross Domestic Expenditures on Research and Development as a percentage of Gross Domestic Product (GDP) (R. Griffith, E. Huergo, J. Mairesse, B. Peters 2006). In this paper we have also showed the other crucial indicators for the relevant findings. False, incomplete or vague information causes confusion and mistaken investment decisions. If the governments want to improve the country rank, they need to invest in crucial variables.

Since the integration of R&D indicators into general development is an obvious necessity, we proposed the I-distance framework for evaluating and potentially enhancing R&D indicators of OECD countries. Our results emphasized the importance of Expenditure on R&D by incorporating the *GERD as a percentage of GDP*, *Business Enterprise Expenditure on R&D (BERD) as a percentage of GDP* and *GERD per capita population*.

Precisely those variables proved to be essential part of the I-distance framework for enhancing R&D indicators.

In I-distance ranking Korea, Switzerland and Finland have kept a place in the top five countries. As previously mentioned, while 2013 R&D investment growth was minimal in the U.S. and Europe, growth in most Asian countries, especially China, continued. The exception to this outlook may be Japan, which is more correlated with trends in the U.S. and Europe. Thus, implementing this concept in the I-distance framework is of great significance, because the results confirmed this order and such predictions. In addition to Finland, Switzerland and Korea which took the top five countries, have found Japan and United States, although they had previously significant the lower positions, which also shows the quality of our model.

In order to create a real, objective index of R&D indicators, we use the I-distance method which can easily integrate variables with different measurement units into one composite indicator. Moreover, our approach could be a foundation for an appropriate framework for evaluation and enhancing R&D indicators which might be in every way independent from subjectively formed weighting factors. We would also like to point out that the I-distance method proved to be quite useful in the first phases of research and that it emphasized important variables and provided us with the foundations for further elaboration of R&D indicators.

REFERENCES

"About.com Economics Glossary". Retrieved 27 Apr 2013

Arndt, S., Acion, L., Caspers, K., Blood, P.: How reliable are county and regional health rankings?. Prev. Sci. 14(5), 497–502 (2013). doi:10.1007/s11121-012-0320-3

Brüggemann, R., Patil, G.P.: Ranking and Prioritization for Multi-indicator Systems. Springer, Dordrecht (2011)

Business and Industry Advisory Committee to the OECD, CREATIVITY, INNOVATION AND ECONOMIC GROWTH IN THE 21st CENTURY

Cahuc, P., Carcillo, S., Rinne, U., Zimmermann, K.F.: Youth unemployment in old Europe: the polar cases of France and Germany. IZA J. Eur. Stud. 2(1), 18 (2013). doi:10.1186/2193-9012-2-18

Cameron, A.J. van Stralen,M.M., Kunst, A.E. te Velde, S.J., van Lenthe, F.J., Salmon, J.O., Brug, J.:Macroenvironmental factors including GDP per capita and physical activity in Europe.Med. Sci. Sports Exerc. 45(2), 278–285 (2013). doi:10.1249/MSS.0b013e31826e69f0

Campbell, N., Saha, S.: Corruption, democracy and Asia-Pacific countries. J.Asia PacificEcon. 18(2), 290–303 (2013). doi:10.1080/13547860.2013.778156

Campisi, D., de Nicola, A., Farhadi, M., Mancuso, P.: Discovering the impact of ICT, FDI and human capital on GDP: a cross-sectional analysis. Int. J. Eng. Bus. Manag. 5, 46 (2013). doi:10.5772/56922

Chew, H.E., Ilavarasan, P.V., Levy,M.R.: The Economic Impact of information and communication technologies (ICTs) on microenterprises in the context of development. EJISDC 44(4), 1–19 (2010)

Costanza, R., Kubiszewski, I., Giovannini, E., Lovins, H., McGlade, J., Pickett, K.E., Ragnarsdóttir, K.V., Roberts, D., De Vogli, R., Wilkinson, R.: Time to leave GDP behind. Nature 505, 283–285 (2014)

Cracolici, M.F., Cuffaro, M., Nijkamp, P.: The measurement of economic, social and environmental performance of countries: a novel approach. Soc. Indic. Res. 95(2), 339–356 (2010)

D'Acci, L.: Measuring well-being and progress. Soc. Indic. Res. 104(1), 47–65 (2011)

Diebolt, C.,Mishra, T., Ouattara, B., Parhi,M.: Democracy and economic growth in an interdependent world. Rev. Int. Econ. 21(4), 733–749 (2013). doi:10.1111/roie.12067

Diener, E., Suh, E.: Measuring quality of life: economic, social and subjective indicators. Soc. Indic. Res. 40, 189–216 (1997)

Dobbie, M.J., Dail, D.: Robustness and sensitivity of weighting and aggregation in constructing composite indices. Ecol. Indic. 29, 270–277 (2012)

Dobrota, M., Jeremic, V., Markovic, A.: A new perspective on the ICT development index. Info. Dev. 28(4), 271–280 (2012)

Farhadi, M., Salehi, H., Embi,M.A., Fooladi, M., Farhadi, H., Chadegani, A.A., Ebrahim, N.A.: Contribution of information and communication technology (ICT) in country's H-index. J. Theor. Appl. Info. Tech. 57(1), 122–127 (2013)

"Glossary:R & D intensity". Eurostat. Retrieved 13 December 2013.

Griffith, R., Huergo, E., Mairesse, J., P, B., : Innovation and productivity across four European countries, OXFORD REVIEW OF ECONOMIC POLICY, DOI: 10.1093/oxrep/grj028

Griffith, R., Huergo, E., Mairesse, J., P, B., : Innovation and productivity across four European countries, OXFORD REVIEW OF ECONOMIC POLICY, DOI: 10.1093/oxrep/grj028

Gross Domestic Expenditures on Research and Development in Canada (GERD), and the Provinces

Grueber, M., Studt, T.,: 2014 GLOBAL R&D FUNDING FORECAST, R&D Magazine, December 2013

Guttorp, P., Kim, T.Y.: Uncertainty in ranking the hottest years of US surface temperatures. J. Climate 26(17)6323–6328 (2013). doi:10.1175/JCLI-D-12-00760.1
Handbook on constructing composite indicators: methodology and user guide – isbn 978-92-64-04345-9 - © OECD 2008
Hamel Gary: What Matters Now: How to Win in a World of Relentless Change, Ferocious Competition, and Unstoppable Innovation, John Wiley & Sons, 2012
Hauner, D., Kyobe, A.: Determinants of government efficiency.World Dev. 38(11), 1527–1542 (2010). doi:10.5755/j01.ee.23.2.1546
Huarng, K.H.: A comparative study to classify ICT developments by economies. J. Bus. Res. 64(11), 1174–1177 (2011). doi:10.1016/j.jbusres.2011.06.18
Isljamovic, S., Jeremic, V., Petrovic, N., Radojicic, Z.,: Colouring the socio-economic development into green: I-distance framework for countries' welfare evaluation, Qual Quant DOI 10.1007/s11135-014-0012-0
ITU. http://www.itu.int/en/ITU-D/Statistics/Pages/default.aspx (2013). Accessed 15 January 2014
Ivanovic, B.: Classification Theory. Institute for Industrial Economic, Belgrade (1977)
Jeremic, V., Bulajic, M., Martic, M., Radojicic, Z.: A fresh approach to evaluating the academic ranking of world universities. Scientometrics 87(3), 587–596 (2011a)
Jeremic, V., Isljamovic, S., Petrovic, N., Radojicic, Z., Markovic, A., Bulajic, M.: Human development index and sustainability: What's the correlation? Metal. Int. 16(7), 63–67 (2011b)
Jeremic, V., Bulajic, M., Martic, M., Markovic, A., Savic, G., Jeremic, D., Radojicic, Z.: An evaluation of European countries health systems through distance based analysis. Hippokratia 16(2), 170–174 (2012)
Jeremic, V., Jovanovic-Milenkovic, M., Martic, M., Radojicic, Z.: Excellence with leadership: the crown indicator of SCImago institutions rankings IBER report. Profesional de la Informacion 22(5), 474–480 (2013)
Jovanovic, M., Jeremic, V., Savic, G., Bulajic, M., Martic, M.: How does the normalization of data affect the ARWU ranking? Scientometrics 93(2), 319–327 (2012)
Kubiszewski, I., Constanza, R., Franco, C., Lawn, P., Talberth, J., Jaskson, T., Aylmer, C.: Beyond GDP: measuring and achieving global genuine progress. Ecol. Econ. 93, 57–68 (2013). doi:10.1016/j.ecolecon.2013.04.19
Mahdavi, S., Alanis, E.: Public expenditures and the unemployment rate in the American states: panel evidence. Appl. Econ. 45(20), 2926–2937 (2013). doi:10.1080/00036846.2012.690849
Markusen, J.: Putting per-capita income back into trade theory. J. Int. Econ. 90(2), 255–265(2013). doi:10.1016/j.jinteco.2013.04.03
Mendola, D., Scuderi, R., Lacagnina, V.: Defining and measuring the development of a country over time: aproposal of a new index. Qual. Quan. 47(5), 2473–2494(2013). doi:10.1007/s11135-012-9665-8
Moffat, I.: Ecological footprints and sustainable development. Ecol. Econ. 32(3), 359–362 (2000)
OECD Factbook 2013: Economic, Environmental and Social Statistics
Paruolo, P., Saisana, M., Saltelli, A.: Ratings and rankings: voodoo or science?. J. R. Stat. Soc. 176(3), 609–634(2013). doi:10.1111/j.1467-985X.2012.01059.x
Petrosillo, I., Costanza, R., Aretano, R., Zaccarelli, N., Zurlini, G.: The use of subjective indicators to assess how natural and social capital support residents' quality of life in a small volcanic island. Ecol. Indic. 24(1), 609–620 (2013)
Radojicic, Z., Isljamovic, S., Petrovic, N., Jeremic,V.:Anovel approach to evaluating sustainable development.Problem Ekorozwoju - Probl. Sustain. Dev. 7(1), 81–85 (2012)
Radojicic, Z., Jeremic, V.: Quantity or quality: What matters more in ranking higher education institutions? Curr. Sci. 103(2), 158–162 (2012)
Ram, R.,Ural, S.: Comparison of GDPper capita Data in PennWorld Table and World Development Indicators.Soc. Indic. Res. 1–8 (2013). doi:10.1007/s11205-013-0284-0
Saisana, M., D'Hombres, B.: Higher education rankings: robustness issues and critical assessment. How much confidence can we have in higher education rankings? EUR23487, Joint Research Centre, Publications Office of the European Union, Italy. (2008). doi:10.2788/92295
Saisana, M., D'Hombres, B., Saltelli, A.: Rickety numbers: volatility of university rankings and policy implications. Res. Policy 40(1), 165–177 (2011). doi:10.1016/j.respol.2010.09.03
Saisana, M., Tarantola, S.: State-of-the-art report on current methodologies and practices for composite indicator development, EUR Report 20408 EN. European Commission, JRC-IPSC, Italy (2002)
Saltelli, A., Ratto, M., Andres, T., Campolongo, F., Cariboni, J., Gatelli, D., Saisana, M., & Tarantola, S.: Introduction to Sensitivity Analysis. In Global Sensitivity Analysis: The Primer, vol. 304, pp. 569. Wiley, Chichester (2008). doi:10.1002/9780470725184.ch1
Saltelli, A.: Composite indicators between analysis and advocacy. Soc. Indic. Res. 81, 65–77 (2007)
Seke, K., Petrovic, N., Jeremic,V.,Vukmirovic, J.,Kilibarda,B., Martic, M.: Sustainable development and public health: rating European countries. BMC Public Health 13(1), 77 (2013). doi:10.1186/1471-2458-13-77

Soo, K.T.: Does anyone use information from university rankings? Edu. Econ. 21(2), 176–190 (2013)
Tarantola, S., Saltelli, A.: Composite indicators: the art of mixing apples and oranges. In: Munnich, R. (ed.) Composite Indicators - Boon or Bane. Statistisches Bundesamt, Germany (2007)
UNDP, Human development report. United Nations Development Program (2008)
Weiner, S.A.: Overview: the role of information policy in resolving global challenges. GPRI Policy Briefs 1(1), 6 (2013)
World Bank. http://data.worldbank.org/data-catalog/world-development-indicators (2013). Accessed 3 March 2014
Zhang, C.: Money, housing, and inflation in China. J. Policy Model. 35(1), 75–87 (2013). doi:10.1016/j.jpolmod.2012.04.06.

THE ROLE OF SPORT IN ECONOMY

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Abstract: *This paper deals with the relation of the level of GDP per capita and the total revenue in four major sport leagues in USA as the most developed sport market in the world. Business linked with sport is one of the most important and profitable parts of developed economy. Sport as an average individual perceives it today is a modern phenomenon of sophisticated approaches in marketing on the one and the expectances of profits from the investors on the other side. In this paper we prove there is a relation between the change of GDP per capita and total revenues in four major USA leagues. The results of this study show new insights to the perception of sport and can be a good indicator for further researches on that field.*

Keywords*: Sport industry, GDP per capita, economy, entrepreneurship, marketing, USA sport league*

1. INTRODUCTION

The main purpose of this paper was to illustrate the connection between sport industry and economy today. Current research focuses on the American sport market because the concept of private ownership reflects in their sport industry the most, relative to other countries. In other parts of the world government is much more involved in the ownership of sport entities but private investors are interested in commercially attractive sports. Other reason for choosing USA sport market is the fact the sport business is the most developed in there. Further, based on Forbes (2014) American sport companies have been found as one of the most valuable brands worldwide in 2013:

- 1. Nike Brand Value: $ 17,3 billion,
- 2. ESPN Brand Value $ 15 billion,
- 5. Under Armour Brand Value $3,7 billion etc.

The relationship between sports and the economy dates back to the first antique Olympic Games when athletes were compensated in either goods or species (Andreff, 2008). Then after sport was not very common phenomenon for some time. According to Ratten (2011) the entrepreneurship and sport management disciplines have grown significantly again in the past decade and further, entrepreneurship is an integral part of sports management and creates a competitive advantage for people and organizations involved in sport. This is somehow not surprising since in recent years renewed attention has been given to the role of entrepreneurship in economic development (Wennekers and Thurik, 1999) or as Ball (2005) argued it has become 'flavour of the month' both in practice and in the development of policy in political, industrial, educational and other setting. It is further recognized that the entrepreneurial process should lead to economic growth with the creation of successful growing companies like Microsoft, Intel and Sun Microsystems among others (Acs and Varga, 2005). From that view entrepreneurship is a necessary condition for economic growth and development (Cucculelli, 2012; Guloglu and Tekin, 2012; Audretsch et al., 2008). In this paper entrepreneurship is concerned as an interest of the individuals and groups in financing sport business in order to make a profit for investors.

This is an exciting time for sport industry around the globe. Not only sport is a multibillion dollar industry (many times over and still growing), but research that examines the management of sport in its various forms is expanding (Parent and Slack, 2007). Sport-related research can now be found in numerous subdisciplines within economics, including industrial organization, labor economics, and public finance (Kahane, et al. 2013). According to Humphreys and Ruseski (2008) several frameworks for defining the sports industry have been proposed; much of this research emerged from Europe, where government policymakers took an interest in estimating the overall economic importance of sport several decades ago:

- Gratton (1998) discusses a general method for estimating the economic scope of the sports industry, and points out that economic interest in sport extends well beyond the boundaries of professional sports. Gratton's (1998) approach uses existing national income and product accounting methods, essentially combing through existing national accounts data to identify sport-related sub-industries and aggregating across them;
- Davies (2002a, 2002b) adopts one national accounts approach, value added, to estimate the contribution of sport to the local economy in Sheffield, England.

In the course of time, sports industry started to grow and has become an important part in the business environment, thus inducing the interest of enterprises and investors. They saw in the sports industry a potential for growth and an opportunity for profits. Economics and finance adopt an instrumentalist notion of rationality in which the allocation of resources is the means (i.e., inputs) by which individuals and organizations seek to attain the end of maximizing their economic well-being (i.e., outputs) (Parent and Slack, 2007).

The most interested parts in financing the sports business are direct investors as also entrepreneurs that distribute and manufacture services and equipment related to professional or recreational sport. Further an interest in organizing sport events is seen also in governments that candidate for different challenges, from Olympic Games to World championships. According to Andreff (2008) the most features of the sports economy today are represented by: (1) sport shows and (2) sports mega-events. Indeed, it is impossible to separate the growth of corporate and government interest in the hosting of mega-events and the media discourse on place competitiveness from the commercialization of sport on a global scale and advances in communication technology (Whitson, 1998; Barney et al., 2002; Coles, 2003; Hall, 2006). Local, national, and international events have molded the sport industry into a shape not seen before (Hums, 2010).

Based on our literature review there seems to be, on the one hand an interest for many scholars for studying sport (e.g. Nicolau, 2011; Staurowsky et al. 2013; Taylor and McGraw 2006) and on the other hand for studying economic growth (e.g. Lewis, 2013; Kilian and Hicks, 2013; Kim and Kim, 2014) but the relation between sport industry income and economic growth measured as a change of GDP per capita till this research stayed an unexplored topic. Since Reynolds et al. (2000) claimed there is a correlation between the level of entrepreneurship (we propose that investors in sport business are mostly entrepreneurs) and between the growth of economy this paper tried to fill a literature gap on the field of GDP per capita and growth of sport business in USA.

There exists very little literature that uses the sports industry to study teammate effects in firms (Kahane, et al. 2013). So current study examines revenues of franchises in four most important sport leagues in USA; NBA, NHL, NFL, and MLB. We compared and examined the correlation between the growth of GDP p.c. and the revenue of franchises total income (gate revenues, sponsors, advertising, sale of merchandise etc.). The purpose of the paper was to examine the relation between the growth of economy, measured as GDP per capita with the growth of sport franchises measured as total revenue and set a theoretical platform for the further research.

2. THE DEVELOPMENT OF SPORT

Professional sports have emerged as a lucrative business, with many opportunities for sports marketers to flourish (Mason, 1999). Today sport as a whole concept is a business which affects us, even if we are not active athletes. For instance, many people buy clothes from sports companies that have transparent logos on the most visible places, computer games (FIFA, NBA live, Formula 1, etc), equipment, watches, and other products. As a condition for that, professional sports leagues provide a unique environment for marketing decisions and processes to occur, in a number of markets and at a number of levels, and should continue to be a growing segment within the broader, global, entertainment industry (Mason, 1999).

Organized sport has become an inevitable part of modern life. There are many definitions of sport; Westenbeek and Smith (2003) give following characteristics of sport:

- it has defined rules,
- it has complex organizational structure,
- it has a physical component included in the game,
- equipment and an appropriate playground are necessary,
- uncertainty is always present – there is always a chance of victory and defeat,
- modern sport demands cooperation and opposition.

Because of many specifics that are related to sport today, there is also another well-known definition of sport according to Parks et al. (1998) who defined sport as activity, experience or enterprise that is in correlation to fitness, recreation, professional sport or free time. Sport is very broad phenomenon. It can be on the one hand dance or jogging and on the other hand wrestling or chess. The sports industry's core sources of revenue can be divided into three main categories: broadcast rights, sponsorships (including licensing and merchandising), and ticketing and hospitality (such as entertainment and catering in sports venues) (Forbes, 2014). Nations, regions, cities and corporations have used mega-events to promote a favorable image in the international tourist, migration and business marketplace (Ritchie and Beliveau, 1974; Law, 2000; Malecki, 2004; Hall, 2006).

Professional sport industry is more regulated than recreational sport industry and has a different income structure. Income in professional sport comes from advertising, sponsorships, broadcasting rights, licenses, etc. It has become an industry which has the same »rules« as other industries. There must be multiple factors which can enable growth. Hardy (1986) defined three key factors of professional sport development:

- Sport product;
- Role of entrepreneurs and investors in product development;
- Types of different organizations and networks created by entrepreneurs.

An important role in the development of sport had also banks. Mandell (1984) stated that banks in USA played an important role in growth of sport industry by being flexible enough to finance new and poorly known industry. Beside this fact, which is true mostly in the later phases of sport industry development, the main credit for the success of sport industry is accorded to individuals who had a vision and saw an opportunity in investing in sport. Banks and other institutions played a more important role by financing franchises and enterprises and in this way accelerated the growth and enlarged the part of sport industry in the overall economy.

Profit seeking promoters and investors over-ran »hobby« investors and their organization became dominant in some sport (Hardy 1986). Sooner or later various leagues in the same sport merged in order to achieve larger market. Regardless of whether we observe NBA, MBL, NHL or NFL, they all have one thing in common; they were created by individuals (or group of individuals) who saw a business opportunity in sport. However, with increasing corporate involvement, an American model of private ownership is now influencing professional sport throughout the world (Nauright and Phillips, 1997).

2.1 Sport industry

There are several factors that potentially distinguish professional sports from other businesses, including stadium lease arrangements, monopolistic bargaining for broadcasting rights, territorial rights in predetermined geographic markets, and the capital depreciation of player contracts (Daly, 1977; Noll, 1974; Zorn, 1994). Based on development of sport organization we separate countries on four categories (Westerbeek and Smith, 2003):

- Highly developed: USA;
- Developed: West and middle Europe, Canada, Japan, Australia;
- In the process of development: South America, east Europe, China, India, and some South Africans countries;
- Undeveloped: Economically undeveloped countries, Africa, Asia.

Sport in general is a mix of different determinants as are equipment for practicing sports, related services (from services related to equipment to food services), sponsorship services (communication with potential buyers), promotion of health life and fair play etc.

3 ECONOMY AND SPORT

3.1 GDP per capita

Gross domestic product (GDP) is the monetary, market value of all final goods and services produced in a country over a period of a year and thus implicitly, and often even explicitly, identified with social welfare – witness the common substituting phrase ‘standard of living’ (van den Bergh, 2007). The real GDP (Gross domestic product) per capita is concerned as the most used indicator in defining the position of one economy over time or relative to that of other countries.

Guest and McDonald (2007) point out that the share in global GDP of a region is of interest because it indicates, to some extent, the economic, political and cultural importance of that region. Nevertheless, GDP deserves its special status because it represents an important bottom line: how much the market economy produces, and what it is worth (Boyd, 2007). In this study a GDB per capita purchasing power index was used. The objective behind a calculation of GDP per capita is to quantify the average amount of goods and services available to each person in an economy (Angeles, 2008).

3.2 Sport business

Entrepreneurship is a driver of change, innovation and employment in these industries and is crucial to meeting the rapidly changing demands of hospitality, leisure, sports and tourism consumers (Ball, 2005). Entrepreneurship is an important force behind success in any industry so in that manner also in sport.

According to Schumpeter's definition of an entrepreneur as an innovator, we could define James Naismith as an entrepreneur. In the 1892 he »invented« basketball – a basic product being a game, which nowadays involves a multi-billion industry. Money in that industry is generated by selling tickets, sport equipment, broadcasting rights, advertising, etc. on the one hand the invention itself it is not enough, for becoming an industry it needs to be organized, it needs promotion, league, rules and other definitions on the other hand. Then certain sport becomes a product which can be sold. A sport that can be sold in a form of a game ticket, broadcasting right, advertising space, and the name of the club becomes a brand with a value and can be sold to investors.

At one point the club owners and promoters noticed that people are prepared to pay for watching the game. The point where a spectator is prepared to pay for watching the game is the point where sport becomes a product (Hardy, 1986). This means that people are willing to trade money for their participation and satisfaction of their needs.

In this research we chose four major leagues in USA because they are the most prominent in the world, there play the best players from the entire world and these leagues are the most commercialized worldwide. The definitions of these leagues according to the data from their official websites are:

- MLB - Major League Baseball is the highest level of play of baseball in northern North America. It consists of the National League (founded in 1876) and the American League (founded in 1901).
- NBA - The National Basketball Association is the premier basketball league. It was founded as the Basketball Association of America in 1946, and adopted its current name in 1949, when the BAA partially absorbed the rival National Basketball League.
- NFL - The National Football League was founded in 1920 as a combination of various teams from regional leagues such as the Ohio League, the New York Pro Football League, and the Chicago circuit. The NFL partially absorbed the All-America Football Conference in 1949 and merged with the American Football League in 1970.
- NHL - The National Hockey League was founded in 1917 as a breakaway league from the Canadian National Hockey Association (founded 1909), taking all but one of the NHA's teams. The NHL partially absorbed the rival World Hockey Association in 1979. There are 30 teams, with 23 in the U.S. and 7 in Canada.

4. METODOLOGY

Based on the upper theory the following hypotheses were formulated:

H1: Total revenue in MLB is positively related to GDP p. c. in USA.
H2: Total revenue in NBA is positively related to GDP p. c. in USA.
H3: Total revenue in NFL is positively related to GDP p. c. in USA.
H4: Total revenue in NHL is positively related to GDP p. c. in USA.

The selected period for research was chosen for nine years from 2004 to 2012. The data for a research were gathered from an online free public bases. The data for GDP per capita p.p. in USA were gathered on the web site of the CIA (2014). This data show GDP on a purchasing power parity basis divided by population as of 1 July for the same year.

Table 1: GDP p.c. in USD in 10^3

Year	GDP p.c. in USD in 10^3
2004	40,1
2005	41,6
2006	44,0
2007	45,8
2008	46,9
2009	46,0
2010	47,2
2011	49,0
2012	52,4

The data for total revenue for four major leagues in USA were gathered on Forbes (2014). Forbes is an American business magazine owned by Forbes, Inc. published biweekly and it features original articles on finance, industry, investing, and marketing topics. When the data were not available on Forbes we gather the data from the official web sites of four major leagues in USA (MLB, NBA, NFL, NHL, 2014).

Table 2: Total revenue in four major leagues in USA in 10^9 USD

League/Year	2004	2005	2006	2007	2008	2009	2010	2011	2012
MLB	4,3	4,7	5,1	5,5	5,8	6,6	7	7,2	7,5
NBA	2,9	4,2	3,4	3,6	3,8	4	4,7	4,9	5
NFL	6	6,2	6,5	7,1	7,6	8,5	9,3	9,4	9,5
NHL	2,2	2,2*	2,3	2,4	2,7	2,7	2,9	3,2	3,3
Sum	15,4	17,4	17,3	18,6	19,9	21,8	23,9	24,7	25,3

**due to a strike in NHL in 2005 we took the arithmetic mean of 2004 and 2006 values*

5. RESULTS

A regression analysis was used to determine the strength of the relationship between the independent variable GDP p.c. and other dependent variables (total revenues in four major USA leagues) in statistical analytical program SPSS for Windows.

Table 3: Statistics for variables

		GDP p.c.	MLB	NBA	NFL	NHL	SUM
N	Valid	9	9	9	9	9	9
	Missing	0	0	0	0	0	0
Mean		45,8889	5,9667	4,0556	7,7889	2,6556	20,4778
Median		46,0000	5,8000	4,0000	7,6000	2,7000	19,9000
Mode		40,10[a]	4,30[a]	2,90[a]	6,00[a]	2,20[a]	15,40[a]
Std. Deviation		3,71330	1,15758	,71434	1,42342	,41567	3,60131

The frequencies for the variables are shown in Table 3. The highest mean value among four major leagues in USA has NFL (7,78 in 10^9 USD) and the lowest NHL (2,65 10^9 USD).

Table 4: Regression Model Summary

Model	League	Adjusted R Square	Standardized Coefficients Beta	t	Sig.
1 (constant) GDP p.c.	MLB	,837	,926	6,481	,000
	NBA	,565	,787	3,378	,012
	NFL	,765	,891	5,201	,001
	NHL	,856	,935	6,976	,000

The results of the regression analysis show that all four hypotheses were confirmed.

H1: Total revenue in MLB is positively related to GDP p. c. in USA.
The relationship was found positive, high and significant (stand. coefficient 0. 926), with variance explained of 83,7%. T- test value was found as good (t = 6,481) and show that the relation is statistically significant at Sig. = 0,000.

H2: Total revenue in NBA is positively related to GDP p. c. in USA..
The relationship was found positive, high and significant (stand. coefficient 0. 787), with variance explained of 56,5 %. T- test value was found as good (t = 3,378) and show that the relation is statistically significant at Sig. = 0,012.

H3: Total revenue in NFL is positively related to GDP p. c. in USA.
The relationship was found positive, high and significant (stand. coefficient 0. 891), with variance explained of 76,5 %. T- test value was found as good (t = 5,201) and show that the relation is statistically significant at Sig. = 0,001.

H4: Total revenue in NHL is positively related to GDP p. c. in USA.

The relationship was found positive, high and significant (stand. coefficient 0. 935), with variance explained of 85,6 %. T- test value was found as good (t = 6,976) and show that the relation is statistically significant at Sig. = 0,000.

The results show that the relation between the growth of GDP per capita and total revenues of franchises in four largest US sport leagues is positive and very strong.

5. CONCLUSION

Sport is a dynamic business which changes constantly. On the one side the sport business tries to fulfill the needs on the market and satisfy expectations from the crowds. Thus on the other site inventors or the leading individuals in certain sport invent new games, new rules and new products or services related to that sport. When people follow new game it has a potential to become a promising business. In the frames of increasing the volume of sport industry, marketing and world known sport stars contribute to the revenue of sport organizations and realization of the aims. Entrepreneurial approach is crucial for development, promotion and commercialization of new sport. Sport and the story behind have big impact on people. Not only that people spend hours watching their favorite team or an individual but they are also prepared to invest their money to be a part of the story.

In current study we showed that the total revenue in four major leagues in USA is dependent from GDP per capita. This is not surprising since more money will people have the more will be able to spend also for sport.

Like every study, this one also has some limitations. One of them could be the fact that in current statistical analysis we used total revenue from four major USA leagues. It would make sense to develop the model with all incomes from all sport business in one country and compare it with GDP p.c. Another limitation could be the fact that this study could not be applied to all countries because of different popularity of different sport (e.g. soccer is popular in Europe vs. baseball is popular in USA). But these limitations present further research opportunities. Next research should be done with the integration of sport industry as a whole business and the comparison of the situations on different markets.

REFERENCES

Acs, Z. J., & Varga, A. (2005). Entrepreneurship, agglomeration and technological change. *Small Business Economics, 24(*3), 323-334.

Andreff, W. (2008). Globalization of the sports economy. *Rivista di diritto ed economia dello sport*, *4*(3), 13-32.

Angeles, L. (2008). GDP per capita or real wages? Making sense of conflicting views on pre-industrial Europe. *Explorations in Economic History*, *45*(2), 147-163.

Audretsch, D. B., Bönte, W., & Keilbach, M. (2008). Entrepreneurship capital and its impact on knowledge diffusion and economic performance. *Journal of Business Venturing, 23*(6), 687-698.

Ball, S. (2005). The importance of entrepreneurship to hospitality, leisure, sport and tourism. *In Hospitality, Leisure, Sport and Tourism Network,1,* 1-14.

Barney, R.K., Martyn, S.G. & Wenn, S.R. (2002) *Selling the Five Rings: The International Olympic Committee and the Rise of Olympic Commercialism*. Salt Lake City: University of Utah Press.

Boyd, J. (2007). Nonmarket benefits of nature: What should be counted in green GDP?. *Ecological economics*, *61*(4), 716-723.

CIA (2014, April). Central Intelligence Agency. Retrieved from https://www.cia.gov

Coles, T. (2003). Urban tourism, place promotion and economic restructuring: the case of post socialist Leipzig, *Tourism Geographies, 5*(2), 190–219.

Cucculelli, M. (2012). Family Firms, Entrepreneurship and Economic Development. *Economia Marche-Journal of Applied Economics*, *31*(2), 1-8.

Daly, J. C. (1977). *Pro Sports--should Government Intervene?: A Round Table Held on February 22, 1977, and Sponsored by the American Enterprise Institute for Public Policy Research, Washington*. The Institute.

Davies, L. (2002a). Consumers' expenditure on sport in the UK: increased spending or underestimation? *Managing Leisure, 7*(1), 83-102.

Davies, L. (2002b). Sport in the city: Measuring economic significance at the local level. *European Sport Marketing Quarterly, 2*(1), 83-112.

Forbes (2014, April). Information for the World's Business Leaders. Retrieved from http://www.forbes.com

Gratton, C. (1998). The economic importance of modern sport. *Culture, Sport and Society,1*(1), 101-117.

Guest, R. S., & McDonald, I. M. (2007). Global GDP shares in the 21st century—An equilibrium approach. *Economic Modelling*, *24*(6), 859-877.

Guloglu, B. & Tekin, R.B. (2012). A panel causality analysis of the relationship among research and development, innovation, and economic growth in high-income OECD countries. *Eurasian Economic Review, 2*(1), 32-47.

Hall, C. M. (2006). Urban entrepreneurship, corporate interests and sports mega-events: the thin policies of competitiveness within the hard outcomes of neoliberalism. *The Sociological Review*, *54*(2), 59-70.

Hardy, S.H. (1986). Entrepreneurs, Organizations, and the Sport Marketplace: Subjects in Search of Historians. V S.W. Pope (ur.). *In The New American Sport History, Recent Approaches and Perspectives Illinois*, University of Illinois, p. 341-365.

Humphreys, B. R., & Ruseski, J. (2008). The size and scope of the sports industry in the United States. In *IASE Conference Papers* (Vol. 833). International Association of Sports Economists.

Hums, M. A. (2010). The Conscience and Commerce of Sport Management: One Teacher's Perspective. *Journal of Sport Management*, *24*(1), 1-9.

Kahane, L., Longley, N., & Simmons, R. (2013). The effects of coworker heterogeneity on firm-level output: assessing the impacts of cultural and language diversity in the National Hockey League. *Review of Economics and Statistics*, *95*(1), 302-314.

Kilian, L., & Hicks, B. (2013). Did unexpectedly strong economic growth cause the oil price shock of 2003–2008?. *Journal of Forecasting*, *32*(5), 385-394.

Kim, T. Y., & Kim, S. (2014). The Catch-Up Illusion: Why Developing Nations that Experience Rapid Economic Growth Can Never Catch Up with Advanced Countries. In *Economic Growth* (pp. 237-261). Springer Berlin Heidelberg.

Law, C.M. (1993). *Urban Tourism: Attracting visitors to large cities*. London: Mansell.

Lewis, W. A. (2013). *Theory of economic growth* (Vol. 7). Routledge.

Malecki, E.J. (2004). Jockeying for position: What it means and why it matters to regional development policy when places compete. *Regional Studies, 38*(9), 1101–1120.

Mandell, R. (1984). *Sport: A Cultural History*. New York: Columbia University Press, 58-59.

Mason, D. S. (1999). What is the sports product and who buys it? The marketing of professional sports leagues. *European Journal of Marketing*,*33*(3/4), 402-419.

MLB (2014, April). Major League Baseball. Retrieved from http://www.mlb.com

Nauright, J., & Phillips, M. G. (1997). Us and them: Australian professional sport and resistance to North American ownership and marketing models. *Sport Marketing Quarterly, 6*(1), 33-40.

NBA (2014, April). The National Basketball Association. Retrieved from http://www.nba.com

NFL (2014, April). The National Football League. Retrieved from http://www.nfl.com

NHL (2014, April). The National Hockey League. Retrieved from http://www.nhl.com

Nicolau, J. L. (2011). The decision to raise firm value through a sports-business exchange: How much are Real Madrid's goals worth to its president's company's goals?. *European Journal of Operational Research*, *215*(1), 281-288.

Noll, R. (1974). *Government and the Sports Business*, The Brookings Institute, Washington, DC.

Parent, M. M., & Slack, T. (2007). Structural Factors Influencing the Volunteer-Professional Staff

Relationship in Large-Scale Sporting Events. *International Perspectives on the Management of Spor*t. Elsevier Academic Press, 229-245.

Parks, J. B., Zanger, B., & Quarterman, J. (1998). Introduction to sport management. In Contemporary sport management, IL: Human Kinetics.

Ratten, V. (2011). Sport-based entrepreneurship: towards a new theory of entrepreneurship and sport management. *International entrepreneurship and management journal*, *7*(1), 57-69.

Reynolds, P. D., Hay, M. & Camp, S. M. (2000): *Global entrepreneurship monitor*. London: Babson College.

Ritchie, J.R.B. & Beliveau, D. (1974). Hallmark events: an evaluation of a strategic response to seasonality in the travel market, *Journal of Travel Research,* 14, 14–20.

Staurowsky, E. J., Weaver, K., & Burchette, B. (2013). BL ParkhouseB. A. TurnerK. S. MilochMarketing for Sport Business Success 2012. Kendall Hunt Publishers Dubuque, IA978-0-7575-7948-6354 p. *Sport Management Review*,*16*(4), 535-536.

Taylor, T. & P. McGraw. (2006) Exploring Human Resource Management Practices in Nonprofit Sport Organisations. *Sport Management Review*, *9*(3), 229-251.

Van den Bergh, J. C. (2007). *Abolishing GDP* (No. 07-019/3). Tinbergen Institute Discussion Paper.

Wennekers, S., & Thurik, R. (1999). Linking entrepreneurship and economic growth. *Small business economics, 13*(1), 27-56.

Westerbeek, H. & Smith, A. (2003). Sport business in the Global Marketplace. *In New York; Palgrave Macmillan*, vol. 53.

Whitson, D. (1998) Circuits of promotion: Media, marketing and the globalization of sport, in L. Wenner (ed.) *Media Sport*. New York: Routledge, pp. 57–72.

Zorn, S.A. (1994). Couldna done it without the players: depreciation of professional sports player contracts under the Internal Revenue Code. *Seton Hall Journal of Sports Law*, (4), 337-95.

AIRPORT CHARGES AND DISCOUNTS: IMPLICATIONS FOR AIRLINES OPERATED AT AIRPORTS IN SOUTHEAST EUROPE

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Abstract: *Deregulation and liberalization processes during 1990s have led to tremendous changes in airline industry forcing all participants, primarily airlines and airports, to actively tailor their business strategy. In order to sustain profit in highly competitive market, a number of airports across Europe offer variety of airport incentives schemes which rely on airport charges discounts as a part of financial incentives as well as on other incentives. This paper illustrates the airport charges systems at several airports in the region of Southeast Europe. Moreover, paper aims to discover the impact of discounts within specific airport charges systems on airline financial performance.*

Keywords*: Airport charges, Financial incentive schemes, Airport charges discount, Airlines*

1. INTRODUCTION

The completion of the three liberalization packages in the European Union in mid-1992 has significantly increased the competition among the existing airlines, but has also led to penetration of new rivals on the market. The advent of low-cost carriers (LCC) has become one of the most important occurrences bringing a number of innovations in air transport industry. Liberalization and the entrance of LCC which offer significantly lower fares have forced the traditional flag carriers to compete for the first time (ELFAA, 2004). Prior to this event, the flag carriers were protected by governments who have even been closely involved with their daily operation and fares that were set through bilateral agreements between states. The aim of the liberalization process was to remove the regulatory protection that most of the airlines had received in the past. This led to serious financial problems at various European air carriers while some of them could not survive in the new environment and went bankrupt.

In order to retain market share and sustain profit growth, traditional airlines had to develop their own strategies which aim to reduce labour costs or increase productivity within the mainline airline operation. Mergers between traditional network airlines across national border, as well as establishing alliances comprising large number of carriers, have been deemed an appropriate response to the challenges imposed by fierce competition on the European market. Some airlines even set up a low-cost carrier subsidiary, while some others transfer services to regional partners.

However, liberalization has also a positive impact on the increased competition between airports bringing lower charges and more efficient services. IATA (2012) argues that a vast majority of European airports evolved from merely infrastructure providers into fully fledged businesses in their own right due to the deregulation and liberalisation of the European aviation industry during 1990s. Therefore, a number of airports in Europe tries to attract new airlines to start operating their services or stimulate existing airlines to expand their offers mainly through discounts on airport charges or/and other financial and non-financial incentives. These arrangements are very well known in the literature as Airport Incentive Scheme. The core strategy of majority incentives schemes considers the reduction of airport charges which are levied on aircraft operators for using airport facilities and services. Classification of airport charges is not standardized across European airports, but some of them are common and charged by almost each airport (landing charges, passenger charges and parking charges). Having in mind that around 3.5% to 5% of an airline's total costs are directly related to airport charges, it is not surprising that many airlines will seek those airports that can provide a variety of discounts.

The goal of the paper is to investigate the different types of incentive scheme employed by several airports situated in region of Southeast Europe (SEE), as well as financial implication that these

incentives may have on airline performance. The special attention is paid to discounts on airport charges since they represent a marketing tool used by airports that aim to increase traffic.

The paper is organizes as follows. Section 2provides an overview of airport charges on several airports situated in region of Southeast Europe (SEE). The essential indicators of current air transport market in the region of SEE are presented in Section 3. Section 5 investigates the different types of incentive scheme employed by specific airport from the sample, as well as their financial implication that these incentives may have on airline performance. Conclusion is given in Section 6.

2. AIRPORT CHARGES

Airport charges are charged to airport users for the use of airport facilities (EC, 2014). In other words, airlines that operate from specific airport are obliged to pay certain amount of money to cover the airport's costs for providing facilities and service. It is clear that these charges are indirectly paid by passengers and freight customers via the ticket price or freight forwarding fee. Nowadays, there is no straightforward classification of airport charges in Europe. Rather, airports adopt classification of airport charges that is the most suitable for them, although they may slightly vary one from another. However, airport charges systems have to comply with regulatory requirements set by authorities. Despite large combinations of different types and methods existing in practice, vast majority of airport charges systems display common elements. According to the ICAO (2009), airport charges contain several elements:

- landing charges based on aircraft weight formula,
- parking and hangar charges depending on aircraft attributes (weight, dimensions)and length of stay,
- passenger service charges levied through the aircraft operators where practicable,
- security charges,
- noise-related charges,
- emissions-related aircraft charges to address local air quality (LAQ) problems at or around airports.

Terms 'fees' and 'charges' are used interchangeably in this paper. Landing fees are very often levied as take-off fees, or fees per landing and take-off, the calculation of which is based on aircraft weight. These charges are sometimes called runway charges. Some airports use different calculation of landing charges for airlines operating domestic or international routes. Majority of airports considered in this paper levied landing charges based on Maximum Take-Off Mass(MTOM) either giving the price of service per ton or in the intervals of aircraft mass.

Passenger fees are commonly charged by the airport per on-board departing passenger and therefore represent a variable cost for airlines. These charges are normally billed to the airline, which then passes the cost onto the passenger. Airport often imposed different charges for passengers who fly international routes and those who fly domestic ones. Passenger fees can very often be combined with security service fees, which is a common practice especially at airports in Europe.

Aircraft parking fees are related to leaving an aircraft stationary at an airport. Parking charges are normally levied on a time basis, but can also be levied by weight or size of aircraft.

Ground-handling fees normally consist of the costs for handling of aircraft, passengers, baggage in arrival and departure. They are often levied on aircraft weight basis and given in interval prices for most airports from the set.

Moreover, in last few years a number of airports, especially those congested, charges airlines for noise they produce in the vicinity of the airport. These fees are levied by aircraft types that are categorised each according to their relative impact. More recently, some airports have also introduced emissions charges, aiming at an improvement of the local air quality at the airport and its surroundings. Noise charges, as well as emission charges, have not yet been introduced into charges systems of airports investigated in this paper. All the above-mentioned charges can be subject to modification to a certain level since they represent the essential part of incentives schemes developed by the large number of airports across Europe.
Although wide varieties of financial and non-financial incentives are currently available at a number of airports, the focus of this research is on financial incentive, particularly the part thereof that deals with

different discounts on airport charges. In addition to discounts on airport charges, financial incentives also encompass direct payments to airlines and different types of risk sharing arrangements. Reduced charges in Europe often cover passenger charges and landing fees in an all inclusive per passenger charge.

3. OVERVIEW OF SOUTHEAST EUROPE AIR TRANSPORT MARKET

The paper investigates the structure of airport charges at airports situated in following countries of Southeast Europe: Serbia, Montenegro, Croatia, Macedonia, Bosnia and Herzegovina and Albania.

Table 1: Air transport market indicators in 2012

	Serbia	Montenegro	Croatia	Macedonia	Bosnia & Herzegovina	Albania
Population	7.1 million	0.6 million	4.4 million	2.1 million	3.8 million	3.2 million
GDP per capita	5190 US$	7041 US$	13879 US$	4565 US$	4556 US$	4000 US$
Total air pax (million)	3.39	1.35	5.96	0.91	0.67	1.66
Number of airports	2	2	8	2	4	1
Primary airport	Belgrade	Podgorica	Zagreb	Skopje	Sarajevo	Tirana
IATA code of prim. a/p	BEG	TGD	ZAG	SKP	SJJ	TIA
No. of paxat prim. a/p (million)	3.36	0.64	2.34	0.83	0.58	1.66
Flag carrier	JAT Airways, from 2014 Air Serbia	Montenegro Airlines	Croatia Airlines	-	B&H Airlines	-
Other a/p (more than 0.5 mil.pax)	-	Tivat (TIV)	Split (SPU), Dubrovnik (DBV)	-	-	-
Other a/p (0.3 - 0.5 mil.pax)	-	-	Zadar (ZAD), Pula (PUY)	-	-	-
Other a/p (0.05 - 0.3 mil.pax)	-	-	Rijeka (RJK)	Ohrid (OHD)	Mostar (OMO)	-
Other a/p (less than 50 000pax)	-	-	Osijek (OSI), Bol (BWK)	-	Banja Luka (BNX), Tuzla (TZL)	-

Table 1 provides an overview of air transport market indicators in respective countries. It is evident that Serbia has the largest population with around 7.1 million passengers, followed by others the population of which ranges from 4.4 million (Croatia) to 0.6 million (Montenegro). On the other hand, Croatia has the highest value of GDP per capita (in current US dollars) which is also considered as a key driver of air travel demand. Tourism highly contributes to the country's overall GDP because of the seacoast and large number of islands which need regular air transport service for passenger mobility all year round and especially during the summer season. Montenegro has also developed summer tourism due to Adriatic coast. It has to be emphasized that all countries considered, except Croatia, have no domestic air traffic. However, the major common denominator for all selected countries is that they are all emerging markets recently passed (or still passing) through the process of transition.

4. AIRPORT CHARGES AND DISCOUNTS AT AIRPORTS IN SOUTHEAST EUROPE

Certain airport charges can significantly vary at different airports. Therefore, it is more useful to analyze total amount of charges levied rather than compare specific airport charges within airport

charges system. Graham (2008) shows that the total amount of airport charges and fees for A319 aircraft varies in the range of 6:1, thus amounting to less than EUR 1000 at Mumbai and Dubai airports, but reaching EUR 5000at Boston and London Heathrow airports.

This paper illustrates the airport charges imposed by different airports located in Southeast Europe, as well as their respective financial incentive schemes within airport charges systems. In order to enable the comparison across the airport set, several hypothetical premises were introduced. Firstly, all flights are operated by Airbus 319, with capacity of 156 seats and MTOM which equals 75.5 tones. Secondly, the assumed average load factor will be 80%, which means that total number of passengers per flight accounts for 125. Finally, an airline operates three flights on a daily basis, which accounts for 1095 flights annually.

Table 2: Prices of airport charges

Airport	Landing	Lighting	Handling+ Centralizedinfrastructure + Use of Air Bridge	Parking	Pax int. service + Security charge (per pax)
BEG	8.1€/t	2.46€/t	(602.64 +335.36 +185) €	1.8 €/t	(12 (T1) + 3.3)€ (16.5 (T2) + 3.3)€
INI	8.5 €/t	2.1 €/t	(902 + 0 + 0)€	-	14 €
SJJ	14 €/t	40% Price of Landing	1388 €	2.55 €/t	18 €
ZAG	6.5 €/t	-	900 € + (1.5 €/t + 1.3 €/pax) +0	1.5 €/t	(15 + 6.5) €
SPU	8.5 €/t	-	939 € + (0.9 €/t + 0.5 €/pax) +0	4 €/t	(10 + 2) €
DBV	12.70 €/t	-	964 € + (96.40 € + 1 €/pax) +0	3.3 €/t	(11 + 2) €
ZAD	11.70 €/t	25% Price of Landing	(927 + 51.78+0) €	4 €/t	12 €
TGD	9.5 €/t	25% Price of Landing	775 €	2 €/t	15 €
TIV	9.5 €/t	25% Price of Landing	1100 €	2.5 €/t	15 €
SKP	7.6694 €/t	25% Price of Landing	(995 + 0 + 40) €	1.6 €/t	(11.50 +6) €
OHD	7.6694 €/t	25% Price of Landing	760 €	1.6 €/t	(10.20 +6) €
TIA	650 €	540 €	1320 €	140 €	(12.50 + 2) €

Table 2 shows a comparative analysis of different charges within specific airport charges systems in SEE. All data used in the research are based on the information published by respective airports and listed in the References. It has to be mentioned that calculation of landing fees, parking fees and lighting and part of centralized infrastructure (but only in some cases) are based on MTOM so that every part of a started ton is calculated as a whole ton. Lighting fees are levied in several cases: adverse weather conditions, during the night and on pilot request which will be the subject of Air Traffic Control (ATC) decision. All airports in the set calculate handling fees according to the categories based on MTOM by defining the price of each, although these categories may vary across the airports. For example, Macedonian airports and Belgrade Airport provide a list of handling fees with fifteen categories, airports in Montenegro and Croatia have thirteen, while Tirana Airport has only eleven. Concerning parking fees, airlines are granted first four hours free of charge at all airports considered. Passenger fees shown in Table 2 consider only passengers on international routes. It can be seen that some airports do not charge security fees. Total amount of passenger and security fees ranges from EUR 12 (Zadar Airport) to EUR 21.5 (Zagreb Airport).

Figure 1 presents the total amount of airport charges which an airline has to pay for a single flight operated from specific airport. The minimum amount which an airline will have to pay for using airport facilities and service is EUR 3216 (Split Airport), while the maximum amount is EUR 4652 (Sarajevo Airport). Average value of airport charges is EUR 3758 with standard deviation of EUR 480.

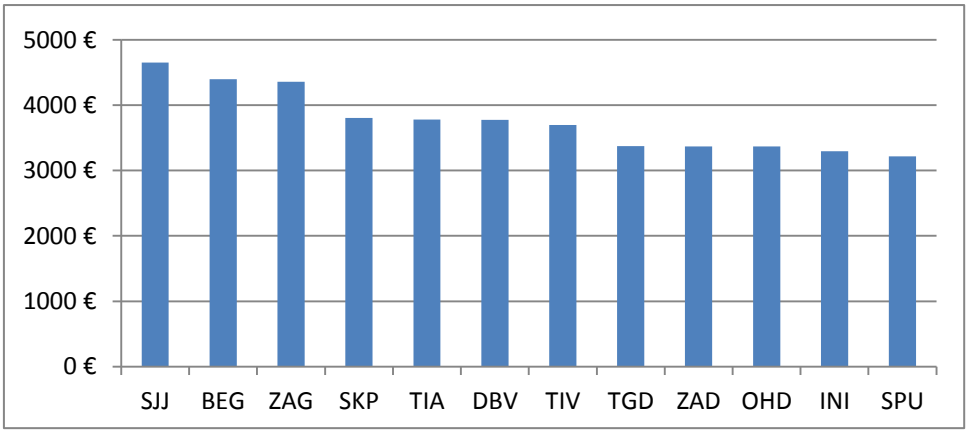

Figure 1: Total airport charges per one flight

Among the charges indicated above, passenger fees together with ground handling fees comprised the large proportion of aeronautical revenue that most airports in the region of SEE received from their users. As observed from Fig 2, the proportion of passenger service fees is 62% in the case of Zagreb Airport and 43% in the case of Dubrovnik Airport.

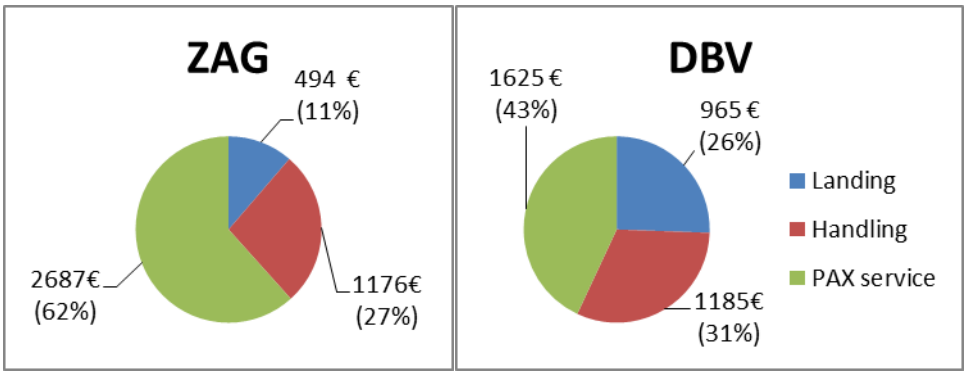

Figure 2: Share of landing, handling and passenger service fees in total airport charges

The amount of total airport charges levied on an annual basis for all flights carried by one aircraft and schedule of three flights per day is given in Fig 3. The average value of total airport charges for all airports is EUR 4.2 million.

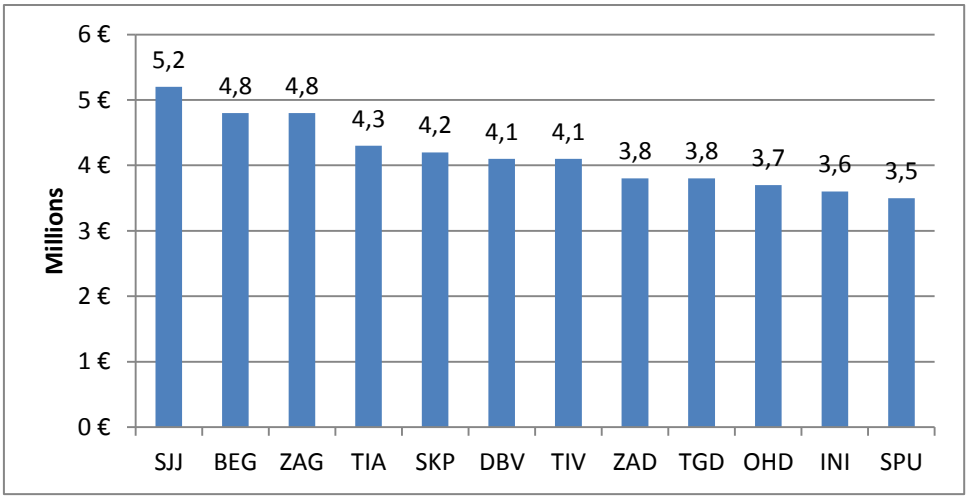

Figure 3: Total annual airport chargesfor all flights

The analysis of the airport incentive schemes operated by airports in SEE tends to display a few distinct characteristics, although some similarities with current practice in Europe may also be observed. The majority of airports investigated in this study suffer from transparency of their financial incentive schemes which an airline can obtain by flying from specific airport, although there are indications that these airports have developed financial schemes.

Among airports observed, Tirana Airport provides the most detailed information on financial incentive scheme offered to airlines. These discounts are published on its website and applicable to each airline which meets the imposed criteria. For airlines that operate or planning to operate from Tirana Airport the following incentives are available: new route incentive for scheduled traffic, additional frequency incentive for scheduled traffic, new route incentive for charter traffic, off-peak discount, non-satisfactory load factors, larger aircraft incentive, airport growth financial support, support for transit traffic and financial support on prepayment. For example, the airport offers the following two year scheme for introducing a new scheduled route: 100% reduction of the published landing, parking and lighting fees in the first twelve months and 10% reduction of ground handling fee, while for the subsequent twelve months 50% reduction of the published landing, parking and lighting fees is offered.

The airports from the set situated in Croatia, Zagreb Airport and Split Airport, have the same mechanism of calculating the reduction in charges (handling charges) based on total number of passengers carried in the previous year, although the percentages of reduction are not consistent. These two airports have transparent discounts on airport charges published on their Internet sites. Additionally, Zagreb Airport offers special anniversary discounts on handling charges for airlines which operate from this airport for a defined period of time.

Two Macedonian airports, Skopje Airport and Ohrid Airport, are operated by *TAV Airports Holding*. There are evident indices about the existing airport scheme, which are not fully published on respective airports' Internet sites. However, it is found that Ohrid Airport offers a reduction in the landing fee if an airline has more than fifty landing within one month.

Airports of Montenegro, namely Podgorica and Tivat airport, provide only partial information about conditions upon which an airline could obtain certain level of reduction in airport charges. Depending on the number of aircraft movements carried, these two airports provide reduction of up to 20% for handling charges. Moreover, airlines are also granted a promotional discount for new destination up to 30% in landing and handling fees for the period up to three years.

Finally, to the best of our knowledge, Belgrade Airport, Sarajevo Airport, Dubrovnik Airport and Zadar Airport do not provide any public information about potential financial incentive offered to airlines.

Table 3: Discounts on airport charges

	SPU	ZAG	OHD	TIV	TGD
Discount on	Handling	Handling	Landing	Handling	Handling
Criteria	Number of passengers in last year	Number of passengers in last year	Number of aircraft movements in one month	Number of aircraft movements	Number of aircraft movements
Number of carried pax or number of movements	136875	136875	90	1095	1095
Discount	55%	6%	25%	20%	20%
Price without discount (annually)	1028205 €	985500 €	638248 €	1204500€	848625 €
Total discount	565513 €	59130 €	159562 €	240900 €	169725 €
Price with discount (annually)	462692 €	926370 €	478686 €	963600 €	678900 €

Table 3 illustrates the discounts offered by respective airports with their implications to possible savings for an airline. It has to be emphasized once again that all calculations are based on the generic examples: airline operating with one aircraft (A319 with 156 seats) and a schedule which assumes three flights per day.

The discounts offered to airlines operated from the airports considered range from approximately EUR 60000 to more than EUR 0.5. It can be observed that the largest amount of savings can be achievedwith discount provided by Split Airport, while the smallest discount is offered by Zagreb Airport.

5. CONCLUSION

Revolutionary changes introduced in air transport industry as a result of deregulation and liberalization during 1990s have evolved intense competition not only between airlines, but also between airports. In such circumstances, most European airports were transformed from passive providers of infrastructure to commercially oriented companies. In order to stimulate the traffic growth which ensuressufficient revenue, a vast majority of airports have recently implemented incentive schemes for airlines within their airport charging system. On the other hand, airlines that strive to increase profit margins have seen these incentives as a suitable tool for additional cutting of their costs.

This paper provides classifications of airport charges levied at several airports situated in Southeast Europe. Additionally, a broad investigation of financial incentive, especially of those parts related to discounts on airport charges, has been conducted. The resultsshowfinancial discounts imposed by specific airport and their implications to airlines. The investigation also reveals that many airports from this sample suffer from the transparency of incentives schemes. Since the European Commission requires the principle of transparency and non-discrimination, the airports in this region should invest significant efforts to achieve this goal in the future.

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REFERENCES

AerodromiCrne Gore.Cjenovnik aerodromskih usluga. Retrieved fromhttp://www.montenegroairports.com/files/cjenovnik%20popusti.pdf(accessed 01.04.2012)

Aerodrom “Nikola Tesla”. Cenovnici usluga. Retrieved from http://www.beg.aero/o_nama/cenovnici.156.html(accessed 01.04.2012)

AIP Srbija, 2013.Retrieved from http://www.smatsa.rs/AIS/Active/eAIP/04-Apr-2014-NA/2014-04-04/html/index_commands.html(accessed 01.04.2012)

Association of European Airlines and Seabury. (2012). Sustainable European Aviation. Retrieved from http://files.aea.be/Downloads/seabury_rept2012.pdf(accessed 08.04.2012)

Dennis, N. (2010, October). Old conflicts, new rivals? Airlines competition in the European market. Paper presented at the European Transport Conference.

European Commission.(2014). Airport charges. Retrieved from http://ec.europa.eu/transport/modes/air/airports/airport_charges_en.htm(accessed 08.04.2012)

European Low Fares Airline Association. (2004). Liberalization of European Air Transport: The Benefits of Low Cost Fares Airlines to Consumers, Airports, Regions and the Environment. Retrieved from http://www.elfaa.com/documents/ELFAABenefitsofLFAs2004.pdf(accessed 08.04.2012)

Graham, A. (2008). Managing airports.An international perspective (3rd edition). Oxford: Butterworth Heinemann.

ICAO. (2009). ICAO’s Policies on Charges for Airports and Air Navigation Services (8th edition), Doc 9082/8.

International Air Transport Association.(2012). Fast facts. Retrieved from https://www.aci-europe.org/policy/fast-facts.html(accessed 01.04.2012)

Međunarodni aerodrom Sarajevo.Cjenovnik avijacijskih usluga. Retrieved from http://www.sarajevo-airport.ba/tekst.php?lang=bos&id=32&kat=2(accessed 01.04.2012)

Međunarodna zračna luka Zagreb. Cjenik temeljnih usluga. Retrieved from http://www.zagreb-airport.hr/Cjenik-temeljnih-usluga-44.aspx(accessed 01.04.2012)

Ohrid Airport–TAV Airports.OHD Tariff charges 2013.Retrieved from http://ohd.airports.com.mk/default.aspx?ItemID=355(accessed 01.04.2012)

Skopje Airport–TAV Airports.Price list 2014.Retrieved from http://skp.airports.com.mk/default.aspx?ItemID=355(accessed 01.04.2012)

Tirana International Airport.Aircraft charges. Retrieved from http://www.tirana-airport.com/files/downloads/pdf/AircraftCharges-EN.pdf(accessed 01.04.2012)

Tirana International Airport, Airline Incentive Policy. Retrieved from http://www.tirana-airport.com/files/downloads/pdf/Incentives-April-2012.pdf(accessed 01.04.2012)

Zračnaluka Split. Cjeniktemeljnihusluga.Retrieved from http://www.split-airport.hr/index.php?option=com_content&view=article&id=183&Itemid=174&lang=hr(accessed 01.04.2012)

Zračnaluka Dubrovnik.Cjenikusluga.Retrieved from http://www.airport-dubrovnik.hr/images/stories/cijenik/cjenik-2014.pdf(accessed 01.04.2012)

Zračnaluka Zadar. Cjenikusluga. Retrieved from http://www.zadar-airport.hr/cjenik-usluga(accessed 01.04.2012)

PROJECT MANAGEMENT

CHALLENGES OF IT PROJECT PORTFOLIO SELECTION*

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Abstract: *This paper presents possible challenges in the process of IT project portfolio selection. The paper begins with explanation IT project portfolio management. IT project portfolio management needs to ensure that the group of IT projects support achievement of the goals of the corporate strategy. The paper considers key aspects of IT selection process and introduces organizational support for IT project portfolio selection. An established PMO that is actively supported at the executive level can help solve problems with project selection and initiative approval.*

Key words: *project management, project portfolio management, project selection, IT project, portfolio management office*

1. INTRODUCTION

The task of the IT project portfolio management is to ensure a consistent approach to the classification, selection, prioritization and planning of the right IT projects and programmes in the company (Reyck, Grushka-Cockayne, Lockett, Calderini, Moura, & Sloper, 2005). The aims of IT project portfolio management are as follows:

- optimization of IT project portfolio results (not an individual project or portfolio);
- harmonization of IT projects and programmes with the company's strategy;
- selection of IT projects and programmes to be realized;
- defining IT projects and programmes priorities;
- discontinuing or stopping IT projects or programmes;
- coordination of internal and external resources for IT projects and programmes; and
- organizational learning between IT projects and programmes.

2. IT PROJECT PORTFOLIO MANAGEMENT

An efficient realisation of an IT project is said to be a key factor of the company's business success. This is, however, only partly true. The achieved competitive advantage is not the result of efficient work on a project only. The fact that companies conduct real IT projects is important. IT project portfolio management is meant to ensure a successful execution of the company's strategy through the most effective and most efficient execution of respective IT projects possible (Verhoef, 2002). It is closely related to the role of the top management in the company and with the key decision makers in creating the environment in which set goals can be achieved.

According to Cooper, Edgett and Kleinschmidt (1997), works dealing with the issues of project portfolio have appeared since 1970. In these works, elements such as "selection of research-developmental projects", "resource allocation in research-developmental projects", "project prioritization"and "portfolio management" are analysed.

The majority of works on this topic deal with the problem of portfolio management by defining the optimization methods and techniques (Cooper, Edgett, & Kleinschmidt, 1998). According to these works, the portfolio management problem appears to be a limited optimization in the conditions of uncertainty: multiproject and multilevel model of decision making should be achieved by means of mathematical programming. The starting models for the selection of projects were mathematically oriented and they used techniques such as linear, dynamic and full number programming. The aim was to develop a portfolio of new and existing projects to maximize some function goals (e.g., the expected profit) as the issue of setting resource limitation.

The application of these methods immediately revealed some difficulties in solving the problems of IT portfolio management (Verhoef, 2002). Contrary to the many methods developed in an early stage of the

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approach to this problem, none of these could be adequately implemented in the IT project portfolio management.

The IT projects are recognized as a vital fact for any company. The influence of the IT projects upon the future of any company is certainly strong since they are related to all the important events and processes in the company, be it the development of a new product, the implementation of a new service process, the change in organizational structure or the launching of a new business (Russell, 2003). The IT project portfolio is a collection of projects which together with other projects make the strategy of the company's investments.

The project portfolio management means the implementation of knowledge, skills, methods and techniques upon a set of projects in order that the needs and expectations of the company's investment should be attained and even exceeded (Dye & Pennypacker, 1999). This calls for a balance to be made between strategic and tactical requirements. The IT project portfolio management usually requires that a definition should be made of what is possible and what is necessary. Balancing between the possibilities and the needs generally results in finding the best possible solution within limited resources.

There is a gap today between a majority of management models and the environment in which the IT projects are executed. These models emerged in the circumstances in which it was possible to predict the consequences of certain decisions and the project's impact upon the company and the community in general. A successful IT project portfolio in the project environment nowadays is characterised by a number of non-economic features, uses an iterative budgeting process and what appears to be the best decision for an organization may not be viewed as such for all its stakeholders. Today's the IT project environment is much more complex compared to a majority of management models, and such a complexity must be taken into account in defining „the best" IT project portfolio to be executed.

The IT project portfolio management focuses upon a clear definition of the values the projects bring to the company (Kaplan, 2001). The IT project portfolio management is applied to all projects, to making decisions as regards the selection and prioritization, which is in accord with the strategic goals and the development of the company.

Alongside decision making on the IT projects execution within a portfolio, there is another process of the final approval of the very beginning and of some specific phases in the IT project execution underway. There certainly must exist a lower level of decision making that takes place in the real time of the IT project execution. Decisions within the IT portfolio are made during the given time intervals, all the projects being discussed together, whereas at a lower level decisions are made on individual IT projects at any moment the project passes from one execution phase into another. All this may cause conflicts between the two levels of decision making, since in decision making processes we most frequently deal with different people, even different criteria.

Decision making at the portfolio level, although taking all the IT projects together and making a comparison among them, does not pay enough attention to individual projects (Levine, 1999). On the other hand, the lower level of decision making focuses upon only one IT project, leaving out all the other IT projects. It is of great importance for the company that these two different decision making processes be integrated and harmonized. The dominance of either of the two is unwelcome in any company.

The weakness of the IT portfolio model appears to be insufficient accuracy or relevance of the facts on the basis of which the processing, the analysis, and the conclusion procedures are conveyed and then a final decision is made. The models used in IT portfolio decision making are by far more advanced compared to the input data. Financial indicators, criteria and the processing and presentation methods themselves may be well created and functional for making the final decision. However, all these calculations and use of the seemingly appropriate criteria may lead to a wrong decision, if the data used are incorrect, inaccurate or unreliable (Morris, 1997). If we wish to enhance the success of an IT portfolio decision making process, we must ensure that we have as high a quality of input data.

In their research Cooper, Edgett and Kleinschmidt (1997) have found that the main problems the companies encounter in the project selection and portfolio management are the following:

1. The project portfolio does not reflect the strategy of the company;
2. The portfolio quality is poor;
3. The checking procedures and the decision making procedures at check points are inefficient;
4. Scarce resources and lack of focus;
5. Simplification of the product development projects.

The issue raised in the companies that apply the project-oriented organization concept is whether the undergoing IT projects should be discontinued or deprioritized in favour of certain better quality projects that we become acquainted with. On one hand, we should try to keep the resources engaged in IT projects flexible and capable of shifting from one project to another, as the need may be. The reason for such an attitude is found in the need that the company's management be granted an opportunity to allocate resources in a best possible way, regardless of their current use. On the other hand, there are attitudes that the resources involved should remain in the project all along, regardless of whether there is a more attractive project in sight. Here the issues of continuity and the morale of the project team and the project manager appear to be considerably more important than an optimal allocation of resources. Such a view resulted from the attitude that discontinuing and restarting the project would mean a substantial loss of resources and time, that a shift from one project to another would by all means affect the projects and that a launch and discontinuation or a final suspension of a project would all need additional time and costs (Wysocki, 2004).

The new IT projects always appear better than those under way, therefore the resources in the projects that are in the final phases are usually transferred as a support to new projects. Such support sometimes results in the projects deprived of resources in this way being never completed (Thomas, 1993). The far-reaching consequences and damages for the company fail to be perceived in that moment.

There is no universal rule on how we should act or set the company policy in such cases (Norton & Kaplan, 2003). It is certain that the long-term IT projects call for a continuity in order that satisfactory results should be obtained. On the other hand, there is a need that the company responds to changes in the market by introducing a flexible model of resources distribution. Many companies find that using only financial methods and criteria in giving priorities to IT projects prove inappropriate. The reasons most frequently lie in the financial simplification, which results into an unreliable image of the project, especially prior to the launching of the project, when the prioritizing is most necessary, but also, during the execution of the project. Analyses carried out upon executions of projects have shown that the evaluations of key parameters on the bases of which decisions are made were significantly incorrect.

Statistical implications of the portfolio choice are complex and varied. They include the analysis of both internal and external factors of the company, the company's market position, the strengths and weaknesses of the company. These analyses may be used to create a wide perspective of strategic directions as well as specific initiatives for achieving competitive advantage (Cleland, 1999). Such a procedure may be used in developing focused goals of the IT project portfolio and determining the necessary resources for its support. In estimating the strategic position of the company a portfolio matrix is used, where the different criteria for the company positioning are presented in one or more graphs within two description dimensions. A decision maker may use such a presentation to estimate the current position as well as the position the company wishes to occupy in the future. It is clear that the company's strategic direction must be defined prior to the analysis of the individual projects for the IT project portfolio. Successful organizations conduct a broad strategy preparation and planning before individual projects are analysed.

Upon determining the strategic direction, it is necessary that IT projects be selected and resources allocated. The IT projects selection includes the identification of opportunities, the estimate of organizational fitting, the cost analysis, the cost and risk analysis, the forming and the selection of the portfolio. The success of the IT project portfolio depends on the readiness and the support of the company's management (Verhoef, 2002). This is more important, sometimes even crucial, than just the selection of the method to be used in project selection.

A periodical review of IT project portfolio is absolutely necessary (Bridges, 1999). This means that each active project should be checked, those on the waiting list as well, and should be compared to another. The aim of this check is to find out whether there is the right set of active projects and whether these projects are still in accord with the strategic goals of the company.

To aid the decision making process it is necessary that general criteria are established, as well as the evaluation of each IT project related to those criteria. Since a majority of decisions are based on multiple factors, it is necessary to evaluate each criterion in order to establish a relative importance of each of them. Thus we could identify what is most important for the company, and every project could be measured as regards the criteria that are defined as important (George et al., 2005).

The company must establish an unbiased mechanism of monitoring and control of IT projects (Reyck, Grushka-Cockayne, Lockett, Calderini, Moura, & Sloper, 2005). Measuring may be based on the revenue from the project in relation to the resources invested; then there is measuring of a number of projects within the project portfolio and a continual adjustment to the overall goals of the company. It is very important that there exists an agreement from the start on the process of authority determination. Only when the company

defines its overall goals and the investment strategy into the IT projects, will it be able to create an optimal group of projects or an IT project mix to implement its strategy and achieve goals.

In order to achieve a respective relation between the risk and the extent of revenue from the investment into IT projects, it is necessary that each project be evaluated on the basis of its two characteristics: technical difficulties and added value. The secret of a successful IT project management is in understanding critical relations between the probability of success and the values the project will earn if successful. This provides a good basis for quality decision making on the input portfolio of IT projects.

A majority of portfolio decisions is aggravated by a long time horizon, high level of uncertainty and a large number of variables affecting each project (Ghasemzadeh & Archer, 1999). The tools most commonly used in developing a business model that would predict a potential project value are a learning diagram, a sensitivity analysis and a decision tree.

The purpose of the decisions related to the IT project portfolio is not only the selection of right projects; it is also the inclusion and strengthening of appropriate personalities and their groups who are to realize these decisions efficiently and effectively. Creating an adequate level of participation between cross-functional teams allows for a constructive dialogue between decision makers and those who are in charge of enacting them, which leads to coordination of ultimate actions to be conducted (Englund, Graham, & Dinsmore, 2003).

The portfolio analyses and deals with the future events and possibilities where the majority of information necessary in the selection of projects is at best uncertain, and at worst is largely unreliable. The decision making environment is dynamic, and the status and the perspective of the IT projects in a portfolio constantly change in accordance with the inflow of new information and technologies. The IT projects in a portfolio are in different phases of execution and compete for available resources. However, the comparison among the IT projects is made with varied quantities and reliability of information. The resources distributed among the projects are limited, which is to say that the decision on resource allocation to one project means depriving another project of resources, and the transfer of resources from one project to another usually leaves deep scars.

3. SELECTION OF IT PROJECT PORTFOLIO

The selection of IT project portfolio is one of the crucial steps in the portfolio management process. It is a periodical activity of choosing one portfolio among the available project propositions and projects which are underway, and which achieve the defined organizational goals in a desired way, without exceeding the resources available or breaking other limitations (Archer & Ghasemzadeh, 1996). IT projects selecting directly guides and adjusts business activities to the strategic guidelines of the company. It is within this process that decisions are made on the future execution of IT projects as well as on any vital aspects of their realization.

By undertaking a proactive approach to the IT project selection and real performance management the companies significantly enhance the achievement of IT project goals as regards time, quality and costs, as well as making sure that these projects will facilitate the overall business success. Using quality principles in decision making on evaluation and management of IT project portfolio profitability and productivity may be significantly improved. The IT projects, however, include factors that account for the complexity in the process of project portfolio harmonization. One of the most important among them is the interaction of the projects within the portfolio (Mantel & Meredith, 1999). IT projects are not independent, they overlap and are related to each other by depending critically on each other, in different ways.

Although there are numerous methodologies to be used in selecting an IT portfolio, so far the consensus on which one is most effective has not been reached (Reyck, Grushka-Cockayne, Lockett, Calderini, Moura, & Sloper, 2005). As a consequence, every company tends to choose a methodology that corresponds to the existing organizational culture and allows for the analysis of project attributes it considers the most essential.

The conventional methods of measuring IT values, the estimation of what is easily measurable – costs – and the expectation that an automatic cost saving or cost avoiding practice will pay the investment off do not, in fact, represent the real value IT earns to the company. The problem is reflected in the IT professionals' inability to establish a link to the business value of the proposed IT solution which consequently fail to get the manager's support until it is too late. The problem of inadequate communication is often largely based on the fact that IT managers do not have an effective access to the data they need in order to approach the benefits of a certain IT initiative.

Numerous IT managers estimate IT investments solely on the basis of IT costs saving. While this approach is valid in case the critical factors of success are directed towards reducing exploitation costs in time, it may prove problematic when it is necessary to take into consideration the overall value created by an innovative application of information technologies in business (Sommer, 1999).

As a consequence, the strategic role of investments in new IT initiatives that may lead towards new business opportunities for an organization is neither recognized nor measured. One of the key problems in the total cost scenario implementation is the lack of communication between business activities and technology management, when decision making on implementing new information technologies and the resulting specific business benefits are concerned.

Without the knowledge of where and how IT earns value for the organization, it is impossible to measure this value in concrete quantitative terms. Also, without financial guidelines in defining the value of increased business flexibility, it is difficult to develop a meaningful proposition of values to invest in any IT initiative.

In preparing the input data for the portfolio selection it is necessary to analyse whether the project is worth the risk undertaken (Cooper, Edgett, & Kleinschmidt, 1998). This means conducting an overall identification of potential risks, risk estimation, the analysis on the impact the risk may have on the project, a discussion on the moves to reduce risk and estimation as to whether the project is still justified after the risk reduction costs are added.

The input information for portfolio selection is to allow for (Levine, 1999):

- finding out which of the projects proposed bears the greatest value for the company, so that the priorities in resource allocation may be defined.
- an estimation of the projects proposed in view of their importance for the overall portfolio, especially as regards the availability of resources and the realization of other projects.
- identifying projects which lag behind the planned terms by 25 percent or more and analysing influences upon the entire portfolio in case these projects are discontinued (depending on the availability of resources and the realization of other projects).

The choice of the method to be used in the project estimate depends on the purpose of the project. The most frequently used methods of project estimate of individual IT projects are the following:

- economic revenue – net current value, internal profit-making rate, return on capital, pay off terms, expected value
- benefit-cost techniques – include the calculation of the benefit-cost ratio, where the inputs represent the total value of all benefits and costs
- risk analysis – a combination of the probability of events (usually undesired events) and consequences related to the event. Every project carries a certain risk of failure to reach the desired goals
- potential project success – specific measuring of the probability of project success
- degree of acquaintance with the organizational strategy
- degree of acquaintance with the activities of competition
- degree of acquaintance with the organizational financial goals.

Individual projects may be estimated as good, however, they may be negative from the point of view of the company (Kerzner, 2003). Therefore it is essential that the project be analysed not only from the aspect of its success, but from the aspect of its contribution to the overall goal of the company as well. The project must not endanger the existing benefits and advantages the company has. No decision on the project requires all the analyses possible, nor is every element equally important.

Strategic decisions affecting the IT portfolio focus should be executed in a broad context that takes into account both external and internal business factors, and before the project portfolio is selected. The frame of the project selection should be flexible enough to allow for prior selecting of individual techniques and methodologies that are adequate for the relevant data analysis and decision making on the selection in a certain type of projects (Markowitz, 1991).

The project portfolio selection and adjustment is an iterative process (Meta Group, 2002). The existing projects require resources from the set available therefore the time of execution and resources are interdependent and affect new projects. It is a general practice that the review of the estimate of the project key elements is conducted at the end of each phase, in order to determine whether the project is eligible to be continued.

As regards the plan and the input information we have when we enter the decision making and the project execution processes, further execution may change many things. The best project may prove to be only average, and sometimes it is necessary to discontinue the project since it does not promise satisfactory results (Ghasemzadeh & Archer, 1999). During the execution stage it is therefore necessary that requireded adjustments be made, in accordance with the changes that appeared in the process.

The current IT projects that reached a certain key event should be reviewed again at the same time when new projects are analysed to be selected into the IT project portfolio. Thus it is possible to, in accordance with the resources available, generate a combined portfolio in regular intervals, and this is defined by:

- project completion or project abandoning
- new project proposition
- changes in strategic focus
- review of available resources
- changes in the environment

Problems related to the project failure and project discontinuation may be reduced if those working on the project approval are better organized and more careful in the decision making process. Within the IT project portfolio the scopes of performances for each project must be identified. It is necessary that certain acceptable values that would serve as an alarm tool within the IT project portfolio management system should be defined in advance.

4. PORTFOLIO MANAGEMENT OFFICE AS ORGANIZATIONAL SUPPORT FOR IT PORTFOLIO PROJECT SELECTION

Companies usually have a large number of different projects within their portfolio and the more these differ, the more complex their management process becomes (Englund, Graham, & Dinsmore, 2003). In order that a successful execution of an individual IT project be supported and its compliance with the goals of other projects and with the overall organizational strategy be ensured, there must exist a specific integrative structure, e.g., strategic centre, expert group, centre for competence in project management or a portfolio office (Block & Frame, 2001; Bolles, 2002; Dinsmore, 1993; Miranda, 2003). Some of these may be virtual organizational units (Gareis & Huemann, 2000; Seltzer, 1999).

The hierarchically highest level is the Portfolio Management Office. The Portfolio Management Office defines projects and programmes in accordance to the general organizational strategy and goals. Its basic role is managerial and is related to the project portfolio management process phases, from defining the portfolio and categories of projects (such as IT projects) to the control and periodical review of the existing priorities and plans. The Office can also be viewed as the director or managing board headquarters, with an impact upon the strategy and a general direction of the company's development. Though primarily engaged in the activities on the strategic management level, it works together with the members of the Project Management Office on the operational jobs related to coordination of project activities, developing and spreading the project management principles throughout the company in certain situations (changes in plans, radically changed business conditions, delay caused by lack of resources, etc.).

The strategic role of the PMO is primarily concerned with the project portfolio development and management and its coordination with the organizational strategic goals. Hence the PMO provides the basis for a quantitative estimate of the portfolio management success in the organization and promotes the awareness of the portfolio management value.

The PMO provides numerous benefits for the organization that implements it, in view of the portfolio management process standardization, project execution improvement, professionalism building, improvement of organizational performances, etc. However, the other part of the PMO implementation has negative aspects that diminish the importance of the benefits listed above. Its significant weaknesses are: implementation costs, stress and conflicts, dualism in decision making, lack of clearly defined responsibilities, delays in execution, etc.

In a large number of organizations the implementation of the PMO remains, unfortunately, at the operational level, therefore the support of modern PM concepts in strategic planning and management is minimized. The management of such an organization will have to make additional efforts towards restructuring, changing the business methods and improving the PM competence level in their employees in order to position the PMO on a strategic level, that is, on project management as a basic competence of the company. Only in this way will the advantages of corporate project management be fully visible.

5. CONCLUSION

Modern companies rely on their IT to a large extent and this cannot be denied. It is almost impossible nowadays or in future to imagine a successful business without an equally successful IT. On the other hand, the link among these structures is often not strong enough so as to make this relation useful for new investments and joint projects. In order to understand why some organizations earn greater financial value from implementing the same information technologies compared to some others, numerous research have been conducted. Among the best practices certainly is the joint vision of valuable opportunities that exist both in the IT and in business units, quality business planning for any initiative and an effective linking of projects and programmes. The basis of all these is the portfolio management with its process of work.

In the project-oriented organization, strategic management is implemented by way of project portfolio management. Classification, selection, prioritization, planning, monitoring and control of programmes and projects are defined and analysed as basic elements of project management. The IT project portfolio management is to allow for a consistent approach to classification, selection, prioritization, planning and execution of the right IT projects and programmes in the company. The IT project portfolio management is characterised by uncertainty as well as by changing information, dynamic possibilities, manifold goals, strategic analyses, interdependence of projects, manifold decision making and group decision making. Defining and managing the IT portfolio is today one of the most demanding processes in modern business.

The development and selection of the IT project portfolio is a process which helps optimize a set of IT projects, not just one project. The approaches in IT portfolio development vary from simple ranking, based on a cost reduction rate, to very complex methodologies that take into consideration the interrelations among the projects. Organizations tend to select a methodology appropriate to their organizational identity and allowing for the analysis of project attributes they consider the most essential. Regardless of the model chosen, the goals should be related to the portfolio optimization, not only the optimization of individual projects. The choice of IT project portfolio mostly depends on the company's strategic direction, its capabilities, limitations and the complexity of the project.

REFERENCES

Archer, N. P., & Ghasemzadeh, F. (1996). *Project Portfolio Selection Techniques: A Review and a Suggested Integrated Approach* (Innovation Research Working Group Working Paper No. 46). Hamilton, Ontario: McMaster University.

Block T. R., Frame J. D. (2001). Today`s Project Office: Gauging Attitudes. *PM Network*, *15*(8), 50-53.

Bolles D. (2002). *Building Project Management Centers of Excellence*. New York, NY: AMACOM.

Bridges, N. D. (1999). Project Portfolio Management: Ideas and Practices. In Dye, D. L., & Pennypacker S. J. (Eds.), *Project Portfolio Management* (pp. 45-54). West Chester, PA: Center for business Practices.

Cleland, I. D. (1999). The Strategic Context of Projects. In Dye, D. L., & Pennypacker S. J. (Eds.), *Project Portfolio Management* (pp. 3-22). West Chester, PA: Center for Business Practices.

Cooper, R. G., Edgett, S. J., & Kleinschmidt, E. J. (1997). Portfolio Management in New Product Development: Lessons from the Leaders, Phase I. *Research Technology Management, 40*(5), 16-28.

Cooper, R. G., Edgett, S. J., & Kleinschmidt, E. J. (1998). Best Practices for Managing R&D Portfolios, *Research Technology Management, 41*(4), 20-33.

Dinsmore, P. C. (1993). *The AMA Handbook of Project Management*. New York, NY: AMACOM.

Dye, L. D., Pennypacker, J. S. (1999). An Introduction to Project Portfolio Management. In Dye, L. D., & Pennypacker J. S. (Eds.), *Project Portfolio Management* (pp. xi-xvi). West Chester, PA: Center for Business Practices.

Englund, R. L., Graham R. J., & Dinsmore, P. C. (2003). *Creating the Project Office: A Manager's Guide to Leading Organizational Change*. The Jossey-Bass Business & Management Series. New York, NY: Wiley.

Gareis, R., Huemann, M. (2000). Project Management Competences in the Project-oriented Organisation. In Turner J. R., & Simister S. J. (Eds.), *The Gower Handbook of Project Management*. Aldershot, UK: Gower.

George, M. et al. (2005). *Fast Innovation - Achieving Superior Differentiation, Speed to Market and Increased Profitability*. New York, NY: McGraw-Hill.

Ghasemzadeh, F., Archer, N. (1999). Project Portfolio Selection Techniques: A Review and a Suggested Integrated Approach, In Dye, D. L., & Pennypacker S. J. (Eds.), *Project Portfolio Management* (pp. 207-238). West Chester, PA: Center for business Practices.

Kaplan, J. D. (2001). White Paper: Strategically Managing Your IT Portfolio. *PRTM's Insight*, April 1.

Kerzner, H. (2003). *Project Management*. Eight edition. New York, NY: John Wiley & Sons.

Levine, H.A. (1999). Project Portfolio Management: A Song without Words?, *PM Network*, *13*(7), 25-27.

Meredith, R. J., & Mantel, J. S., Jr. (1999). Project Selection. In Dye, D. L., & Pennypacker S. J. (Eds.), *Project Portfolio Management* (pp. 135-168). West Chester, PA: Center for Business Practices.
Markowitz, H. M. (1991), *Portfolio Selection*. London, UK: Basil Blackwell.
Meta Group (2002). *Centralizing Management of Project Portfolios*. Meta Group, January 29.
Miranda, E. (2003). *Running the Successful Hi-Tech Project Office*. Boston, MA: Artech House.
Morris, P. (1997). *The Management of Projects*. London, UK: Thomas Telford.
Norton, D., & Kaplan, R. (2003). *The Strategy-Focused Organization*. Boston, MA: Harvard Business School Press.
Reyck, B. D., Grushka-Cockayne, Y., Lockett, M., Calderini, S., Moura, M., & Sloper, A. (2005). The impact of project portfolio management on information technology projects. *International Journal of Project Management*, *23*(7), 524-537.
Russell, A. (2003). *Managing High-Technology Programs and Project*. New York, NY: John Wiley & Sons.
Seltzer, L. (1999). The Virtual Office. *PC Magazine*. October 19.
Sommer, R. (1999). Portfolio Management for Projects: A New Paradigm. In Dye, D. L., & Pennypacker S. J. (Eds.), *Project Portfolio Management* (pp. 55-60). West Chester, PA: Center for business Practices.
Thomas, R. J. (1993). *New Product Development: Managing and Forecasting for Strategic Success*. New York, NY: Wiley.
Verhoef, C. (2002). Quantitative IT portfolio management, *Science of Computer Programming*, *45*(1), 1–96.
Wysocki, R. (2004). *Project Management Process Improvement*. Boston, MA: Artech House.

ORGANIZATIONAL PROJECT MANAGEMENT MATURITY ANALYSIS OF ENERGY SECTOR COMPANIES

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Abstract: *This paper discusses the current situation in project management in the energy sector in Serbia, by analyzing the results of the project management maturity research. The research was conducted on a relevant sample of project managers and members of project teams implementing energy projects in more than 70 organizations in Serbia. Firstly, the paper presents an overview of the generic project maturity model, followed by the presentation of data on current and projected situation in energy sector in Serbia, with the aim of understanding the context of the research. Secondly, it moves on to presenting the results of research and the analysis of results obtained. Finally, the paper offers recommendations for improvement of specific aspects of project maturity, as an answer to the challenges that the Serbian energy sector is likely to face in the years and decades to come.*

Keywords*: energy sector companies, projects, project management maturity*

1. INTRODUCTION

At the beginning of the second decade of the twenty-first century, Serbia has been facing numerous problems in the energy sector. Great dependence on import of oil and natural gas, which constitute as much as 17.4% of the total national import volume (Statistical office of the Republic of Serbia, 2013), obsolete electrical and energy capacities, low energy efficiency in almost all sectors (Oka et al.), represent only several among many problems affecting the country's development. As an attempt to solve some of these problems, Serbia has adopted The Energy Sector Development Strategy of the Republic of Serbia by 2015 (MMERS, 2005). The Strategy lists the following five energy policy priority programs in the forthcoming period (MMERS, 2005):

- Priority of continuous technological modernization of the existing energy facilities/systems/sources in the following sectors: oil, natural gas, coal including strip mining and underground mining, power sector, production facilities – thermal power plants and hydro power plants, distribution systems, thermal energy sector – district heating companies and industrial power plants.
- Priority of economical use of quality energy products and increase in energy efficiency in production, distribution and utilization of energy by end consumers of energy services.
- Priority of use of new renewable energy sources and new, more energy efficient and environmentally acceptable energy technologies and installations/equipment for energy utilization.
- Priority for extraordinary/urgent investments in new power sources with new gas technologies (combined gas-steam thermal energy installations).
- Priority of constructing new energy infrastructure facilities and electric and thermal power sources within the energy sectors of Serbia, as well as capital-intensive infrastructure, within the frameworks of regional pan-European infrastructure systems connected with Serbian systems.

Aiming to implement the priority programs and encourage the development of energy sector, the strategy has envisioned investments of up to EUR 8 billion between 2008 and 2015 (MMERS, 2005). Given the overall workload anticipated over the mentioned period, the emerging imperative is the need to establish an efficient system of project management in energy sector.

2. PROJECT MANAGEMENT MATURITY ANALYSIS OF ENERGY PROJECTS

Maturity models can be implemented in almost all processes in an organization, including quality management maturity, energy management maturity, human resource management maturity, overall organizational maturity model, etc. Recognizing the significance of project management in achieving organizational strategic goals, it was to be expected that the organizations would develop the need for

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assessing the project management maturity (Cooke-Davis and Arzymanov, 2003). The key reasons for the growing interest and significance of these models underline the fact that many organizations implementing project management principles were unable to measure the success of implementation, or to compare their own practices with those of other organizations. Additionally, these models enable the identification of phases critical to the process of advancing of project management practices and achieving higher performance levels (Mihic, 2010). Maturity models identify strengths and weaknesses of the organizations and provide data used for benchmarking (Judgev and Thomas, 2002).

Project maturity can be viewed as a capacity of an organization to successfully implement its projects and programs. Analysis of the project maturity allows for evaluation of achievement of strategic goals through implementation of project management principles. The research conducted by Loader (2006), indicates the existence of a strong link between organizational project maturity and the success of the projects it implements. Organizations at a higher project maturity level are also more successful in implementation of their projects, whereas those at lower project maturity levels often encounter problems such as failing to achieve project objectives, exceeding deadlines and budget, underachieve client requirements, etc.

Analysis of some of the best known project maturity models, such as CMM, PMMM, OPM3, PRINCE2, EFQM, IPMA project excellence award model, etc, helps define a generic project maturity model consisting of five levels: initial, repeatable, managed, distributed and continual improvement level (Mihic, 2010). The level of project maturity can be determined by means of standardized questionnaires containing key elements of project maturity in an organization (Crawford, 2006). The elements of project maturity have been derived from knowledge areas defined by Project Management Institute (PMI, 1996).

The energy sectors of most countries are facing numerous challenges, most of which represent the results of multi-decade global orientation towards fossil fuels as the main generators of economic growth. Such orientation is contrary to the sustainable development principles, which, in relatively close future, can lead to serious environmental, economic, social and political consequences on a global level (UN, 1987). In addition, the accelerated economic growth of certain countries or regions contributes to an increase in the overall energy consumption worldwide (Zhang and Wang, 2011). Therefore, projects in the field of energy tend to focus more on the development of energy efficiency, construction of facilities for producing energy from renewable sources and electrification in developing countries.

Several general characteristics of the projects in this area can be identified in accordance with the established practices of implementation of energy projects and Flyvbjerg and Flyvbjerg's research (2004). The characteristics are as follows:

- Energy projects are classified as capital investment projects and often require substantial financial investments.
- Inherent to these projects are numerous risks that come as a result of the inability to forecast all threats in the process of long-term planning.
- Implementation of these projects is complex and often includes hundreds (or thousands) of activities.
- Implementation of these projects does not employ standardized technology.
- Decision making and planning involves a number of stakeholders who may have conflicting interests at times.
- Workload may significantly differ at times.
- Project budgets are often set without contingency reserves for funds and time, which leads to exceeding budget or time boundaries, often resulting in exceeding the deadlines and costs or in underachieving of forecasted benefits in the majority of projects.

Organizations in energy sector operate in a very dynamic environment with significant risk exposure; in addition, these risks have escalated since the beginning of the global downturn. The mentioned environment, being prone to frequent fluctuations, affects the regular operations of energy companies, and also influences project management in this field. Nevertheless, the problems such as delayed implementation or exceeded budgets are not exclusive characteristics of energy projects; rather, they are a reflection of project management shortcomings connected with an organization's deficient project maturity. Improving project maturity may result in improved project success.

3. OVERVIEW OF THE EMPIRICAL RESERCH

Empirical research of the project maturity in the energy sector in Serbia was conducted in 2013 on a sample of 75 respondents from 75 organizations. The respondents were expected to answer a questionnaire built around key aspects of project maturity. Five questions were defined for each of the aspects. The

questionnaire also featured questions important for appreciation of the strategic aspect of project management analysis. To ensure the collection of high-quality data important for understanding and verifying the obtained results, focus groups and interviews included key management personnel from selected organizations. The data was processed using the software package SPSS ver.16.0.

Data about a broad span of characteristics of organizations and projects that were researched, speak in favor of relevance of the questionnaire. The research encompassed some of the largest and most prominent organizations from the Serbian energy sector, as well as smaller organizations that provide goods and services to the energy companies. The average number of participants in projects covered by this research was 84.61; falling within the interval ranging from 5 to 240. The average duration of the projects was 19.98 months, with the duration ranging between 2 and 90 months. Average project budget was EUR 7.452.367, i.e. ranging between EUR 30.000 to EUR 55 million. The research included 10 program managers/directors, 27 project managers and 38 members of project teams. The majority of projects in organizations covered by this research were implemented in Serbia, whereas only a few were executed abroad (in ex-Yugoslav states). Based on the data about the characteristics of the sample, it can be concluded that the research presented herein is consistent with the trends in the area of project management in the energy sector in Serbia and can, therefore, be taken as a foundation for assessing the actual state of matters in project management in the organizations observed, as well as for the formulation of recommendations for further improvement. Furthermore, it is useful to point out that there are no statistically relevant dependencies between the success of the implementation and the number of people hired for the projects, the duration of project implementation and project budgets. Therefore, the sample constitutes an adequate basis for further research of project maturity in the Serbian energy sector.

The principles of examination of project maturity in individual organizations were used as a starting point for analysis of project maturity in Serbian energy sector. Inclusion of the majority of energy companies in Serbia in this research facilitated the identification of common characteristics of project management practices in this sector nationwide.

The research presented herein was envisaged so as to incorporate all questions and elements of project maturity most pertinent to the successful implementation of this type of projects, not necessarily adhering to the format of any of the existing project maturity models mentioned in the second chapter. The research of the project maturity in energy sector, presented in this paper, is the first of this kind in Serbia. The results obtained in this research, as well as the recommendations for further improvement, may largely contribute to the more efficient implementation of energy projects.

Analysis of the results obtained should be complemented with the results of the statistical testing relating to the existence of statistically relevant dependencies between certain categories in the research conducted and statistical differences in maturity between strategic and operational levels of management of observed projects.

According to Andersen and Jessen (2003), the concept of maturity indicates that there might be a development from one level of capability to a higher one. One of the goals of this research is to establish whether there is a statistically important difference in maturity between managing the project as a whole and managing individual activities within it. For this purpose, we have compared 2 groups of answers relating to the questions that directly correspond to different levels of project management: the level of project/program and the level of activities. The value of paired t-test equals 4.143, with statistical relevance at 0, which means that there is statistically important difference in project maturity on the level of project/program on one side and project activities on the other. In addition, according to statistical data, we can conclude that energy projects in Serbia are better managed on the level of entire program/project than on the level of individual activities.

4. ANALYSIS OF RESEARCH RESULTS AND DISCUSSION

Analysis of gathered results relating to various aspects of project maturity and individual questions has shed the light on some of the obvious problems in the area of managing energy projects in Serbia. Some of these problems are as follows:

- Project management office is not adequately developed;
- IT systems are not sufficiently used;
- Poor risk management;
- Poor planning, particularly in the segment concerning the use of methods, techniques and mechanisms for monitoring project implementation;

- Poor results in the area of planning and implementation of benefits, etc.

Furthermore, certain positive examples of project maturity can be identified in individual elements or questions, such as:

- Clearly defined responsibilities and roles of project managers an project staff;
- Relatively efficient financial management;
- Largely successful identification and alignment of benefits;
- Relatively sound communications management, etc.

The results relating to project maturity elements or questions should not be observed independently from other elements or questions. Discerning correlations between different processes of project management provides for appropriate examination of the project maturity and enables us to determine the true nature of any deficiencies, and implement the appropriate improvement measures accordingly.

The results relating to the existence of well-defined responsibilities of project managers and project staff can be considered satisfactory. Given that the clearly defined roles and responsibilities of project management and staff are one of the prerequisites for successful project communication, it is understandable that positive results in this segment reflect positively on solid results in communications management. However, fairly low results were recorded in the segments concerning the existence of project management office (42.7% positive answers and as much as 32% negative answers). The main functions of project management office (PMO) are: risk management; communications management; use of software tools in project management, and stakeholder management (Mihic, 2010). Also the PMO plays an important role in project monitoring and coordination. Despite the fact that relatively good results were achieved in some segments of communications management and monitoring of project costs, underdeveloped PMO largely contributed to the poor research results in the area of risk management, IT support and stakeholder management. Absence of a fully functioning PMO or its partial existence in many organizations has a profoundly adverse effect on the existence of efficient mechanisms for project monitoring and coordination among projects/activities with the purpose of transferring surplus resources to those projects or activities that need them. The conclusion is that energy companies in Serbia need to establish PMOs as functional units that would strive to efficiently contribute to the implementation of the organizational strategy. The manager of PMO would have complete responsibility for achieving the project goals of an organization. Based on the results of dependency analysis, it is possible to conclude that the PMO is particularly essential in organizations involved in the implementation of multiple projects involving a vast number of participants, long duration and a sizable budget.

Analysis of planning of the projects/programs points to certain discrepancies between the processes of planning and implementation of projects/programs. Namely, the results of monitoring of the course of projects are in collision with the results relating to resource allocation planning and establishing efficient mechanisms for monitoring project implementation. Given that energy projects often imply considerable funding, and that, as a result of long duration, frequent changes take place in the course of implementation, it is important to monitor the course of the project on a regular basis. Consequently, it is understandable that over 90% of the organizations partially or fully monitor the use of resources and changes in cost structure. However, in order for the monitoring to be efficient, it is important to clearly define and implement a system for monitoring the course of project. This system should largely be supported by information technologies, i.e. appropriate software solutions. Poor results in these segments are the result of an inadequate structure and level of development of the PMO, as mentioned earlier in this paper. Fairly low implementation of project planning methods and techniques (such as WBS diagrams, milestones, schedule analysis, etc.) are rather easy to identify in the segment of planning of projects/programs. The use of these methods largely contributes to the success of project implementation as it forms the basis for risk analysis, assessing the duration of the project, its budget, number of participants in the project, etc. Taking all of the above into account, the conclusion is that the organizations operating in the energy sector in Serbia are in need of efficient mechanisms for measuring project progress indicators. These systems should be supported by appropriate software solutions and should be implemented both on the level of individual activities and on the level of programs. Likewise, there is a need for consistent use of methods and techniques of project planning, which, in turn, can contribute to the improvement of other elements of project maturity and improve projects' success rate. This finding was confirmed by analysis of dependencies.

Results of research relating to the identification and alignment of all benefits that the project/program should produce can be regarded as positive (68% positive answers, and only 6.7% negative answers). However, other aspects of benefits management show serious deficiencies, primarily in areas of planning, monitoring and securing the benefits. More often than not energy projects produce direct benefits that are fairly easily identifiable. They mainly consist in improving the energy balance of the country or region, growth of employment in the energy sector, securing procurements for energy industry, increased certainty of energy

supply to consumers, etc. (Mihic et al. 2011, 2012a, 2012b). However, poor results relating to planning, monitoring and securing the benefits, primarily stem from the complexity of this type of projects (several hundreds or thousands of activities, long implementation periods, unforeseen events…) and identified deficiencies in use of project planning methods and techniques. Analysis of dependencies has proven that efficient benefits management is critical for the success of any project.

Risk management is of the weakest aspects of project maturity. It has already been pointed out that energy projects often encounter problems such as exceeding deadlines and budgets. The root cause of these lies in the project/program planning phase. The planning phase in energy projects is often affected by varied stakeholder interests in terms of time or cost constraints. The budget is often set according to estimated costs, and it often does not include contingency reserves. The situation is similar in the case of overall project duration. Since the budget and the timeframe are preset, the need for thorough risk analysis seems to disappear. This analysis would, however, cover a detailed identification of risks, assessing the likelihood of their occurrence, and defining the procedures for risk avoidance, reduction or addressing the consequences. This is the reason why risk analysis is taken somewhat more seriously on the level of entire project/program, whereas on the level of activities only key risks and the likelihood of their occurrence, reduction procedures and response plans are identified.

In terms of the strategic aspect of project management in Serbian energy sector, the gathered results indicate the need for improvement of the implementation of strategic management in observed organizations. To be precise, 61.3% of managers in the surveyed organizations have recognized the need for strategic management and 72% of the organizations have a strategic plan in place. This in itself is a positive result. However these results are inconsistent with the much less positive results of the examination of well-defined phases in strategic management and the existence of the department for planning and (strategic) analysis. Likewise, positive results were recorded in relation to the examination of central coordination of resources in an organization (62.7% positive answers), but these were also inconsistent with the identified deficiencies of project management office, efficient coordination of multiple projects and the existence of professional mechanisms for project monitoring. The results obtained lead to the conclusion that Serbian energy sector is in need of further strengthening of the links between strategic and project management, in order for the strategic goals of an organization, as well as of the entire country, to be achieved. The links between an organization and project management should be strengthened trough the development of strategic plans specifying the roles and responsibilities of both the functional units and the PMO in the attainment of an organization's strategic goals during the course of project implementation.

Having in mind the previously described characteristics of project maturity in Serbian energy sector, it is necessary to define measures aimed at removing deficiencies in project management and at encouraging a faster development of the energy sector. The proposed measures are presented in Table 1.

Table 1: Summary of recommendations for improving project management maturity in Serbian energy sector

Area	Recommendations
General	• A more detailed project planning and management, most of all on the level of individual activities; • Education of project managers relating to the implementation of project management methods and techniques, as well as to the use of relevant software tools.
Program/project management	• Establishing of PMO in organizations implementing a numerous large-scale projects; • Establishing efficient mechanisms for monitoring project progress; • A more intensive implementation of project planning methods and techniques supported by adequate software tools; • Establishing an efficient system for coordinating parts of a project.
Benefits from the program/project	• Definition of plans and responsibilities relating to project benefits.
Risk and quality management	• Definition of risk management procedures on the level of project phases and activities within a project. • Establishing a special service in charge of project quality management; • Certification of quality management system; • Definition and consistent implementation of quality plans in all projects.
IT support	• Implementation of project management software and adequate training of project staff.

5. CONCLUSION

The research of project management maturity in the energy sector was conducted in Serbia in 2013. It featured a questionnaire divided into nine areas of project maturity. The research has shown that organizations in this industry are not fully prepared for numerous, dynamic, large-scale changes expected in the forthcoming period. Energy projects, their complexity and inherent risks, as well as the fast-paced changes characterizing the contemporary market and world in general, impose an obligatory improvement of nearly all project management processes in organizations. An integrated analysis of results from the entire questionnaire confirmed that managers lack proper training for leading energy projects, stressing the need to implement extensive measures aimed at professional and specialized trainings. An analysis relying on the elements of project maturity detected several critical points relating to project management in Serbian energy sector. Key areas that, according to the results, require immediate improvements are: establishing of a functional PMO; utilization of risk management tools; use of software solutions for planning and monitoring project implementation; improved communication with stakeholders, etc. The statistical analysis of gathered answers confirmed that an adequate implementation of project management methods and techniques is necessary in projects requiring substantial investments, involving long duration and numerous staff, because it contributes to a higher success rate of projects. In addition, a statistical analysis confirmed that project management teams focus more on projects than on individual activities within them. This also stresses the need for a more intensive implementation of project management methods and techniques in energy projects implemented in Serbia.

Energy sector in Serbia faces considerable challenges. Investments expected in this area over the years to come can potentially generate immense benefits to the society. Nevertheless, in order for these benefits to be generated, it is important to manage the projects in this area efficiently. Application of the project management maturity model facilitates assessment of the current capacities of Serbian organizations to successfully implement energy projects, and offers a set of recommendations aimed at improving project management processes. Only a consistent implementation of project management concepts in the energy sector will lead to the achievement of strategic goals of, not only the energy companies, but also the Republic of Serbia, as defined in the national development strategies.

REFERENCES

Andersen, E. S., Jessen, S. A. (2003). Project maturity in organizations. International Journal of Project Management, 21 (6), 457-461.

Cooke-Davis, T.J., Arzymanov, A. (2003). The maturity of project management in different industries: An investigation into variation between project management models. International Journal of Project Management, 21 (6), 471-478.

Crawford, J.K. (2006). The Project Management Maturity Model. Information Systems Management, 23 (4), 50-58.

Flyvbjerg, B., Flyvbjerg, C. (2004). Procedures for Dealing with Optimism Bias in Transport Planning: Guidance Document, United Kingdom Department for Transport, London, UK.

Loader, R.J. (2006). The role of enterprise project management in improving organizational project performance. International Conference in Project Management, Sydney, Australia.

Mihic M. (2010). Strategic Aspects of Project Management Maturity Analysis of Serbian ICT Sector. Proceedings of the XIV International symposium YUPMA 2010, Opening lecture, Zlatibor, Serbia.

Mihic M., Petrovic, D., Vuckovic, A. (2012a). Energy efficiency project portfolio optimization for public buildings. Metalurgia International, 17 (6), 166-173.

Mihic, M., Petrovic, D., Vuckovic, A. (2011). Possibilities of application of Cost-Benefit analysis to energy efficiency projects in buildings. Economic Themes, 49 (3), 355-378.

Mihic, M., Vuckovic, A., Vuckovic, M. (2012b). Benefits management in energy efficiency projects in public buildings. Management, 17 (62), 57-66.

MMERS (2005). Energy development strategy of the Republic of Serbia by 2015. Ministery of Minning and Energy of the Republic of Serbia, Retrieved from http://www.mie.gov.rs/dokumenta/ (accessed: 20 August 2012) (In Serbian)

Oka, S., Sedmak, A., Djurovic-Petrovic, M. (2006). Energy efficiency in Serbia – research and development activity. Thermal Science, 10 (2), 5-32.

PMI (1996). A Guide to the Project Management Body of Knowledge. PMI Standards Committee, Project Management Institute, Newtown, PA, USA.

Statistical office of the Republic of Serbia, *External trade of the Republic of Serbia, 2012, final data*. Belgrade, 2012., Retrieved from http://webrzs.stat.gov.rs/WebSite/repository/documents/00/01/07/42/st12g072013e.pdf (accessed: 3 August 2013)

UN (1987). Report of the World Commission on Environment and Development – Our Common Future. United Nations, Available online at: http://www.un-documents.net/our-common-future.pdf (accessed: 20 August 2012)
Zhang, M., Wang, W. (2011). Analysis of China's energy utilization for 2007. Energy Policy, 39 (3), 1612-1616.

EMOTIONAL INTELLIGENCE: NEW COMPETENCE OF PROJECT MANAGERS

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Abstract: *Emotional intelligence is not a new concept. However it is not applied to modern management in an adequate manner. This paper tries to examine whether this personal characteristic is needed competence for successful project manager. For this purpose, substantial theory review was conducted and two surveys were analyzed. Results show that there is correlation between success of project managers and their competence. Also it is clearly shown that project managers do need to have emotional intelligence in order to run successful projects and move forward in their careers.*

Keywords*: emotional, intelligence, competence, project, manager*

„Emotional intelligence, more than any other factor,
more than intelligence, or expertise, counts 85% to 90% success on the job...
Intelligence is the limit.
You need but it, but it cannot make you a star.
Emotional intelligence can.“
Warren Bennis

1. INTRODUCTION

Project managers should understand that the people involved in it represent a heart and a soul of every single project - their relationships, skills and ability to function as a compact entity. Skilled project managers from the first day of the project focus their attention on the understanding of human dynamics and predict possible human interaction along the project. Human Dynamics is based on researches originated back from 1979, which involved more than 40,000 people from 25 different cultures. They identify and document the inherent differences in the functioning of the people as a part of a system. Generally, team dynamic is defined as a motivating and driving force that "pushes" the team members towards achieving their goal or mission. It is a social process in which people interact and behave in accordance with environment of the group they belong to.

The starting point for the use of emotional intelligence is when you realize that project management refers to the work with other people. Project manager's success depends on the other people involved in the project. In order to achieve what was important, it is necessary to work at the team level. Big and important projects generally require big and effective project team, as well as an effective project manager. Efficient project teams do not just happen, they are carefully prepared by a group of highly qualified (in terms of skills and abilities) and motivated individuals who have a clear picture of their own goals and receive a clear and tangible evidence of their accomplishments.

People do not realize the importance of emotions in general, and today especially they do not understand their key role in the doing business. In terms of project management, emotional intelligence can be crucial to the success of the project. It is essential that the project manager becomes aware of his own feelings, learn to trust them and accept them as a source of information. If he or she properly recognize and regulate its own emotions and the emotions of the team members, this will be helpful in carrying out the project activities, resolving potential problematic issues, becoming a better leader and will create a "dream team", which will be, thanks to the good atmosphere and the energy, more productive and achieve a better performance.

2. EMOTIONAL INTELLIGENCE

Intelligence comes from the Latin word *inteligere*, which means understand, comprehend. Many definitions do not currently define it as mental function. Certain authors state that intelligence is the ability to solve new problems and cope with new situations, and some believe that it includes the capacity for abstract thought,

understanding the causes and consequences of a problem, the ability to distinguish important from unimportant, ability to learn and to adapt to a given goal. Other authors focus on intelligence as the ability of small and rapid learning and acquiring new skills.

David Wechsler defines intelligence as a global concept of an individual to act with intention, think rationally and effectively deal with its environment (Wechsler, 1958).

Numerous studies of intelligence, lead to the conclusion that intelligence has its own categories, and this model is called model of multiple intelligences defined for the first time by Howard Gardner (Gardner , 1983). He named the six categories of intelligence that involves the abstract (symbiotic reasoning, mathematics and formal logic), social (understanding the social context and addressing the people), practical (common sense), emotional (awareness and managing own emotions), aesthetic (sense of form, design, music, art and literature), and kinesthetic intelligence (skills of the whole body including sports, dance, music). After him, Sternberg gave a little clearer and more accepted image of intelligence by defining its aspects, so-called aspects of successfulness. The concept of multiple intelligences (MI model) is based on the idea that human beings are equipped with the whole range of mental abilities, not just IQ and is now widely accepted in business and in education. MI model radically changes the view of intelligence as a genetic predisposition, an innate ability that never changes and makes it clear that the "intelligence" is capabilities that can be learned and developed. Intelligence is now divided into seven intelligences as follows:

- Analytical Intelligence - refers to the resolution of problems which means that clearly defined problem has only one solution;
- Creative intelligence - a new situation creates new ideas;
- Practical intelligence - involves the lack of clear, common situations with multiple solutions;
- Social intelligence - is successful navigation the complex social situations;
- Emotional intelligence - observation, expression, understanding and regulation of emotions;
- Moral Intelligence - involves understanding and judgment, righteousness;
- Existential intelligence - raises questions about the meaning, life, and death.

Project Management Institute has published research on the intelligence in the project environment. The research shows that intelligence is a factor of success in almost all projects, and has an incredibly large impact on the achievement of project objectives. The project team, led by project manager must possess the competence of not only cognitive intelligence, but also many other competencies that are based on the individual capability as well as the ability to establish positive relationships between all members of the project team. PMI lists the following types of intelligence in the project:

- Professional Intelligence - the ability to master and control the knowledge, information and skills within a given project professional environment;
- Rational intelligence - the ability to solve logical problems in the project environment;
- Physical Intelligence - the ability to learn and master the physical skills;
- Creative intelligence - the ability to produce new and original ideas;
- Emotional intelligence - a productive personal interaction of team members (self-confidence, self-control, self-motivation and empathy);
- Social intelligence - the ability to accomplish complex social skills such as teamwork, communication, conflict resolution, harmony, achievement of consensus, multiculturalism; and
- Leadership Intelligence - the ability to express leadership skills such as leadership, motivation, negotiation, influence and control.

Recent research after 90s have confirmed that there is an emotional brain - a place called the limbic system, where our emotions reside. This place is separate from the rational part of the brain (the neocortex), but they are certainly linked and developed together. This means that our power of reasoning and our feelings are intended to be used together. Because of the design of the brain, all the information go first to our emotional center, and then in the center of our thinking. Emotions come before thoughts and behavior. What scientists have confirmed is that we badly need our emotions, our feelings which "turn on the engines" that produce energy and creativity. As a result of these studies, it has become important to understand what we feel, what other people feel, how to manage our own emotions and how to manage relationships with other people. This is the essence of emotional intelligence - terms used to describe the complexity of regulating our impulses, connecting with other people, and resilience in the face of difficulties. Because of this, emotional intelligence is the product of a number of information exchanges between the rational and the emotional center of the brain (Mackin, 2006).

Among researchers there is a lot of indecisions when it comes to emotions. While most agree in their basic set, their opinions differ when it comes to less well-known emotions. One of the most common definitions of emotions explains that emotions are a mental condition that often arises spontaneously rather than through

conscious effort and are often accompanied by physiological changes, feelings - feelings of joy, sadness, respect, love and hate (The American Heritage Dictionary of the English Language, 2006).

Founders of emotional intelligence are two psychologists Peter Salovey and John D. Mayer who, with their definition of emotional intelligence pushed psychological concept forward, who received the most attention in the academic and practical literature ever since (Salovey & Mayer, 1990). According to them, emotional intelligence is the "ability of monitoring our own emotions and feelings, and emotions and feelings of others, the ability to create discrimination among them and the use of this information for the management of our own thoughts and actions."

Their model includes and identifies five main areas: understanding own and other people's emotions, managing emotions, self-motivation, recognizing emotions in others, and relationship management. After Salovey and Mayer's research, interest in emotional intelligence has begun to grow significantly, and many authors have begun to explore this concept. Each of them gave their own "stamp" to emotional intelligence, by changing certain competencies it covers, but basically, it all finally came down to research Salovey and Mayer's. It is a great pity that the two of them did not called the concept of emotional intelligence using something that is characteristic for them, say "SaloMayer principle" because in future studies this term was used as a global term.

In 1995, Daniel Goleman wrote the book "Emotional Intelligence - why it can matter more than IQ?", which rapidly became a bestseller. After that, he wrote more books on this subject, linking emotional intelligence with a successful business and this book became synonymous for this concept. His definition, perhaps the most general of all, states: "The ability to recognize our own and others' emotions, self-motivation and managing emotions in ourselves and our relationships with other people. (Goleman, Emotional Intelligence: Why It Can Matter More Than IQ, 1995)"

Goleman adapted by Salovey and Mayer's model as a basis for its discussion on the theory of emotional intelligence and its impact on life, including the business world. He adapted the model of emotional intelligence to develop four emotional competences and this is one of the most accepted and most widely used approach in the development of emotional intelligence in humans. He lists the following competencies:

1. Self-awareness. High emotional intelligence is associated with high self-awareness, which means recognizing and interpretation of emotional signals in ourselves and others, and the impact of emotions on the other. Once a person becomes aware of its own thoughts and feelings, he or she can use them as positive thoughts and feelings - the instructions. A high level of self-awareness leads to self-confidence, realistic self-assessment and a sense of humor. He stated that the skills associated with self-awareness include:
    - Emotional self-awareness – recognition of our own emotions and their effects (recognition of emotions, connecting feelings with actions, words and thoughts, understanding the impact of emotions on performance, possessing leading awareness of personal values and goals).
    - Accurate self-assessment - knowledge of our own strengths and limitations (awareness of personal strengths and weaknesses, ability to learn from experience, open to sincere feedback, new perspectives and personal development, the ability of showing a sense of humor and own perspectives).
    - Self-confidence - honest belief in ourselves (the ability to have the confidence and "presence", demonstration of views that are different and/or unpopular, determination and decisions making despite uncertainty).
2. Self-management. The ability to use awareness of our own emotions in order to provide flexibility and direct and positive behavior. Self-management is a strategy to change our own mood, a tendency not to judge other people and to think before acting. Emotions affect the personal performance, and the performance of the other. Emotions are contagious. People with self-management skills tend to show integrity and reliability, are open to change and are comfortable with ambiguity. Self-management skills help people to overcome the perspective of "victims" and reframe stressful situations into a challenge, in addition to becoming more than feasible. Knowing and managing our own "emotional triggers" is critical for self-management. It includes the following components:
    - Self-control - managing disruptive emotions and impulses (managing impulsive feelings and stressful emotions, staying calm and positive even in difficult times, thinking clearly and stay focused under pressure).
    - Trust - maintaining standards of honesty and integrity (to act ethically and above complaint even in the face of conflicting emotions, to build trust through reliability and authenticity, admit mistakes and deal with the actions of others).

- Conscientiousness - taking responsibility for personal performance (to learn about the obligations and keep promises, to be responsibility to the goals).
- Adaptability - flexibility in managing change (smoothly managing various demands, changing priorities and rapid introduction of change, flexibility of views on situations and events).

3. Social consciousness. Once a person becomes aware of his own emotions honestly and with the intention of understanding them, it's time to look around itself. Emotional intelligence is reflected in the inclusion of our own feelings and the feelings of people around us. A key component of social consciousness is empathy, which is basically the ability to see the world from another's perspective. It begins by listening. Individuals who do not have the skills of empathy are more focused on their own needs and problems and do not pay attention to anyone else. They do not build positive relationships with others. Social awareness involves the development of positive and effective relationships with people in the environment and the ability to communicate in order to prevent conflict, achieve higher consciousness and light distribution of the basic tension that can accumulate and have a negative impact on work relations. These relationships encourage cooperation and teamwork. Research shows that people when they get to know the other person, within 3-5 seconds determine whether they like him or her and if he or she can be trusted. This is how much it takes for the emotional part of the brain to form a first impression. The rational part of the brain does not have time to engage, and it deliver an intellectual proof later on. Components of social consciousness are as follows :
   - Empathy - feeling other people's emotions and perspectives and demonstrating an active interest in other people's problems and concerns (paying attention to the emotional signs and good listening, showing sensitivity and understanding of others' perspectives, providing assistance on the basis of understanding of others' needs and feelings).
   - Orientation - predicting, identifying and meeting the people needs (answering to their needs, finding ways to increase satisfaction and loyalty of others, offering appropriate assistance).
   - Political awareness - identifying current and potential emotional relationship of the group (accurately identifying key relationships, detecting crucial social networks, understanding the forces that shape the attitudes, views and actions, "reading" the situation accurately).

4. Relationship management. Relationship management involves mastering the skills of self-awareness, self-management and social awareness that paves the way for more effective relationships. It refers to the interaction with people and skills in managing others' emotions. Relationship management includes:
   - Impact - the use of effective negotiation tactics (skillful persuasion, the use of complex strategies like indirect influence to obtain consensus and support, management of dramatic events to effectively highlight some key points).
   - Communication - sending clear and convincing messages (efficiency of sending and receiving emotional signals, openly dealing with difficult issues, good listening, mutual understanding and full exchange of information, fostering open communication and humility in accepting the bad news).
   - Conflict management - negotiation and resolving misunderstandings (dealing with difficult people and tense situations diplomatically and tactfully, identifying potential conflicts, disagreements and bringing them to light, encouraging debate and open discussion, providing win-win solutions.
   - Collaboration and cooperation - functioning with the others towards common goals (directing focus on duties with special emphasis on relationships, free sharing plans, information and resources to promote friendly, cooperative climate, nurturing the opportunities for collaboration).

Matthews, Zeidner and Roberts (Matthews, 2007) published their research and make a distinction between two concepts of emotional intelligence - the capabilities model of emotional intelligence and attributes model of emotional intelligence.

The first model explains emotional intelligence as the ability similar to cognitive abilities and measure it through tests based on performance. It is seen as another legitimate form of intelligence. This model is also known as emotional cognitive capabilities or emotionally intelligent information processing. This model uses Salovey-Mayer's definition and explains that emotional intelligence is divided into four branches. The first relates to the emotional identification, perception and expression – it deals with the ability of accurate perception of emotions in verbal and nonverbal behavior of others. The second one relates to the emotional relief - the ability to use emotions to assist thinking and problem solving. Third, emotional understanding is the ability to analyze feelings, discrimination of emotions and thinking about the results. Finally, emotion management deals with the possibilities of reflection and change of feelings.

The second model, a model of emotional intelligence attributes, perceive it in relation to personality and self-reporting. In this model, emotional intelligence is defined as a set of cognitive skills, competencies and skills that influence one's ability to successfully struggle with the demands and pressures of the environment.

This model uses the broadest definition of emotional intelligence. Capabilities such as perception of emotions are usually combined with non-cognitive competencies, abilities and personality attributes. This model measures the five wide factors and fifteen aspects, namely:

- Intrapersonal - emotional self-awareness, self-confidence, independence, own meaning and self-actualization;
- Interpersonal - empathy, social responsibility, and interpersonal relationships;
- Stress management - stress tolerance and impulse control;
- Adaptability - reality testing, flexibility and problem solving;
- General mood - optimism and happiness.

There are conceptual and methodological issues related to research of emotional intelligence with this mixed model, mainly due to the ambiguous definition and very broad content of the model.

Hendrie Weisinger said: "People are born with the ability to regulate emotions, like a thermostat, but rather to nurture skills, most people walk around them, like mercury in a thermometer, only as a response to what is visible around them. (Weisinger, 2000)" He believes that whenever people blame someone else for the way they feel or behave, they gave up control over their emotions and behavior and handed control to the people around them. Also, according to managers, leaders or people with a high coefficient of emotional intelligence understand that people need to be valued and appreciated, that they need a sense of belonging, a real future, a future full of hope, and the basic organization of their lives.

Bruce Cryer and Lew Childre added to the above Goleman's definition that emotional intelligence improves through the internal quality management (Bruce & Lew , 2004). They say that it is about a genuine increase in the internal coherence and balance in person, and that there is not any doubt that emotional conditions of people affected by the brain and its ability to process information.

We can conclude that all the research on emotional intelligence and its definition can be reduced to four, what we can call - components:

- Self-awareness,
- Social awareness,
- Relationship management and
- Managing emotions.

These components can be viewed through two dimensions related to social and personal skills. Personal competencies include self-awareness and self-management, i.e. own emotions, and the social skills relate to social awareness and relationship management.

3. PROJECT MANAGERS AND EMOTIONAL INTELLIGENCE

If you take a look at list of the competences successful project manager should have, even though there are numerous competences, most of the authors dot mention emotional intelligence as a necessary one. Having that in mind we have conducted several researches trying to establish whether that is important or not.

One of the researches was focused on identification of correlation between project managers' emotional intelligence and educational and business success. A sample of 75 project managers had to show are there any correlation between emotional intelligence and success. One of the standardized test was used. Results show (Figure 1.) that Project managers on top management level have an average EI of 4.33, on executive management level 4.09, on middle management level 3.68 and on operational management level 3.71 (Obradović, Jovanović, Petrović, Mihić, & Mitrović, 2013).

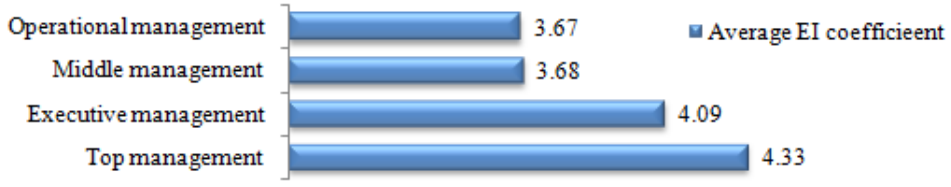

Figure 1. Coefficient of EI in relation with position in organizational hierarchy

Another research conducted had slightly different focus. It aimed to all managers in the organization, not only project managers and to establish is there any correlation with type of manager and emotional intelligence. Results show that highest level of emotional intelligence have middle managers which are actually project managers since the survey was conducted in a project based organization.

Table 1. Emotional intelligence levels on various managerial positions

Managerial level	Average emotional intelligence
Operational management	3.90
Middle management	4.25
Executive management	4.06
Top management	4.19

One can see that results show different results in these two researches, implying that there are differences in emotional intelligence among various managerial levels, but also among different types of managers.

4. CONCLUSION

We came to the conclusion that emotional intelligence is defined by mixed set of capabilities that allow a person to manage themselves and others. This definition can be more accurate if it is accompanied with frequency with which an individual shows itself or use constituent skills or competencies inherent to emotional intelligence that determines the way in which certain persons deals with itself, life and, other people. Decades of research of the effects of psychotherapy, cognitive behavioral therapy, training and education programs have shown that people can change their behavior, mood and self-image (Goleman, 2001).

The current conceptualization of emotional intelligence raises a challenging question: Can a person change their capabilities in a set of competencies that makes emotional intelligence, and that has been proven to bring great results in many occupations, including project management? Series of studies conducted on this topic, confirm that people can change in relation to the competencies of emotional intelligence, usually within two to five years (Weatherhead School of Management (WSOM) of Case Western Reserve University).

Daniel Goleman states that there are three reasons why a person may wish to develop their emotional intelligence. The first is to increase the effectiveness of the work or to increase of the potential for improvement. The reason could be called career development objective or professional development. Another reason is that a certain person wants to become a better person, which is connected with the goal of personal development. Third, people may want to help other people to develop emotional intelligence. All these reasons lead to the simple conclusion that people definitely need to work on their personal development in terms of emotional intelligence competencies, and a starting point for this development and self-change is actually finding out who we really are and who we want to become.

Exploring this theme we have proved that an improvement in emotional intelligence assist project managers in developing their careers and the impact of this concept on the success of the project manager is really great.

Anhtony Mersin states that while working with project managers he realized that they really understand the emotional intelligence at a concept level (Mersin, 2006). The challenge for them is that they lack the tools to use this concept in project management. Ultimately, how you use emotional intelligence in project management?

In life, it is clear that the smartest people are not always those who are the most successful and most fulfilled. There are people who have excellent academic background, but who are socially unsuccessful in work or in their personal relationships. Emotional intelligence affects the following:

- Success on work
- Physical health
- Mental health
- Connections and relationships with other people

All information come into our brain through our senses, and when the information is too stressful or emotional, instinct can take over the ability of behavior. In order to have access to a wide choice and the ability to make good decisions, primarily we need to be able to balance the emotions that arise. It is clear that in order to enhance emotional intelligence primarily we need to understand and learn to manage our own

emotions. This can be achieved by developing key skills for the control and management of overwhelming stress and effective communication. Each skill is build on the lessons learned from the past and by practicing following (Segal & Smith, 2014):

1. Quick reduce of stress at different times;
2. Recognizing own emotions and keeping away from indulging them;
3. Emotional bonding with other people through the use of non-verbal communication;
4. Using healthy humor and a connections in challenging situations;
5. Resolving conflicts in a positive manner and with trust.

By emphasizing the importance of emotional intelligence for project management, as well as in relation to the above-mentioned quote, we conclude that the impact of emotional intelligence on the performance of project managers is extremely high. Emotional intelligence of the project manager can make a different and much needed "star" in every modern organization.

Open expression of thoughts, feelings, and intentions allows people to really see each other for what they are and encourages confidence and building of positive social relationships. These managers are freed from prejudice and very clear and real in observing current relationships and situations. Knowing yourself and having the ability of making good choices when it comes to relationships, fosters a climate in which even the most diverse and difficult issues can be discussed. Self-conscious project manager is at all times ready to undertake concrete actions and absolutely sure about decisions he or she made, displaying at the same time a clear opinion on issues related to the implementation of projects.

What are the possibilities of a project manager who has a strong sense of empathy? People believe that others are really interested in their feelings, intentions, problems and deepest hopes. The project manager must take the time for the members of his team in order to understand exactly what they feel and think. This kind of relationship creates authentic and close relationships between people and assist managers to cooperate with people from their project team much easier.

What are the possibilities of achieving the objectives of the projects being run by a project manager who has the perspective to see the needs and interests of all members of the team? Such manager, even in difficult and dangerous situations reflect careful and firm presence. It is clear that people with this brilliant ability to influence other people are respected and valued for their vision and the possibility of transforming people through building relationships of trust. The possibilities are simply immeasurable.

Emotional intelligence coefficient of various managerial levels are different. It turned out that mid-level managers that are project managers have an extremely high coefficient of emotional intelligence, and therefore a greater awareness of this concept. We certainly believe that in the short time they will become very successful senior level project managers who will be able to manage the most complex projects in a very simple way.

Since this is a concept that will become more and more popular in a future, a concept necessary for any job interview, and certainly for a daily life, it is important to begin a general rise of awareness about emotional intelligence and its competences. For the new generation, a work on this concept will be required in early childhood, and emotional intelligence will be introduced in the education system. We hope that the importance of self-awareness, social awareness, emotions and relationships management will be fully recognized.

REFERENCES

Bruce, C., & Lew , C. (2004). *From Chaos to Coherence: The Power to Change Performance.* CA: HeartMath LLC.

Gardner , H. (1983). *Frames of Mind: The Theory of Multiple Intelligences.* New York: Basic Books.

Goleman, D. (1995). *Emotional Intelligence: Why It Can Matter More Than IQ*. New York: Scientific American, Inc.

Goleman, D. (2001). *The Emotionaly Intelligent Workplace: How to Select for, Measure and Improve Emotional Intelligence in Individuals, Groups and Organizations.* San Francisco: CA: Jossey-Bass.

Mackin, D. (2006). *Emotional Intelligence.* US: New Direction Consulting, Inc.

Matthews, Z. (2007). *The Science of Emotional Intelligence: Knowns and Unknowns.* Oxford University Press.

Mersin, A. (2006). *Project Manager's Guide to Emotional Intelligence.*
Obradović, V., Jovanović, P., Petrović, D., Mihić, M., & Mitrović, Z. (2013, March 29). Project managers' emotional intelligence – a ticket to success. *Procedia – Social and Behavioral Sciences, 74*, 274-284.
Salovey, P., & Mayer, J. (1990). Emotional intelligence. Imagination, Cognition, and Personality. *9*, 185-211.
Segal, J., & Smith, M. (2014). *Key Skills for Raising Emotional Intelligence.*
The American Heritage Dictionary of the English Language. (2006). Boston: Houghton Mifflin Company.
Weatherhead School of Management (WSOM) of Case Western Reserve University. (n.d.).
Wechsler, D. (1958). *The Measurement and Appraisal of Adult Intelligence.* Baltimore: The Williams & Wilkins Company.
Weisinger, H. (2000). *Emotional Intelligence at Work: the Untapped Edge for Success CA: Jossey-Bass.* San Francisco: CA: Jossey-Bass.

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HOW TO SELECT THE BEST PROJECT MANAGER?

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Abstract: *This paper proposes a method for ranking candidates according their past performance and their qualitative personal qualifications for managing a project. The rank allows selecting the best candidate to be the project manager. The method also allows evaluation of the past performance of project managers. The proposed method combines between two common methodologies: the Data Envelopment Analysis (DEA), the Analytical Hierarchical Process (AHP) and ranking methods via DEA. The method is especially useful for the assignment of project manager for an important project.*

Keywords*: Project Management (PM), Analytical Hierarchical Process (AHP), Data Envelopment Analysis (DEA), Ranking Methods (RM).*

1. INTRODUCTION

Experts for organizations and human resources managers are constantly busy in searching ways to examine the performance of workers and managers. The evaluation of past performance of the employees can be made according to quantitative and/or quality parameters. The evaluation allows to establish a comparison between the workers and to rank them according to their performance. The rank allows selecting the best candidate for a specific job. This paper proposes a method to rank candidates for managing a project. The method also allows evaluation of the past performance of project managers.

A project success is depended on several critical success factors. One important factor is a competent project manager with proven leadership skills (Fortune & White, 2006). In the selection of the project manager his/her past performance should be considered and his/her personal and professional skills. If there are several candidates for managing an important project, it is a common practice to select the best candidate on the basis of several criteria. Some of the criteria are qualitative/subjective (for example, leadership, technical skills and teamwork ability) and others are quantitative/objective related to previous projects (for example, completion time, completion cost and meeting the technical requirements). In order to evaluate the past performance of candidates to be the selected project manager their completed projects should be examined. Many criteria can be used to compare the relative performance success of completed projects. Asosheh et al. (2010) discussed about 30 criteria reviewed in six papers they surveyed concerning IT project management.

The project manager selection process has been widely discussed in the literature. Hadad et al. (2013) surveyed several papers of this topic, here some of them in brief. Zavadskas et al. (2008) proposed a set of criteria for the selection of construction managers. El-Sabaa (2001) conducted a survey concerning the skills of successful project managers. Hauschildt et al. (2000) identified five types of project managers. They calculated the prevalence of each type and examined the success levels of project managers classified to each type. Muller & Turner (2007) claimed that project managers' past performance depends on their competence, particularly their leadership. It can be concluded that the criteria most often taken into consideration are the candidate's personal skills, project management skills, and experience in similar projects. Cheng et al. (2005) concluded that task competencies are specific to a given project. However, when selecting a project manager one must consider both: the past performances of the candidates as well as their suitability for the specific project. Eilat et al. (2006) stated that project performance evaluation is a multiple-criteria problem. The criteria and their weights must be determined and weighted according to the organization's preferences.

In order for project managers to successfully and effectively perform all of their functions, they must be experienced, knowledgeable and skilled - in other words, they must possess competence, and personal competence is proven through certification (Uhlir, 2013). Of course, a certificate cannot guarantee an individual's success, but Uhlir (2013) claimed that a certification is a significant indicator and tool for differentiation between project managers. In this paper we propose we assume that there is a group of certified project managers. The aim is to rank the managers according their past success and according to their qualitative personal criteria and then to select one of them for managing a specific project.

This paper is expansion of the decision-making support system (DMSS) which proposed by Hadad et al. (2013). The DMSS of Hadad et al. (2013) used only objective criteria in order to rank a group of candidates. This paper proposes to use the scores that each project obtains by the previous DMSS as input to a revised

DMSS, and with other qualitative/subjective criteria to obtain a full rank of the candidates. The revised DMSS combines two well-known methodologies: Data Envelopment Analysis (DEA) (Charnes et al., 1978) and the Analytical Hierarchical Process (AHP) (Saaty, 1980). Moreover, the DMSS uses ranking method in the contest of the DEA (see, Adler et al. 2002, Hadad & Hanani, 2011). Combining AHP with DEA can be found for example in: Sinuany-Stern et al. (2000); Hadad & Hanani (2011); Hadad et al. (2013); Yang & Kuo (2003) and others.

2. LITERATURE REVIEW

This section introduces the two well-known methodologies that are at the basis of the proposed model, the Data Envelopment Analysis (DEA) and the Analytical Hierarchical Process (AHP). The DEA evaluates the relative efficiency of Decision-Making Units (DMUs) and the AHP converts qualitative evaluations into quantitative criteria. Furthermore, this section introduces ranking methods in the DEA context that can be used to rank the project managers.

2.1 DATA ENVELOPMENT ANALYSIS (DEA)

The DEA (CCR model) was first developed by Charnes et al. (1978). The DEA is a non-parametric method to evaluate the relative efficiency of DMUs based on multiple inputs and multiple outputs, even if the production function was unknown. The DEA provides a mechanism for measuring a DMU efficiency (in our case project), compared with other DMUs. The DEA methodology solves a linear programing (LP) formulation per DMU and the weights assigned to each linear aggregation are the results of the corresponding LP (Adler et al., 2002). The DEA has become a useful tool for operations researchers (Emrouznejad, et al., 2008 report on over 4000 references on DEA; see also Tavares, 2002 and Seiford, 1996), its use by economists is limited (5%). There are also many papers that use the DEA for comparing project efficiency (for example, Vitner et al., 2006; Eilat et al., 2006; Mahmood et al., 1996, Hadad et al, ,2013, Hadad & Keren, 2013).
The DEA finds different weights for each DMU, such that any DMU in the objective function with the optimal weights will receive a maximal efficiency score. In the DEA, the weights of the inputs and outputs vary from DMU to DMU. Moreover, DEA can distinguish only between efficient and inefficient DMUs (dichotomic classification). Therefore all the efficient units have the same ordering score and it is difficult to rank according to the DEA score. The DEA measures the relative efficiency score as a ratio between the weighted output and the weighted input. DEA calculates for each DMU *k* the ideal weights for each output- U_r^k $\left(r=1,2,..,s\right)$ and the ideal weights for each input-V_i^k $\left(i=1,2,..,m\right)$ that maximizing its relative efficiency score under the restriction that this score is bound by 100% efficiency. If a DMU with its ideal weights receives an efficiency score of 100% - it is efficient, while a score of less than 100% is considered inefficient.
Consider *n* projects, where each project *j* (*j*=1,…,*n*) is characterized by *m* kind of inputs $\vec{X}_j=\left(X_{1j},X_{2j},.....,X_{mj}\right)^T>0$ and by *S* kind of outputs $\vec{Y}_j=\left(Y_{1j},Y_{2j},.....,Y_{sj}\right)^T>0$. The CCR model (output-maximized) for project *k* is formulated as follows:

$$
\begin{aligned}
& h_k = Max \sum_{r=1}^{s} U_r^k \times Y_{rk} \\
& s.t \\
& \sum_{i=1}^{m} V_i^k \times X_{ik} = 1 \\
& \sum_{r=1}^{s} U_r^k \times Y_{rj} - \sum_{i=1}^{m} V_i^k \times X_{ij} \le 0 \quad j=1,....,n \\
& U_r^k \ge \varepsilon > 0 \quad \mathrm{r}=1,2,..,\mathrm{s} \\
& V_i^k \ge \varepsilon > 0 \quad \mathrm{i}=1,2,..,\mathrm{m}
\end{aligned}
\qquad (1)
$$

where ε is an infinitesimal number.
The CCR model assumes that the production function exhibits Constant Returns To Scale (CRTS). The results of the CCR output-maximized formulation are identical to the CCR input-minimized results (Adler et al., 2002).

2.2 ANALYTICAL HIERARCHICAL PROCESS

The Analytical Hierarchical Process (AHP) methodology was developed by Saaty (1980). AHP is methodology to quantify the value of the qualitative/subjective criteria. AHP has been widely used in real-life applications (see a survey in Zahedi 1986, Vaidya & Kumar 2006, Hadad and Hanani, 2011). The AHP is designed for subjective evaluation of a set of alternatives (elements or units in our case) based on multiple criteria, organized in a hierarchical structure. At the top level, the criteria are evaluated and at the lower levels, the alternatives are evaluated by each criterion. The decision maker assesses his evaluation separately for each level and sublevel subjectively. He creates a pairwise comparison matrix in which his subjective evaluation for every pair of items is assessed (Sinuany-Stern et. al., 2000). While AHP has been widely used in real-life applications, there have been some reservations regarding its lack of axiomatic foundations on the utility preferences of the decision maker (see Dyer, 1990 and response Saaty, 1986; Winkler, 1990; Barzilai et al., 1987).

In our case each project manager is evaluated according to several criteria, not all quantitative. The output of AHP is numeric scores of each project manager in each qualitative/subjective criterion. In input of the AHP is a pairwise comparison matrix for every pair of project managers for each qualitative criterion that is created by the decision makers. A common scale of values for pairwise comparison is ranging from 1 (indifference) to 9 (extreme preference). Note that in AHP, the pairwise comparison matrix $A=\left(a_{i,j}\right)_{n\times n}$ on the diagonal has a rank of 1 $\left(a_{i,i}=1\right)$ and the elements $a_{i,j}$ reflect the evaluation of i over j, $a_{i,j}=1/a_{j,i}$ and each element in the matrix is strictly positive - $a_{i,j}>0,\ i=1,2,...,n,\ j=1,2,...,n$ .If $a_{i,j}<1$, it means that i is evaluated less than j .

For *n* project managers and *m* criteria the number of comparisons to be carried out is:

$$m(n^2-n)/2+m(m-1)/2.$$

According to Saaty's definition, the eigenvector $\vec{N}$ of the maximal eigenvalue λ_{max} of each pairwise comparison matrix is utilized for ranking the project managers. For more detail about the AHP methodology see Saaty (1980, 1986, 1990). AHP has been widely used in real-life applications (see a survey in Hadad & Hanani, 2011).

Saaty (1980) defined a statistical measure to test the consistency of the respondent. The statistical measure of the consistency index (CI) is:

$$CI=\mu=\frac{\lambda_{max}-n}{n-1}$$

and the Consistency Ratio (*CR*) is given by:

$$CR=\left(\frac{CI}{RI}\right)100\%.$$

where:

λ_{max} - is the maximal eigenvalue of the matrix,

n - is the number of rows/columns of the matrix,

RI - is the random index. It is the average of the CI for a large number of randomly generated matrices. The values of RI can be found in the table that developed by Saaty (1980, p.51).

The consistency of the decision makers can be checked by the value of CR. Generally, if the CR is 10% or less, the respondent is considered consistent, acceptable, and the computed comparison matrix can be used (Saaty, 1980). If $CR>10\%$, the respondent is not consistent and he/she must correct his/her pairwise estimations.

2.3 RANKING METHODS

There are many different methods for ranking DMUs within the DEA context (for reviews see Adler et al., 2002, Hadad & Hanani, 2011). This sub-section presents two of them.

2.3.1 THE SUPER EFFICIENCY METHOD

One drawback of the DEA methodology is that it does not rank efficient DMUs (those with efficiency scores of 1). To overcome this drawback Anderson & Peterson (A&P) (1993) proposed the Super efficiency ranking method. They suggest allowing the efficient DMUs to receive a score greater than 1 by dropping the constraint that bounds the score of the evaluated the efficient DMU to 1. The A&P formulation for the DMU *k* is follows:

$$
\begin{aligned}
& h_k = Max \sum_{r=1}^{s} U_r^k \times Y_{rk} \\
& s.t. \\
& \sum_{r=1}^{s} U_r^k \times Y_{rj} - \sum_{i=1}^{m} V_i^k \times X_{ij} \le 0 \quad for\ j = 1,2,..,n,\ j \ne k \\
& \sum_{i=1}^{m} V_i^k \times X_{ik} = 1 \\
& U_r^k \ge \varepsilon > 0 \qquad r = 1,2,..,s \\
& V_i^k \ge \varepsilon > 0 \qquad i = 1,2,...,m
\end{aligned}
\tag{2}
$$

2.3.2 THE CROSS EFFICIENCY METHOD

Other drawback of the DEA methodology is that it does not use common weights while evaluating the efficiency of DMUs. To overcome this drawback Sexton et al. (1986) proposed the Cross Efficiency (CE) ranking method. This subsection presents the steps for setting the score of each DMU by the CE.

Step 1 – Find the optimal weights $u_r^k \ \left(r = 1,2,...,s;\ k = 1,2,...,n\right)$ and $v_i^k \ \left(i = 1,2,...,m;\ k = 1,2,...,n\right)$ by the CCR model.

Step 2 – Calculate the elements of the cross-evaluation matrix as follows:

$$
h_{k,j} = \frac{\sum_{r=1}^{S} u_r^k \times Y_{r,j}}{\sum_{i=1}^{m} v_i^k \times X_{r,j}},\ k = 1,2,...,n,\ j = 1,2,...,n\ .
$$

Thus, $h_{k,j}$ represents the efficiency given to DMU j in the CCR run of DMU k (the efficiency of DMU j by the optimal weights of DMU k).

Step 3 - Calculate the score for each DMU j as follows:

$$
\bar{h}_j = \frac{\sum_{j=1}^{n} h_{k,j}}{n} \tag{3}
$$

Step 4 – Rank the DMUs according to the scores $\bar{h}_j$, $j = 1,2,...,n$. The DMU with the highest score will be ranked first and so on.

2.4 INPUTS AND OUTPUTS FOR RANKING PROJECTS

Many quantitative criteria can be used to compare the relative performance success of completed projects. The decision makers must determine the appropriate criteria for projects evaluation and how they can be measured. The criteria should reflect the organization's objectives and the projects type. In order to use ranking method in the DEA context the criteria must be classified into inputs and outputs. Hadad et al. (2013) proposed the following inputs and outputs:

Input 1- The cost stabilization coefficient of project i .

$$
X_{1,i} = \frac{E(C_i)}{\sigma(C_i)} \tag{4}
$$

Where

$E(C_i)$ - the i-th project's expected cost.

$\sigma(C_i)$ - the i-th project's standard deviation cost.

$X_{1,i}$ - the coefficient of variation (Levy and Sarnat, 1995).

Input 2- The completion time stabilization coefficient of project i.

$$X_{2,i} = \frac{E(T_i)}{\sigma(T_i)} \tag{5}$$

Input 3- The reciprocal of the intensity of project i.

$$X_{3,i} = \frac{E(T_i)}{E(C_i)} \tag{6}$$

Output 1- The ratio between the expected cost and the actual cost of project i.

$$Y_{1,i} = \frac{E(C_i)}{e(C_i)} \tag{7}$$

Where $e(C_i)$ is the i-th project's implementation expenses.

Output 2- The ratio between the expected and the actual completion time of project i.

$$Y_{2,i} = \frac{E(T_i)}{e(T_i)} \tag{8}$$

Output 3- The ratio between the actual cost, excluding implementation expenses, and the implementation expenses of project i.

$$Y_{3,i} = \frac{e(C_i)}{l(C_i)} \tag{9}$$

where $l(C_i)$ is the i-th project's implementation expenses.

Output 4- The ratio between the actual completion time, excluding the implementation duration, and the implementation duration of project i.

$$Y_{4,i} = \frac{e(T_i)}{l(T_i)} \tag{10}$$

3. CANDIDATES RANKING

This section presents the steps of the proposed method that allows full rank of the candidates. The rank is carried out according to the average scores of the projects that each project manager performed in the past, and according to the scores of his personal qualitative criteria.

Step 1: Define the candidates to be evaluated. For each candidate k, $k = 1,2,...,K$, determine the projects that will be used for candidate ranking $l = 1,2,...,L_k$. L_k is the number of the projects that according to them candidate k will be evaluated.

Step 2: Calculate for each project k,l the input and output values according to equations $(4),...,(10)$, respectively.

Step 3: Select one of the ranking methods (section 2.3) and compute the level of performance, $F_{k,l}$, for all the projects k,l, $k = 1,2,...,K;\ \ l = 1,2...,L_k$. For A&P ranking method use equation (2) to compute $F_{k,l}$. For the CE ranking method use equation (2) to calculate the optimal weights and then compute $F_{k,l}$ via equation (3).

Step 4: The average level of past performance of candidate k is calculated as follows:

$$F_k = \frac{1}{L_k} \sum_{l=1}^{L_k} F_{k,l} \quad (11)$$

Step 5: Determine the qualitative personal criteria that according to them the candidates will be evaluated. For each criterion t, $t = 1,2,...,T$ perform pairwise comparison according to AHP methodology and create a pairwise comparison matrix A_t. Calculate for these matrixes $\lambda_{t,max}$ and the consistency ratio CR_t. If $CR_t \leq 10\%$, go to the next step. If not, the pairwise comparison must be modified.

Step 6: Calculate the normalized eigenvector $\vec{N}_t$ $(t = 1,2,...,T)$ of the maximal eigenvalue $\lambda_{t,max}$. The elements of this vector, $P_{k,t}$, represent the score of candidate k in criterion t.

Step 7: Determine the relative weights, W_t $(t = 1,2,...,T,T+1)$ for all the criteria (qualitative and quantitative). Note that there are T criteria that represent the qualitative attributes of the candidate and one quantitative criterion that represents his/her past performance level. The relative weights can be set directly by the decision makers, or subjectively by AHP or objectively by DEA.

Step 8: The final score of each candidate, S_k, is the weighted score he/she obtained in all the criteria. This score is calculated as follows:

$$S_k = \sum_{t=1}^{T} W_t \times P_{k,t} + W_{T+1} \times F_k$$

Step 9: Rank all the candidates by S_k. The candidate with the highest S_k is ranked first and so on.

4. CONCLUSIONS

This paper proposes a method that uses DEA, AHP methodologies and ranking method for selecting the best candidate for a managing a project. The proposed method allows calculating the weighted score and the rank of each candidate according to quantitative and qualitative criteria. It is important to select the appropriate criteria for the ranking because the selected criteria have influence on the final rank. The values of the criteria (quantitative and qualitative) are based on the past performance of the candidates. Therefore it is applicable only for experienced candidates. The proposed method can be used in project oriented organizations such as building companies and software companies, where all the projects have similar characters.

REFERENCES

Adler, N., Friedman, L. and Sinuany-Stern, Z. (2002), Review of ranking methods in the DEA context. European Journal of Operational Research, 140(2), 249–265.

Anderson, P. and Peterson, N.C. (1993), A Procedure for ranking efficient units in DEA. Management Science, 39(10), 1261–1264.

Asosheh, A., Nalchigar, S. and Jamporazmey, M. (2010), Information technology project evaluation: An integrated data envelopment analysis and balanced scorecard approach. Expert Systems with Applications, 37(8), 5931-5938.

Barzilai, J., Cook, W.D., Golany, B. (1987), Consistent weights for judgments matrices of a relative importance of alternatives. Operations Research Letters 6 (3), 131-134.

Charnes, A., Cooper, W.W. and Rhodes, E. (1978), Measuring the efficiency of decision making units. European Journal of Operational Research, 2(6), 429–444.

Cheng, M.I., Dainty, A.R.J. and Moore, D.R. (2005), What makes a good project manager?, Human Resource Management Journal, 15(1), 25–37.

Dyer, J.S. (1990), Remarks on the analytic hierarchy process. Management Science, 36 (3), 249-258.

Eilat, H., Golany, B. and Shtub, A. (2006), R&D project evaluation: An integrated DEA and balanced scorecard approach. Omega, 36(5), 895-912.

El-Sabaa, S. (2001), The skills and career path of an effective project manager. International Journal of Project Management, 19 (1), 1-7.

Emrouznejad, A., Barnett, R. P. and Tavares, G. (2008), Evaluation of research in efficiency and productivity: A survey and analysis of the first 30 years of scholarly literature in DEA, Socio-Economic Planning Sciences 42, 151-157

Fortune, J. and White, D. (2006), Framing of project critical success factors by a systems model. International Journal of Project Management, 24(1), 53-65.

Hadad, Y & Keren, B. (2013), Decision support model for ranking project network activities based on multiple criteria of precedence, duration, and cost International. Journal of Engineering Management and Economics, 4(1), 1-17.

Hadad, Y. and Hanani, Z.M. (2011), Combining the AHP and DEA methodologies for selecting the best alternative. International Journal of Logistics Systems and Management, 9(3), 251- 267.

Hadad, Y., Keren, B. and Hanani, Z.M. (2013), Hybrid methods for ranking DMUs that combine performance and improvement trend over successive periods. Int. J. Logistics Systems and Management, 16(3), 269-287.

Hadad, Y., Keren, B. and Laslo, Z. (2013), A decision-making support system module for project manager selection according to past performance. International Journal of Project Management, 31(4), 532-541.

Hauschildt, J., Gesche, K. and Medcof, J.W. (2000), Realistic criteria for project manager selection and development. Project Management Journal. 31(3), 23-32.

Levy, H., Sarnat, M. (1995), Capital Investment & Financial Decisions, Prentice-Hall, Englewood Cliffs, New Jersey.

Mahmood, M.A., Pettingell, K.J. and Shaskevich, A.I. (1996), Measuring productivity of software projects: A data envelopment analysis approach. Decision Sciences, 27(1), 57–80.

Muller, R. and Turner, J.R. (2007), Matching the project manager's leadership style to project type. International Journal of Project Management, 25(1), 21-32.

Saaty, T.L. (1980), The Analytic Hierarchy Process, Planning Priority Setting Resource Allocation. McGraW-Hill book company, New York.

Saaty, T.L. (1986), Axiomatic foundation of the analytic hierarchy process. Management Science, 32 (7), 841-855.

Saaty, T.L. (1990), An exposition of the AHP in reply to the paper remarks on the analytic hierarchy process. Management Sciences, 36(3), 259-268.

Seiford, L.M. (1996), Data envelopment analysis: The evolution of the state of the art (1978–1995). Journal of Productivity Analysis, 7(2-3), 99-137.

Sexton, T.R., Silkman, R.H. and Hogan, A.J. (1986), Data envelopment analysis: Critique and extensions. In: Silkman, R.H. (ed.). Measuring Efficiency: An Assessment of Data Envelopment Analysis. Jossey-Bass, San Francisco, CA, pp. 73-105.

Sinuany-Stern, Z., Mehrez, A. and Hadad, Y. (2000), An AHP/DEA methodology for ranking decision-making units. International Transactions in Operational Research, 7, 109-124.

Uhlir, Z. (2013), The Effect of the Project Manager Certification Process on the Development of Project Management – A Croatian Perspective, Procedia - Social and Behavioral Sciences, 74, 223-232.

Vaidya, O.S. and Kumar, S. (2006), Analytic hierarchy process: An overview of applications, European Journal Of Operational Research, 169 (1), 1-29.

Vitner, G., Rozenes, S. and Spraggett, S. (2006), Using data envelope analysis to compare project efficiency in a multi-project environment. International Journal of Project Management, 24(4), 323-329.

Winkler, R.L. (1990), Decision modeling and rational choice: AHP and utility theory. Management Science, 36 (3), 247-248.

Yang, T. and Kuo, C. (2003), A hierarchical AHP/DEA methodology for the facilities layout design problem, European Journal of Operational Research, 147, 128-136.

Zahedi F. (1986), The Analytic Hierarchy Process: A Survey of the Method and Its Applications, Interfaces, 16 (4), 96-108.

Zavadskas, E.K., Turskis, Z., Tamosaitiene, J. and Marina, V. (2008), Multi-criteria selection of project managers by applying grey criteria. Technological and Economic Development of Economy, 14(4), 462-477.

APPLICATIONS OF RANKING INDEXES OF PROJECT ACTIVITIES FOR PROJECT MANAGEMENT TASKS

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Abstract: *This paper reviews ranking indexes of project activities for project management tasks. The ranking of project activities in one project is applicable for focusing the project manager attention on the important activities. The selection of the appropriate ranking indexes should be done according to the managerial purpose: 1) Paying attention to activities throughout the execution phase and in the resources allocation process in order meet the determined qualities, and to deliver the project on time and within budget, i.e., to accomplish the project within the "iron triangle" 2) Setting priority in order to share the managerial care and control among the activities. The paper proposes to use multi-criteria ranking methods in order to rank the activities in a case where several ranking indexes are selected.*

Keywords*: Project Management (PM), Ranking Indexes (RI), Multi-Criteria Ranking Method (MCRM), Analytical Hierarchical Process* (AHP).

1. INTRODUCTION

Project is a complicated task that requires coordinated efforts to achieve a set of goals. These goals are typically: meeting the determined qualities, delivering the project on time and within budget (the iron triangle). Other goals can be performing the project according to the organization culture and rules and minimizing the interruptions to other activities. Keren and Cohen (2012) developed a formulation that reflects a triangular trade-off structure between the project objectives: time, budget, and quality. The major challenge of the project manager is carrying out a balanced distribution of his managerial efforts between various project tasks, activities and objectives (Hadad and Keren, 2013).

The project program should be prepared initially, taking into consideration the set of the project activities with their precedence priorities and the possible execution modes of each activity (Laslo & Gurevich, 2013a). The planning of the project includes optimization allocation of the project activities' budgeting, i.e., minimization of the total budget subject to on time accomplishment of the project. Such optimizations of multi-mode optimization problems are performed via the Critical Path Method (CPM) time-cost tradeoffs procedure (Kelley & Walker, 1959; Kelley, 1961) when deterministic duration of all project activities is considered. In a case of project with stochastic durations, a semi-stochastic time-cost tradeoffs procedure (Golenko-Ginzburg, 1993) or a stochastic time-cost procedure (Laslo & Gurevich, 2013b) are performed. Recently, many heuristics for multi-mode resource-constrained scheduling optimization problems have been tested on sets of benchmark instances from the PSPLIB library (Kolisch & Padman, 2001; Kolish & Hartman, 2006)). However, the uncertainty throughout the project's lifecycles disables following the initial timetable, and thus, the practice requires a dynamic scheduling routine where in cases of resource shortages during the project execution decisions should be reconsidered and taken via dispatching. When the decision-making is based on the deterministic approach, the MINSLACK dispatching was found very effective for the reestablishment of the project's time target (Davis & Patterson, 1975). Considering uncertain durations of project activities, Laslo (2010) introduced for this purpose a heuristic pairwise dispatching that raises the probability confidence of accomplishing the project on time. The dynamic scheduling determines which of the project activities is in process at each point during the execution of the project.

When several activities are processed simultaneity, it is important to rank the activities according to their relative importance in keeping the project performances within the iron triangle. Such rank enables the project manager to focus his/her managerial efforts and control in the most important activities and by that to increase the probability for a project success. This paper reviews several ranking indexes that help to rank the project activities in process by their importance for attaining the project targets. By selecting an appropriate ranking index a project manager can rank all these activities. If the project manager prefers to use several ranking indexes, he/she must set relative weights for each selected index. The most important activities would be managed by the project manager himself/herself (similar to the Pareto principle). The values of the relative weights can be determined by subjective methods such as: Analytical Hierarchical Process (AHP) (Satty, 1980); ELECTRE (Roy 1989, 1990); Simple Multi-Attribute Technique (SMART) (Edwards 1977, Edwards and Barron 1994) or by the decision makers. The values of the relative weights can be determined by objective methods via Data Envelopment Analysis (DEA) (Charnes et al., 1978) such as the Super Efficiency (Anderson and Peterson, 1993); Canonical Correlation Analysis (Friedman and

Sinuany-Stern, 1997); Global Efficiency Method (Ganley and Cubbin,1992); Cross Efficiency Method (Sexton et al., 1986). For reviews see Adler et al. (2002), Hadad and Hanani (2011).
Ranking of the project activities can be done for two distinguished goals. The first goal is for setting priority for performing the activities and for resources allocation in order to meet the due date. The second goal is for setting priority in order to share the managerial care and control among activities. Ranking indexes that important for meeting the due date are the minimum slack (the difference between the latest and earliest start time of the activity) in a deterministic case and the Significance Index (SI) (Williams, 1992); Activity Criticality Index (ACI) (Van Slyke ,1963, Martin, 1965); Cruciality Index (CRI) (Williams, 1992, Elmaghraby, 2000); time–cost tradeoffs under uncertainty (Laslo and Gurevich, 2013) and others in a stochastic case. These indexes are presented in the next section. Ranking indexes that useful for sharing the managerial care and control are related to the cost, duration and risk of an activity. Several indexes of this type are also presented in the next section.
Furthermore, the importance of the activities is dynamic and can be changed during the project execution. Therefore in every major mile stone the project manager must recalculates the ranking indexes taking into account the current status of the project. In other words, when several activities have been completed – the ranking of the uncompleted activities should be carried out again. Milestones are events in a project that divide the project into stages for monitoring and measurement of work performance. These events typically indicate a completion of a major deliverables of a project.

2. RANKING INDEXES FOR PROJECT ACTIVITIES

The Critical Path Method (CPM) is developed in the 1950's. It represents a project as an activity network as a graph that consists a set of nodes $N=\{1,\ 2,\ \ldots,\ n\}$ and a set of arcs $A=\{(i,\ j\ )\,|\,i,\ j\in N\}$. The nodes represent project activities whereas the arcs that connect the nodes represent precedence relationships. Each activity j has either deterministic activity duration t_i or a stochastic duration. Each activity can start after all its predecessors have completed. CPM uses an early-start schedule in which activities are scheduled to start as soon as possible. However, most projects are not deterministic since they are subject to risk and uncertainties due to external factors, technical complexity, shifting objectives/scopes, and poor management. In practice, project risk management includes the process of risk identification, analysis, and handling (Gray and Larson, 2005).
Ranking indexes enable the ranking of project activities based on the impact they have on project objectives (Creemers et al., 2010, 2011, 2014). This section presents the ranking indexes that will be used for calculating the scores of each project activity. The first indexes are related to the duration of the project and to the duration risks (2.2), and the rest are related to the cost and to the managerial care.

2.1 NOTATIONS

This sub-section presents the notations that are used for determined the ranking indexes.
$\mu(t_i)$ - The expected duration of activity $i\ (i=1,2,...,n)$.
$\sigma(t_i)$ - The standard deviation of the duration of activity $i\ (i=1,2,...,n)$.
$\mu(c_i)$ -The expected cost of activity $i\ (i=1,2,...,n)$.
$\sigma(c_i)$ - The standard deviation of the cost of activity $i\ (i=1,2,...,n)$.
t_i^k - The duration of activity $i\ (i=1,2,...,n)$ in simulation run $k\ (k=1,2,...,K)$.
c_i^k - The cost of activity $i\ (i=1,2,...,n)$ in simulation run $k\ (k=1,2,...,K)$.

2.2 RANKING INDEX FOR DURATION OF AN ACTIVITY

In this sub-section the ranking indexes for the duration of an activity are presented. For a more detailed discussion on the ranking indices presented below, refer to Elmaghraby (2000), Demeulemeester and Herroelen (2002).

2.2.1 RANK POSITIONAL WEIGHT (RPW)

Hadad and Keren (2013) suggested to use the Rank Positional Weight (RPW) index that developed by Helgeson and Birnie (1961) for ranking index for duration of activity. The RPW of an activity is the sum of the duration of all activities following the activity in the precedence network, including the duration of the activity itself. The RPW is calculated by:

$$RPW = \frac{1}{K}\left(RPW^1 + RPW^2 + ... + RPW^K\right) \quad (1)$$

where

RPW^k -The RPW index of simulation run $k\ (k = 1,2,...,K)$ is computed by the equation $RPW^k = A \times t^k$.

In this equation, A is the $(n \times n)$ fixed precedence matrix with elements $a_{i,j} = \begin{cases} 1 & \text{if } i = j \text{ or } i \prec j \\ 0 & \text{otherwise} \end{cases}$

2.2.2 SIGNIFICANCE INDEX (SI)

The Significance Index (SI) was developed by Williams (1992). In order to better reflect the relative importance between project activities, the sensitivity index of activity i has been formulated as follows:

$$SI_i = \frac{1}{K}\sum_{k=1}^{K}\left(\frac{t_i^k}{t_i^k + TF_i^k}\right)\left(\frac{T_{\max}}{\bar{T}}\right) \quad (2a)$$

The SI is usually estimated by simulation methods (Vanhoucke, 2010), and is calculated by:

$$SI_i = \frac{1}{K}\sum_{k=1}^{K}\left(\frac{t_i^k}{t_i^k + TF_i^k}\right)\left(\frac{T^k}{\bar{T}}\right) \quad (2b)$$

where

t_i^k - duration of activity $i\ (i = 1,2,...,n)$ in simulation run $k\ (k = 1,2,...,K)$.

TF_i^k - total float of an activity $i\ (i = 1,2,...,n)$ in simulation run $k\ (k = 1,2,...,K)$. (Refer to Demeulemeester and Herroelen (2002) for a definition of total float).

T - total project duration (a random variable).

T^k - total project duration in simulation run $k\ (k = 1,2,...,K)$.

$\bar{T}$ - average project duration over K simulations.

2.2.3 COEFFICIENT OF VARIATION (CV) FOR ACTIVITY DURATION

The coefficient of variation (CV) is often used as a risk measure for time and cost (Levy and Sarnat, 1995). Yeo (1991) claimed that the CV can be used as a reasonable measure of cost variation and as a complement to the sensitivity measures. Khorramshahgol (1988); Khorramshahgol and Steiner (1988); Khorramshahgol and Vassilis (1988) used the CV for project evaluation and selection. The coefficient of variation for the duration of activity i is computed by:

$$CV(t_i) = \frac{\hat{\sigma}(t_i)}{\bar{t_i}} = \frac{\left(\frac{1}{K-1}\sum_{k=1}^{K}\left(t_i^k - \bar{t_i}\right)^2\right)^{\frac{1}{2}}}{\bar{t_i}} \quad (3)$$

2.2.4 ACTIVITY CRITICALITY INDEX (ACI)

A common practice in project risk management is to focus mitigation efforts on the critical activities of the deterministic early-start schedule (Goldratt, 1997). The Activity Criticality Index (ACI) was developed by Van Slyke (1963) and later by Martin (1965). The ACI index of activity i is computed by:

$$ACI_i = \frac{1}{K}\sum_{k=1}^{K}\delta_i^k, \quad \delta_i^k = \begin{cases} 1 & \text{if } i \text{ is critical in simulation run } k \\ 0 & \text{otherwise} \end{cases} \quad (4)$$

For more details about the activity criticality index see Creemers et al. (2010, 2011).

2.2.5 CRUCIALITY INDEX (CRI)

The Cruciality Index (CRI) was developed by Williams (1992) and Elmaghraby (2000). This index defined as the absolute value of the correlation between the activity duration and the total project duration. The CRI of activity i is computed by:

$$CRI_i = \left|\text{corr}\left(t_i^k, T^k\right)\right| \quad (5a)$$

Cho and Yum (1997) suggested calculating the cruciality index according to Spearman's rank correlation. This measure is computed as following:

$$CRI_i = \left|1 - \frac{6}{K(K^2-1)}\sum_{k=1}^{K}\left(\text{Rank}(t_i^k) - \text{Rank}(T^k)\right)^2\right| \quad (5b)$$

2.2.6 SCHEDULE SENSITIVITY INDEX (SSI).

Cho and Yum (1997) proposed to measure the impact of the variability in activity durations on the variability of the project completion time. Their uncertainty importance measure (UIM) is evaluated as flowing:

$$UMI_i = \frac{Var(t_i)}{Var(T)} \quad (6a)$$

The PMI Body of Knowledge (2008) and Vanhoucke (2010) defined a ranking index- SSI that combines the ACI and the variance of t_i (duration of activity i) and T (total project duration). The Schedule Sensitivity Index (*SSI*) is computed as following:

$$SSI_i = ACI_i \sqrt{\frac{Var(t_i)}{Var(T)}} \quad (6b)$$

2.2.7 CRITICAL DELAY CONTRIBUTION (CDC)

The Critical Delay Contribution (CDC) was developed by Creemers et al. (2014). The CDC redistributes the project delay over the combinations of activities and risks that cause the delay. The term $CDC_{i,e}^{(E)}$ represents the proportion of the project delay that originates from the impact of a risk $e : e \in E$ on an activity i and is computed as following:

$$CDC_{i,e}^{(E)} = \frac{1}{K}\frac{\sum_{k=1}^{K} m_{i,e,k} \times \delta_{i,k}^{(E)}\left(T_k^{(E)} - T\right)}{\sum_{i\in N}\sum_{e\in E}\sum_{k=1}^{K} m_{i,e,k} \times \delta_{i,k}^{(E)}} \quad (7)$$

where $m_{i,e,k}$ is the random variable of the risk impact of a risk e on the duration of an activity j in simulation k. $\delta_{i,k}^{(E)}$ equals 1 if *j* is critical in simulation k and 0 otherwise.

2.3 RANKING INDEX FOR COST

In this sub-section the ranking indexes for the cost of an activity are presented. For more details see Hadad and Keren (2013).

2.3.1 EXPENDITURE RATE (ER)

The Expenditure Rate (ER) was used by Hadad and Keren (2013) as a ranking index for project activities. The expenditure rate of activity i, ER_i, is calculated by:

$$ER_i = \frac{1}{K}\sum_{k=1}^{K}\frac{c_i^k}{t_i^k} \quad (8)$$

Where

c_i^k is the cost of activity i in simulation run k.

2.3.2 COEFFICIENT OF VARIATION (CV) FOR ACTIVITY COST

The coefficient of variation for the cost of activity i is computed by:

$$CV(c_i) = \frac{\hat{\sigma}(c_i)}{\overline{c}_i} = \frac{\left(\frac{1}{K-1} \sum_{k=1}^{K} \left(c_i^k - \overline{c}_i \right)^2 \right)^{\frac{1}{2}}}{\overline{c}_i} \quad (9)$$

3. A PROCEDURE FOR RANKING PROJECT ACTIVITIES

In order to rank project activities according to their importance the following procedure is proposed.

Step 1: Plan the project and collect data: Build the CPM network and set milestones. Determine duration and budget for each activity. Estimate the excepted values and the variances for each activity.

Step 2: Determine the managerial objectives (meeting the due date and/or sharing of the managerial care and control) and select the appropriate ranking indexes that would support these objectives.

Step 3: Simulate the project and obtain the needed values for calculation of the selected ranking indexes (durations, costs, variances, criticality, etc.). Calculate the values of the indexes for each activity.

Step 4: If only one ranking index is selected – all the activity should be ranked according to the value of this index (step 5). If several ranking indexes are selected then a multi-criteria ranking method must be selected (e.g., AHP, DEA). The weights of the indexes must be determined and the weighted score of each project activity is calculated.

Step 5: Rank the uncompleted activities of the project in descending order according to their scores. One rank is for supporting the objective of meeting the due date and the second rank is for sharing of the managerial care and control.

This procedure must be performed at each milestone for the uncompleted activities.

4. CONCLUSIONS

This paper reviews ranking indexes of project activities for project management tasks. The ranking indexes can be used for focusing the attention of the project manager on the important activities and to spread correctly his/her managerial efforts and control among the activities. The ranking of the project activities is useful for two distinguished goals: 1) Prioritizing activities in execution and in resources allocation in order to meet the due date. 2) Setting priority in order to share the managerial care and control among the activities. The paper proposes to use multi-criteria ranking methods in order to rank the activities in a case where several ranking index are selected. Note that the decision makers must select the proper indexes for the activities ranking. The selection of the appropriate ranking indexes is very important task because different indexes yield different rank. Moreover, one can find after the indexes selection that some of the indexes are highly correlated with other indexes. In such case one must decide which indexes would be removed.

The proposed method solves the difficulty of determining the relative weights for each ranking index that is used for the ranking by using mathematical methodology (DEA). The proposed method is useful for a project with many activities or for a program that includes several projects which are executed in parallel. In these cases the proposed method allows the project manager to share his or her managerial efforts and care among the activities.

REFERENCES

Adler, N., Friedman, L., & Sinuany-Stern, Z. (2002). Review of ranking methods in the DEA context. European Journal of Operational Research, 140(2), 249–265.

Anderson, P., & Peterson, N.C. (1993). A Procedure for ranking efficient units in DEA. Management Science, 39(10), 1261–1264.

Charnes, A., Cooper, W.W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. European Journal of Operational Research, 2(6), 429–444.

Cho, J.G., & Yum, B.J. (1997). An uncertainty importance measure of activities in PERT networks. International Journal of Production Research, 35 (10), 2737-2758.

Creemers, S., Demeulemeester, E., & Van de Vonder, S. (2011). Project risk management: A new approach. IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), 839-843.

Creemers, S., Demeulemeester, E., & Van de Vonder, S. (2010). A New Approach for Quantitative Risk Analysis, KBI Working Paper No. 1029. Available at SSRN: http://ssrn.com/abstract=1719502.

Creemers,S, Demeulemeester, E., & Van de Vonder, S. (2014). A new approach for quantitative risk analysis. Ann Oper Res 213:27–65 DOI 10.1007/s10479-013-1355-y

Davis, E.W., &Patterson, J.H. (1975). A comparison of heuristic and optimum solutions in resource-constrained project scheduling. Management Science, 21 (8), 803n res

Demeulemeester, E., & Herroelen, W. (1997). New benchmark results for the resource-constrained project scheduling problem. Management Science, 43, 1485–1492.
Edwards, W. (1977). How to use multi attribute utility measurement for social decision making. IEEE Transactions on Systems, Man and Cybernetics, 7, 326-340.
Edwards, W., & Barron, F.A. (1994). Smarts and SMARTER: Improved simple methods for multi attribute utility measurement. Organizational behavior and human decision processes, 60, 306-324.
Elmaghraby, S.E. (2000). On criticality and sensitivity in activity networks. European Journal of Operational Research, 127 (2), 220-238.
Friedman, L., & Sinuany-Stern, Z. (1997). Scaling Units Via the Canonical Correlation Analysis in the DEA Context. European Journal of Operational Research, 100 (3), 629-637.
Ganley, J.A., & Cubbin, S.A. (1992). Public Sector Efficiency Measurement: Applications of Data Envelopment Analysis. Elsevier Science Publishers, Amsterdam, North-Holland.
Goldrat, E. (1997). Critical Chain. The North River Press, Great Barrington.
Gray, C.F., & Larson, E.W. (2005). Project Management: The Management Process, third ed. McGraw-Hill, New York.
Golenko–Ginzburg, D. (1993). A two-level decision–making model for controlling stochastic projects. International Journal of Production Economics, 32(1), 117–127.
Hadad, Y., & Keren, B. (2013). Decision support model for ranking project network activities based on multiple criteria of precedence, duration, and cost International. Journal of Engineering Management and Economics, 4(1), 1-17.
Hadad, Y., & Hanani, Z.M. (2011). Combining the AHP and DEA methodologies for selecting the best alternative. International Journal of Logistics Systems and Management, 9(3), 251- 267.
Helgeson, W.B., & Birnie, D.P. (1961). Assembly line balancing using the ranked positional weight technique. Journal of Industrial Engineering, 12 (4), 394-398.
Kelley, J.E.Jr., & Walker, M.R. (1959). Critical Path Planning and Scheduling. In Proceedings of the Eastern Joint Computer Conference, 160–73. Boston MA.
Kelley, J.E.Jr.,(1961). Critical Path Planning and Scheduling: Mathematical Basis. Operations Research 9, 296–320.
Keren, B. & Cohen, Y. (2012). Optimizing project performance: the triangular trade-off optimization approach. Int. J. Engineering Management and Economics, 3, 152–170.
Khorramshahgol, R., & Steiner, H. (1988). Resource analysis in project evaluation: Amulticriteria approach. Journal of Operational Research Society, 39 (9), 795–803.
Khorramshahgol, R., & Vassilis, S. (1988). Delphic Hierarchy Process (DHP): A methodology for priority setting derived from the Delphi Method and Analytical Hierarchy Process. European Journal of Operational Research, 37 (3), 347–354.
Khorramshahgol, R., (1988). An integrated approach to project evaluation and selection. IEEE Transactions on Engineering Management, 35, 4: 265–271.
Kolisch, R. & Hartmann, S. (2006). Experimental investigation of heuristics for resource-constrained project scheduling An update. European Journal of Operational Research 174, 23–37.
Kolisch, R. & Padman, R. (2001). .An integrated survey of deterministic project scheduling. Omega, 29, 249–272.
Laslo, Z. (2010). Project portfolio management: An integrated method for resource planning and scheduling to minimize planning/scheduling-dependent expenses. International Journal of Project Management 28, 609–618
Laslo, Z., & Gurevich G, (2013a). A simulation-based decision support system for managing information technology project portfolios. International Journal of Information Technology Project Management, 4(2), 1-17.
Laslo Z., & Gurevich G, (2013b). PERT-type projects: time–cost tradeoffs under uncertainty. Simulation, 89 (3), 278-293.
Levy, H., & Sarnat, M. (1995). Capital Investment & Financial Decisions. Prentice-Hall, Englewood Cliffs, New Jersey.
Mahmood, M.A., Pettingell, K.J. ,& Shaskevich, A.I. (1996). Measuring productivity of software projects: A data envelopment analysis approach. Decision Sciences, 27(1), 57–80.
Martin, J. (1965). Distribution of the time through a directed acyclic network. Operations Research, 13 (1), 46–66.
Roy, B. (1989). The outranking approach and the foundations of ELCTRE methods, Readings in multiple criteria decision aid, C. A. Bana e Costa, ed., Springer- Verlag, Berlin.
Roy, B. (1990). Decision-Aid and decision-Making. European Journal of Operational Research, 45, 324-331.
Saaty, T.L. (1980). The Analytic Hierarchy Process, Planning Priority Setting Resource Allocation. McGraW-Hill book company, New York.
Sexton, T.R., Silkman, R.H., & Hogan, A.J. (1986). Data envelopment analysis: Critique and extensions. In: Silkman, R.H. (ed.). Measuring Efficiency: An Assessment of Data Envelopment Analysis. Jossey-Bass, San Francisco, CA, pp. 73-105.

The Project Management Institute. (2008). Guide to the project management body of knowledge (PMBOK guide). Newton Square: The Project management Institute.
Van Slyke, R.M. (1963). Monte Carlo methods and the PERT problem. Operations Research, 11(5), 839-860.
Vanhoucke, M. (2010). Using activity sensitivity and network topology information to monitor project time performance. Omega, 38(5), 359-370.
Williams, T.M. (1992). Criticality in stochastic networks. Journal of Operations Research Society, 43 (4), 353-357.
Yang, T., & Kuo, C. (2003). A hierarchical AHP/DEA methodology for the facilities layout design problem. European Journal of Operational Research, 147, 128-136.
Yeo, K.T. (1991). Project cost sensitivity and variability analysis. International Journal of Project Management, 9 (2), 111-116.

PROJECT SUCCESS ANALYSIS: EVIDENCE FROM SERBIA

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Abstract: *This paper presents the basic concepts for defining the project success and it-s measurement. Based on the literature review, the research was conducted to investigate: 1) the level of development of project management in project-based organizations in Serbia, 2) the level at which the organizations define project success factors and key performance indicators and 3) whether they are used for assessing the project success. The main conclusion is that the success factors of the project, taking into account the organizational and external environment factors are defined in something more than 1/3 of respondent's organizations. The almost same situation is present when we consider performance indicators, and their usage in evaluating the project success, considering organizations in Serbia.*

Keywords*: Project, success, analysis, CSF, KPI.*

1. INTRODUCTION

Project managers today are faced with many challenges of project management specially with the need for fast decision making in selection of an appropriate project and how to make the best use of existing knowledge and information from previous projects in order to avoid waste of resources and achieve better results for further projects.

One of the most common ways of gathering information about the project is the analysis of achieved project results, or in other words, achieved project success. However, the biggest challenge in measuring and analyzing the project success is the transfer of something that is defined as a success or success factor at the operational level, through measurable indicators that will allow the evaluation of the project during and after it's implementation. The starting point of this statement is the organization observation through its four perspectives (according to BSC concept every organization has four perspectives: financial perspective, customer perspective, the perspective of learning and development and internal processes) where only the usage of the strategic map enables the concretion of measures for analysis and evaluation of organizational performances. Similarly, it can be concluded that defined success factors must be transferred to the operational level and become measurable in order to analyze the success of the project .

Below are presented the Critical Success Factors - CSF and Key Performance Indicators - KPI as concepts for project success analysis, along with empirical research that examines the usage of CSF and KPI in project success assessment.

2. PROJECT SUCCESS ANALYSIS TROUGH ITS DEFINITION AND MEASUREMENT

Retrospective of understanding/perception of project success can be shown through three stages. The first stage is a theoretical interpretation of the project success (Pinto and Slevin, 1988a; Baker et al., 1988 cited in Prabhakar (2008); Shenhar et al., 2001; Abdullah and Ramly, 2006; Olsson et al., 2010). The second stage consists of empirical research on the factors that contributes to the project success, resulting in list(s) of critical success factors. The idea of CSF was created with the paper published in Harvard Business Review in 1961. on the topic Management Information Crisis, but the first article which defines the term CSF was published in 1979. According to Rockart (cited in (Fortune & White, 2006)) CSFs are: limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. Khandelwal and Ferguson (1999) believe that the definition of success factors present the preconditions for measuring the development of the organization. By applying this approach the scope of project management has been expanded.

Belassi & Tukel (1996) in their work give an overview list of CSFs developed during 70th and 80th in XX century. Researches that led to the formation of the list of CSFs conducted from 90th of the last century are presented in (Freeman and Beale, 1992; Cooke-Davis 2002; Judgev and Muller, 2005; Shenhar et al., 2005; Kerzner, 2011; Diallo and Thuillier, 2012), however, the general conclusion is that there are CSFs which are typical for most projects and that usually were replicaed in these studies, but there is no single list of CSFs,

which can be applied to all projects. CSFs have a role in the business processes controle and according Van Veen-Dirks and Wijn (2002) „controle process begins with the CSF identification". The authors link the concepts of Balanced Scorecard and CSF and claim that the Balanced Scorecard can be used as a diagnostic control system, however CSF allow managers to define the areas that leads to success. The outcome of this process of CSFs identification should be used as a starting point for the Balanced Scorecard. The advantage of using CSFs is that the measurement system can be more associated with the environment.

The third phase streams to development of concepts and models for representing the project success as presented through the perspective of stakeholders (Anbari et al, 2008), life-cycle stages (Yu et al., 2005) and value-centered approach (Freeman and Beale, 1992; Yu et al., 2005).

One of the key challenges of managing project-oriented organizations is how to measure project success in a manner that will contribute to the success of the entire organization? The organizations, whose management models were multiple awarded, have based their management systems on the model of corporate performance management (Paladino, 2011). However the key to success is not in simple definition of performance measures but in defining key performance measures that will serve as a guide for behavior in the organization. The key performance measures are the base for obtaining key performance indicators (KPI), which due to its role in decision-making can have a big impact on the efficiency of organizational management.

There are a several researches conducted in this field by Eckerson (2006), Kerzner (2001), Franceschini et al. (2007), Hubbard (2007) and others who worked on definition of characteristics and categories of KPIs, interdependence of KPI, and the possibility of an integrated performance measurement.

According to Eckerson (2006) KPIs are measures that show how well the organization or individual is performing the operational, tactical and strategic actions that are critical to current and future success of the organization. The first step in selection of the right KPIs is to define the general and specific characteristics that KPIs should satisfy. It can be concluded that conversion of measures in KPI can be performed by reexamine whether the measures meet KPIs criteria (predictable, measurable, actionable, relevant, and automated). If all criteria are met, the measure is KPIs. Notice that the rating of met criteria provides key answers in creating the list of the most important KPIs. Also what can be helpful are the following questions: what is the decision KPI is supposed to support; what really is being measured with KPI; why does this thing matter to the decision being asked; what is known about it now; what is the value to measuring it further (Hubbard, 2007).

Having this facts in mind the aim of this paper was to investigate whether a project-oriented organization in Serbia define CSFs for their projects, whether and how they measure the success of their projects. The main research questiones were:

1. How is the project management process regulated in the organization?
2. Whether and how the organizational processes and procedures an external environment influence the project success?
3. Wherether CSFs are defined on project?
4. In what way the project success is measured and evaluated?
    a) What are the most frequent ways to evaluate the performance of projects?
    b) Do the organizationes define the projects KPIs?
    c) Are the KPIs used in the analysis of the project success?

3. EMPIRICAL RESEARCH

3.1. Research method and sample description

The authors had composed a questionnaire in order to examine does the project-oriented organizations define project success and how, and how they, measure project success (if the answer on the previous question was positive). The questions were based on literature overview and previous studies in this field. Afterwards, the authors conducted structured interviews with project managers in different industries, after which the questions were modified in order to generate the most precise answers.

Out of 400 distributed questionnaires to project managers in different industries (i.e. construction sector, IT sector, energy sector, public sector, education, NGO, agro-industry) 107 or 26,75% participants have completed the survey, 4 questionnaires have been rendered as inadequate on the grounds of being

incomplete. Therefore, only 103 questionnaires have been taken into consideration. The following chapter presents the results of the research processed in SPSS 17.0.

3.2. Findings

54% of respondents were project managers or coordinators of several projects, while the remaining respondents were project team members. As much as 45% percent of them participated in over 15 projects, 93.2% of respondents have university degree. Besides the abovementioned demographic data, the research also encompassed questions relating to the definition and measuring of project success.

The next part of the survey relates to the project management process and on the examination of whether and to what extent CSFs are defined on the project. Within the segments relating to the definition of CSFs following questions were asked:

- Whether the organizational processes and procedures have the influence on project success?
- Whether the organization has documented procedures for the project management?
- Wherether factors from an external environment have the influence on the project?
- Do you define CSFs for your project, considering the organization and factors in the external environment ?
- Who is responsible for defining the CSF project?

According to the survey 96.1% of respondents said that the internal documentation (organizational processes and procedures) have the influence on project success. Respondents ware offered scale of 1 to 5 to assess the impact of the individual procedures and processes in organizations that mainly affect the project success (table 1) showed that the biggest impact on project success has an existing technology (the mean is 3.83), even the variance is the lowest one compared to the rest of organizational procedures and processes. The next one is a business policy (mean is 3.81), than a development strategy (mean 3.71), recent projects (mean 3.69) and a human resource policy (mean 3.61).

Table 1. Organizational procedures and processes procedures impact assessment on the project success

		Org. procedure and processes	Development strategy	Business policy	Human resource policy	Technology	Recent projects
N	Valid	103	103	103	103	103	103
	Missing	0	0	0	0	0	0
Mean			3.74	3.81	3.61	3.83	3.69
Median			4.00	4.00	4.00	4.00	4.00
Std. Deviation			1.038	.919	1.022	.879	1.039
Variance			1.078	.844	1.044	.773	1.079

71.8% of respondents said their organizations have the procedures for project management, while 5.8% did not know the answer on this question. But when they were offered the scale of 1 to 5 to assess the degree of the regulation of individual sub-processes of project management process, the average score was ranged between 3 and 4 (on scale from 1 to 5). It is interesting that higher scores have the process of project planning, project monitoring and reporting on progress and completion of the project, while the processes of project initiation and selection were assessed with the lower grades (average grades ranging from 3 to 3.5). When asked whether factors from the external environment have influence on their project, 97.1% of the respondents answered in the affirmative.

On the question of whether the CSF are defined on their projects, considering the organizational and factors from the external environment, only 36% of respondents said yes, 2.9% said that the critical success factors is not defined, while 61.2% did not know the answer to this question.

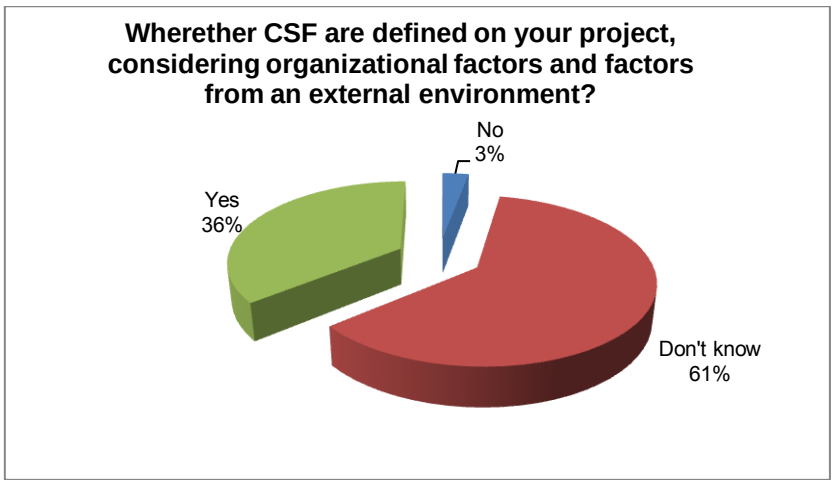

Figure 1. Definition of CSF

Respondents who have previously answered the question in the affirmative said that CSF are determined by top management (40.5%), project manager at 29.7% situation, while the CSF is defined by team members in 13.5% situations.

The next group of questions relates to measuring the project success:

- Is there a defined procedure of project performance evaluation at the project level?
- Do you establish performance measures for the evaluation of the project performances?
- What performance measures are used in the evaluation of the project?
- Do you define a set of KPI for your project?
- Who is responsible for determining the KPI?

In most cases (54.4%) there is no defined procedure of project performance evaluation at the project level, but it is done at the organizational level, while 42.7% of respondents reported that, in their organizations, there is a defined procedure of performance evaluation at the project level. Based on these results it can be concluded that the performance evaluation of the project carried out in 97.1% of cases.

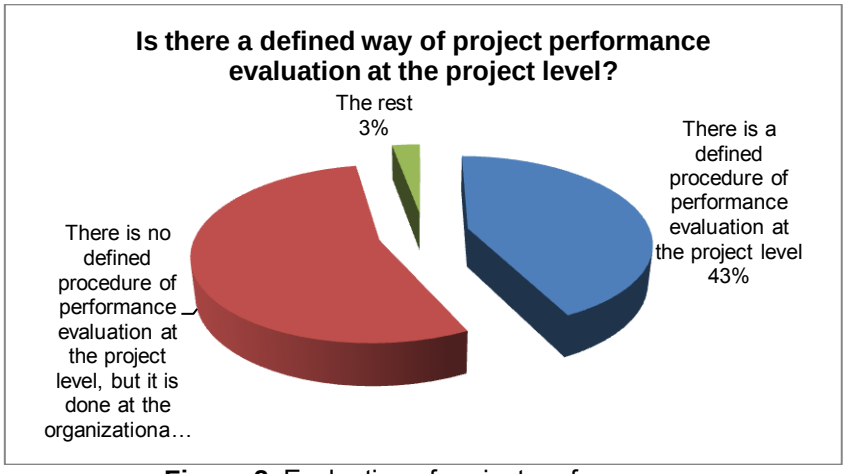

Figure 2. Evaluation of project performance

Slightly more than half of the respondents answered that they determines the performance measures for the evaluation process while 35% of respondents said they do not.

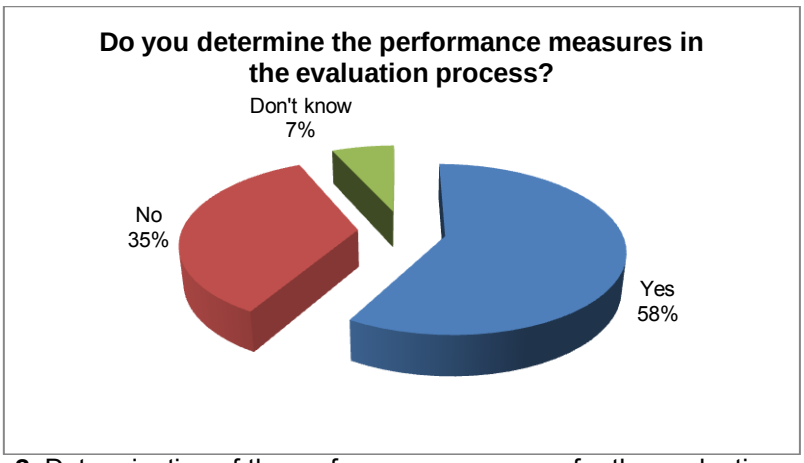

Figure 3. Determination of the performance measures for the evaluation process

The most commonly used measures to evaluate the project performance are: actual cost, the actual time, the technical characteristics of the product of the project, the level of quality etc.). In a much lesser extent (only 16%) used financial measures such as NPV, ROI, payback period etc., while measures related to the process of project management as well as process efficiency and labour productivity are used in only 1% of cases. About 14% of respondents written its own response, and the most of them said that they use a combination of measures related to the project and financial measures.

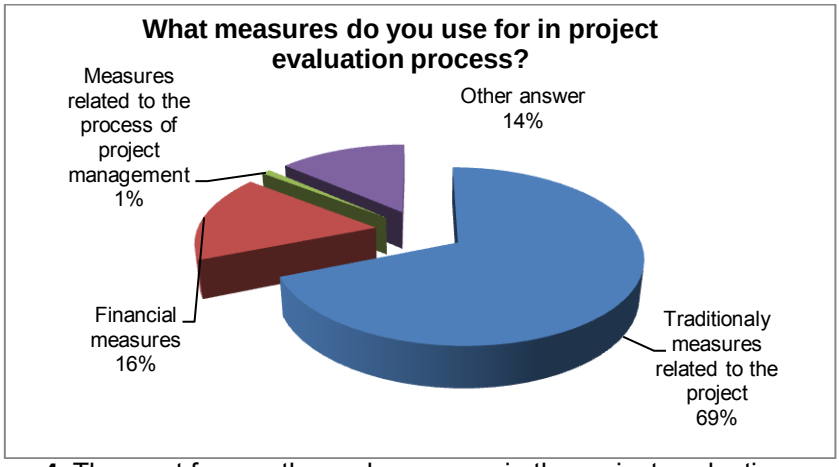

Figure 4. The most frequently used measures in the project evaluation process

34% of respondents determines KPI, only 7% of respondents did not define KPI for the project, while 59% of respondents did not answer to this question.

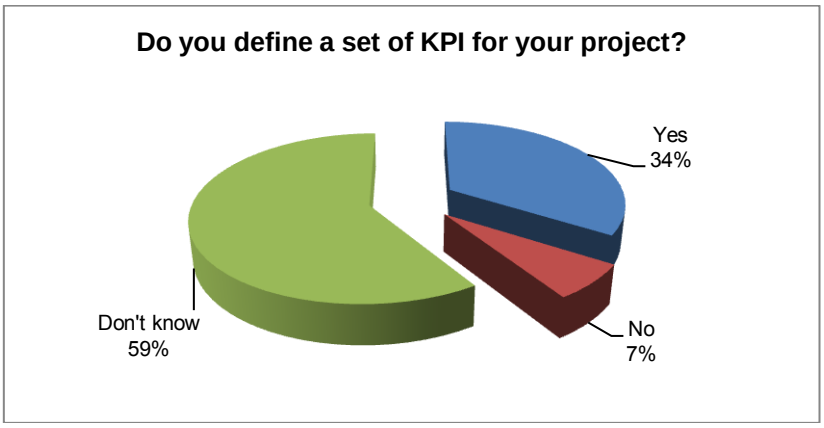

Figure 5. KPI definition

Unlike those responsible for determining the CSFs, the responsible person(s) project KPIs definition in 40% of situations are project team members, in about 34% of the situation the responsible person is project manager, while the participation of top management is in much smaller percentage (14%). Based on a

comparison of the obtained answers to these two questions, it can be concluded that the determination of KPIs more operational and technical issue and is usually in the area of competence of project managers and team members, while the determination of CSFs is more an issue that is considered in terms of the whole organization, by management.

Of those who responded that they define KPIs, 63% are using KPIs to assess the success of the project.

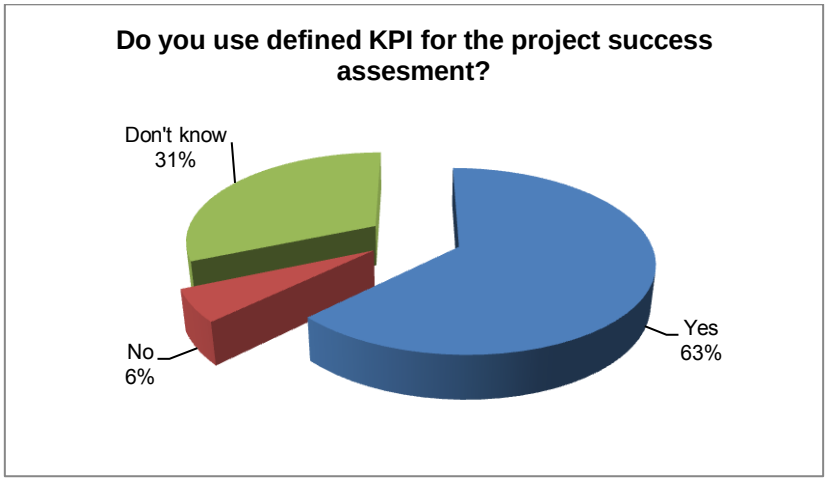

Figure 6. The usage of KPI in project success assessment

4. CONCLUSION

More than 70% of project oriented organizations have project management procedure defined, but the sub-processes that are well regulated are project planning, project monitoring and reporting on progress and completion of the project. The processes of initiation, selection and initiation of the project assessed the lower grades. The organization are aware that factors from external environment can affect the success of their projects, as well as organizational processess and procedures but very small percentage defined project success trough success factor considering those influences. The main conclusion of this paper is that the success factors of the project, taking into account the organizational and external environment factors are defined in something more than 1/3 of organizations. The almost same situation is present when we consider performance indicators. Their usage in evaluating the project success is at a very low level when it comes to organizations in Serbia. The research results show that the definition of CSF is in responsibility of organization management in the most of cases, like this is a more strategic issue. That is very much in line with the literature that link Balanced Scorecard and CSF (Van Veen-Dirks and Wijn, 2002) according to witch Balanced Scorecard can be used as a diagnostic control system and CSF allow managers to define the areas that leads to success (CSF identification should be used as a starting point for the Balanced Scorecard). On the other hand KPIs determination is, regarding presented results here, more operational issue, under the responsability of project team and project manager.

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REFERENCES

Abdullah, W., Ramly, A. (2006). Does successfull project management equates to project success. Learning by Effective Utilization of Technologies: Facilitating Intercultural Understanding. Beijing: OS Press.

Anbari, T., Carayannis, G., i Voetsch, J. (2008). Post-project reviews as a key project management competence. Technovation, 28, 633-643

Belassi, W., Tukel, O. (1996). A new framework for determining critical success/failure factors in Projects. International Journal of Project Management, 14 (3), 141-151.

Cooke-Davies T. (2002). The real success factors on project. International Journal of Project Management , 20 (3), 185-190.

Diallo, A., Thuillier, D. (2004). The success dimensions of international development projects: the perceptions of African project coordinators. *International Journal of Project Management, 22*, 19–31.

Eckerson, W. (2006). Performance Dashboards: Measuring, Monitoring and Managing Your Business. New Jersey, NJ: John Wiley and Sons.
Fortune, J., White, D. (2006). Framing of project critical success factors by a systems model. International Journal of project management, 24, 53-65.
Franceschini, F., Galetto, M., & Maisano, D. (2007). Management by Measurement. Torino, To: Politehnico di Torino.
Freeman, M., Beale, P. (1992). Measuring project success. Project Management Journal, 23 (1), 8-17
Hubbard, W. (2007). How to Measure Anything. New Jersey: John Wiley and Sons.
Ika, L., Diallo, A., Thuillier, D. (2012). Critical success factors for World Bank projects: An empirical investigation. International Journal of Project Management , 105-116.
Judgev, K., Muller, R. (2005). A Retrospective Look at our Envolving Understanding of Project Success. Project Management Journal, 36 (4), 19-31
Kerzner, H. (2001). Strategic Planning for Project Management Using a Project Management Maturity Model. New Jersey, NJ: John Wiley and Sons.
Khandelwal, K., Ferguson, J. R. (1999). Critical success factors (CSFs) and the growth of IT in selected geographic regions. Annual Hawaii International Conference. IEEE Press.
Olsson O.E.N., Krane P.H., Rolstadas A., Veiseth M. (2010). Influence of reference points in ex post evaluations of rail infrastructure projects. Transort policy, 17, 251-258.
Paladino, B. (2011). Innovative Corporate Performance Management - Five Key Principles to Accelerate Results (1st izd.). New Jersey, NJ: John Wiley & Sons, Inc.
Pinto, J., Slevin, D. (1988a). Critical success factors across the project life cycle. Project Management Journal, 19 (3), 67-75.
Prabhakar, P. (2008). What is project success: A literature review. International Journal of Business and Management, 3-10.
Shenhar, A., Dvir, D., Levi, Maltz, A. (2001). Project success: a multidimensional strategic concept. *Long Range Planning, 34*, 699-725.
Van Veen-Dirks, P., Wijn, M. (2002). Strategic Control: Meshing Critical Success Factors with the Balanced Scorecard. *Long Range Planning, 35*, 407–427.
Yu G.A., Flett D.P., Bowers A.J. (2005). Developing a value-centred proposal for assessing project success. International Journal of Project Management, 23, 428-436.

RISK MANAGEMENT METHODS: HOW TO DEAL WITH RISKS IN A PROJECT

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Abstract: *Projects have complex nature in many fields. That is why during the project implementation many unpredicted situations could be encountered. The answer to the question what can help to deal with them before they occur is that by implementing methods of risk management the project team will have greater control over the overall management of the project. Software project involves many uncertainties, that if not controlled, project will be exposed to risks during the development phases as well as throughout the project life cycle. Every method of risk management has its specific area of application and can be used in order to cut down the risk element of a project to a minimum. Because of the need for cost saving in software development projects, it is important to manage risks during the early project development phases. Then risks can easily be maintained at an acceptable cost level.This paper will emphasize the features, similarities and differences between methods that can be used as tools to minimize risk in software projects: BOEHM method, RISKIT method and GSRM - Goal-driven Software Development Risk Management Model. Methods are different by their nature, but risk management process within the methods provide a structure to ensure visibility into risks and at the end to achieve project success.*

Keywords: *risk, project, risk management method*

1. INTRODUCTION

Risk in a project environment cannot be totally eliminated, but can be shaped and controlled by risk management. The main goal of a risk management process is to minimize the influence of some incidents that have not been planned on the project by identifying and addressing possible risks before negative consequences occur. Risk management process needs to be continuous and with high priority. This is important to the project success because it allows all team members to identify the top risks. Projects have complex nature in many fields, for example in the construction related field or in the software related field. That is why lots of unpredicted problems could be encountered during the project implementation, which results in exceeding budgets, fact that projects fall behind on deadlines, etc.

What can help managers to deal with problems before they occur? The answer is that by implementing methods of risk management, the project team will have greater control over the overall management of the project. Risk assessment, as the first of the two major risk management processes, includes identification, analysis and prioritization of risks. The second one is risk mitigation, which includes developing and monitoring strategies and residual risks. The result of great manager`s effort is a risk management plan that becomes a subset of the project management plan. A project manager needs to manage project risks and control them at the level that is acceptable for the project.

Every method of risk management has a specific area of application and can be used in order to cut down the risk element of a project to a minimum. Also, every method has the framework and is effective within a specific type of project. In different words, the method that could be the most appropriate for one project could be the most ineffective in another project. There are some methods that can be used as tools to minimize risk in software projects. It is important to emphasize the features, similarities and differences among these methods which consider many aspects while assessing and estimating the risks. Methods are different by their nature. It means that they explore different structures in the software development process, use different techniques and are applied over different phases in the development process. The process of risk management provides a structure to ensure visibility into risks and eventually to achieve project success.

Humans are included in developing, managing and using the software. Because of their education, experience, skills, motivation, working atmosphere or other personal reasons, they may commit different kinds of errors. These risk factors which are connected with the humans make it easier for us to understand the great importance that humans have and to realize the relevance of the human role. That is why risk assessment should take into consideration human factors involved in different processes in the software development, and not only to examination of these processes. Since people usually do not work alone, risk management methods need to include observation of the picture of cooperation in the process between different people, people and equipment, people and tasks, etc.

2. LITERATURE REVIEW

Schmidt *et al.* (2001) define risk factors as "a condition in which may be present a serious threat to the complete success of a software development project." Risk management can help project managers to anticipate delays that cause projects not to be delivered on time (Grant *et al.,* 2006). According to Dey *et al.* (2007), although some managers claim that they manage risks in their projects, there is evidence that they do not manage them systematically. Charette (2005) stated that the most common factors why software projects fail so often are: unrealistic goals, inaccurate estimates of necessary resources, badly defined system requirements, poor presentation of the project status and not managed risks.

According to Cervone (2006), project risk management is a necessary and critical task of the project manager and project team, where understanding risk management entails understanding the underlying factors that contribute to project risks. Boehm's (1991) results were quite significant as he identified the list of 10 software risk items and was the pioneer in developing methods for risk management in software industry. Berg (2010) stated that risk management is about making decisions that contribute to the achievement of an organization's objectives by applying them both at the individual activity level and in functional areas. According to Dey *et al.* (2007), managers often address technical risks, instead of dealing with market and financial risks, which are vital for a successful software development. Obviously, there is a need for integrated risk management. Berg (2010) stated that integrated risk management does not focus only on the minimization or mitigation of risks, but also supports activities that foster innovation, so that the greatest returns can be achieved with acceptable results, costs and risks. Ahmed *et al.* (2007) noted that unexpected events occur in projects and may result in either positive or negative outcomes that are a deviation from the project plan.

Dey *et al.* (2007) stated that frameworks suggested by other authors usually present problems from the clients` perspectives. Because of that, there is need for analysing the risk management issues in software development from the developers' perspective, with the involvement of the stakeholders, with the consideration of both qualitative and quantitative risk factors and integrating the risk management process with the software development cycle (project management). Cervone (2006) stated that by managing risks within a project, the project manager and team ensure that the project will be delivered on time and to the satisfaction of the end-user community. Berg (2010) noted that in order to apply risk management effectively, it is vital that a risk management culture be developed. The risk management culture supports the overall vision, mission and objectives of an organization. Cervone (2006) noted that project manager should record the results of risk assessments as well as the mitigation strategies for each of the risks pursued so that he could learn from the past.

3. RISK MANAGEMENT METHODS

3.1 BOEHM method

Barry Boehm was the pioneer in developing methods for risk management in software industry. In 1986. he developed the first risk-driven Spiral model (Boehm, 1986) by using the theory Win–Win model. Then, in 1991. he divided the process of risk management into two main phases: risk assessment and risk control (Boehm, 1991). Furthermore, risk assessment is divided into identification, analysis and prioritization and risk control is divided into planning, reduction and monitoring. The main aim of risk assessment part is to identify the underlying risks and assess the degree of risks and priority of risks. After that estimation, the risk control part has an important role in the whole management process, which includes risk management planning, risk reduction and risk monitoring. In the process of risk estimation and mitigation, it is more convenient to do analysis in the early stages of the software development process in order to encounter and overcome the problems in these early stages.

The Boehm method includes a set of principles and practices called the risk-analysis paradigm. It can be applied to software related projects for managing the risk of developing software. Basic concept in the model is risk exposure, which is defined by:

$$RE = P(UO) * L(U0) \quad (1)$$

where RE is the risk exposure, P(U0) is the probability of an unsatisfactory outcome and L(U0) is the loss to the parties affected if the outcome is unsatisfactory. The valence of the risk event is defined by this.

According to the rating, a project has a relatively low (0.0 to 0.3), medium (0.4 to 0.6) or high (0.7 to 1.0) probability of some risk (Boehm, 1991).

Software projects involve several classes of participants (customer, developer, user and maintainer), each with different, but highly important satisfaction criteria, so the unsatisfactory outcome is multidimensional:

- For customers and developers, budget overruns and schedule slips are unsatisfactory.
- For users, products with the wrong functionality, user-interface shortfalls, performance shortfalls, or reliability shortfalls are unsatisfactory.
- For maintainers, poor-quality software is unsatisfactory (Boehm, 1991).

These components of an unsatisfactory outcome provide a checklist for identifying and assessing risk items. This model uses a decision tree method for identification the software risk items. It could be said that the goal of the risk management is to reduce the risk exposure associated with the software. This method can be used in all phases of software development process. Boehm identifies ten risk items and recommends risk management techniques to address them (Table 1).

Table 1: Boehm's top ten risk items (adapted from Boehm, 1991)

Risk item	Risk-management technique
Personnel shortfalls	Staffing with top talent, job matching, team building, key personnel agreements, cross training.
Unrealistic schedules and budgets	Detailed multisource cost and schedule estimation, design to cost, incremental development, software reuse, requirements scrubbing.
Developing the wrong functions and properties	Organization analysis, mission analysis, operations-concept formulation, user surveys and user participation, prototyping, early users' manuals, off-nominal performance analysis, quality-factor analysis.
Developing the wrong user interface	Prototyping, scenarios, task analysis, user participation.
Gold-plating	Requirements scrubbing, prototyping, cost-benefit analysis, designing to cost.
Continuing stream of requirements changes	High change threshold, information hiding, incremental development (deferring changes to later increments).
Shortfalls in externally furnished components	Benchmarking, inspections, reference checking, compatibility analysis.
Shortfalls in externally performed tasks	Reference checking, preaward audits, award-fee contracts, competitive design or prototyping, team-building.
Real-time performance shortfalls	Simulation, benchmarking, modeling, prototyping, instrumentation, tuning.
Straining computer-science capabilities	Technical analysis, cost-benefit analysis, prototyping, reference checking.

Managers can use the checklist on projects to identify and resolve risk items and the following set of risk-management techniques can be used in avoiding or resolving the source of risk. This is not only a method that covers all phases of software development project, which is its main advantage, but it is also a traditional and relatively simplistic method. On the other hand, its disadvantage lies in the fact that it doesn't handle generic risk implicitly. The Boehm method was the first method of risk management and risk items in the checklist sometimes are insufficient to cover the real situation because of continual changes in an unstable environment.

3.2 Riskit method

Jyrki Kontio, professor at the Helsinki University of Technology, proposed the Riskit method in 1996. The method has its focus on qualitative understanding of risks before their possible quantification. The method

was developed for software development projects and it is mainly applied in large organisations, though the method has some aspects of the business analysis that could be applied to any project in other areas (marketing, technology related business, etc).

Riskit method extends Boehm's approach by maintaining links between risks and stakeholders explicitly (Kontio *et al*, 1998). It is clear that every project has more than one stakeholder and they may have different priorities and levels of expectations. Therefore, risk management should be based on the recognition of their expectations and priorities.

When risk scenarios are defined, each risk can be described by its potential impact on project goals and each stakeholder can use this information to rank risks from their perspective. This allows full traceability between risks and goals (Kontio *et al*, 1998). In RISKIT method, a risk is defined more precisely, as a possibility of loss, the loss itself, or any characteristic, object or action that is associated with that possibility.

The method framework shows that method can be used for any software development project, but it fails to cover small to medium sized organisations. The main advantage of the method is flexibility, which means that it is originally developed for software development projects, but it can be applied to other areas (marketing, business planning, etc). On the other hand, a disadvantage is the fact that the method doesn't bridge the gap between risk estimation and risk metrics, which means that it is very difficult to predict the potential risk reliably.

The method`s main characteristics can be described by the following principles:

- The Riskit method provides precise and unambiguous definitions of risks;
- The Riskit method results in explicit definition of objectives, constraints and other drivers that influence the project;
- The Riskit method is aimed at modelling and documenting risks qualitatively;
- The Riskit method can use both ratio and ordinal scale risk ranking information to prioritize risks reliably;
- The Riskit method uses the concept of utility loss to rank the loss associated with risks;
- Different stakeholder perspectives are explicitly modelled in the Riskit method;
- The Riskit method has an operational definition and training support (Kontio *et al,* 1998).

Summaries of the activities in the Riskit process, as well as the main output of each activity are described in table 2.

Table 2: Overview of outputs and exit criteria of the Riskit process (Kontio *et al*, 1998).

Riskit step	Description	Output
Risk management mandate definition	Define the scope and frequency of risk management. Recognize all relevant stakeholders.	Risk management mandate: why, what, when, who, how, and for whom.
Goal review	Review the stated goals for the project, refine them and define implicit goals and constraints explicitly. Analyze stakeholders' associations with the goals.	Explicit goal definitions.
Risk identification	Identify potential threats to the project using multiple approaches.	A list of "raw" risks.
Risk analysis	Classify and consolidate risks. Complete risk scenarios for main risk events. Estimate risk effects for all risk scenarios.	Completed Riskit analysis graphs for all analyzed risks. Ranked risk scenarios.
Risk control planning	Select the most important risks for risk control planning. Propose risk controlling actions for most important risks. Select the risk controlling actions to be implemented.	Selected risk controlling actions.
Risk control	Implement the risk controlling actions.	Reduced risks.
Risk monitoring	Monitor the risk situation.	Risk status information.

Figure 1. presents flows of information among basic activities within the risk management cycle in a project: defining the scope and focus of risk management, review and definition of goals, risk identification and

monitoring, risk analysis, risk control planning and controlling of risks. Each activity can be performed several times during the project duration and they may be conducted concurrently.

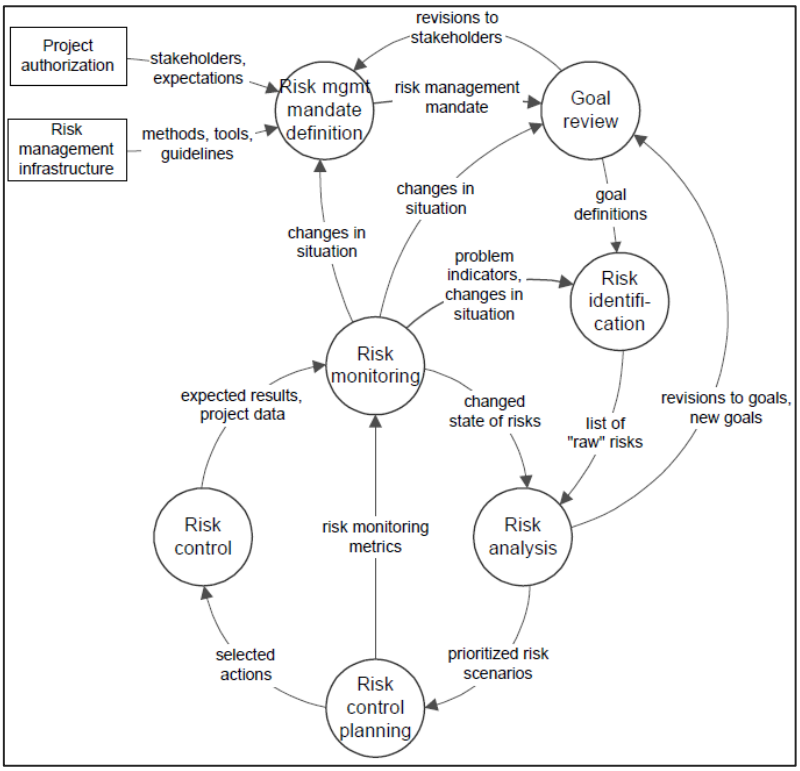

Figure 1: The Riskit risk management cycle (Kontio,1997).

3.3 Goal-driven Software Development Risk Management Model (GSRM)

The model was built with the goal of offering the solution how to integrate risk management activities into the project and it shows which techniques are needed to perform risk management activities. The authors stated that the literature fails to provide comprehensive and detailed guidelines on how to integrate risk management activities into the project at the early stages of development. Also, the practitioners should be acquainted with the impact of risk management practice on software projects (Islam *et al.,* 2014). Therefore, Goal-driven Software Development Risk Management Model was introduced as a goal-driven approach for risk management where risk management activities are integrated into early stages of project development. The model includes techniques identified as necessary to perform the risk management activities. Also, the results produced by the activities are precisely defined.

According to the authors, risk management is considered as an integral part of all organisational processes, including strategic planning and all project and change management processes. They have pointed out that the other risk management methods and frameworks include a number of limitations. Although the Boehms method made theoretical foundation of putting risk management into a single framework, a disadvantage is that this approach requires intensive active involvement of project customers/users, which is difficult to obtain in real on-going project. In spite of the fact that Boehm extended the original method to satisfy the objectives and concerns of the stakeholders, there is still a space for improvement. Also, the Riskit method has some important limitations, according to the authors of GSRM. They have agreed that this method provides a complete conceptual framework for risk management and precise and unambiguous definitions of risks. But, there are no clear sources specified from where the goals originate and how the identified goals are modelled. Also, risks are analysed by creating scenarios, which are always hard to create from factors, and it is difficult to make a comparison between them when a scenario depends upon more than one probabilistic element.

The GSRM adopted the risk management context considering internal and external organisational issues, risk management process and risk criteria from *ISO 31000:2009* standard (Islam *et al.,* 2014). The standard introduces guideline for implementing risk management into organisational processes using process, framework and principals and GSRM follows the guideline to define the risk management context within the

process. The framework of GSRM is an extension of the KAOS goal modelling language with concepts related to risk management (Islam *et al.,* 2014). The KAOS (Knowledge Acquisition in Automated Specification or Keep All Objectives Satisfied) method is a specific goal modelling method.

The framework, which is a layer based modelling framework, is comprised of four layers:

1. *Goal* (focuses on the factors that contribute to completion of the project activities and directly link to the project success),
2. *Obstacle* (identifies the potential software development risk factors and establishes the obstruction link from risk factors to sub-goals and from events to the main goal),
3. *Assessment* (quantifies the risk events as a consequence of single or multiple risk factors, establishes the causal relationship model between risk factors and related risk events);
4. *Treatment* (focuses on the control actions to counter the risks so that goals can be attained, monitors the effectiveness of the implemented control actions and identifies any new risks throughout the development).

Specific activities can be performed under any layer with appropriate tasks, methods and techniques in order to consider these components: project execution, development process, product, human, and internal and external environment. The main aim of this effort is to understand all the layers.

Layer based modelling allows usage of different techniques and methods across the layers which provides that the outcome can be transferred between the layers (Islam & Houmb, 2011).

Figure 2. introduces conceptual view of the model. According to it, goals and obstacles are derived from the development components, stakeholder expectations and project success indicators. And the main output is the goal-risk model.

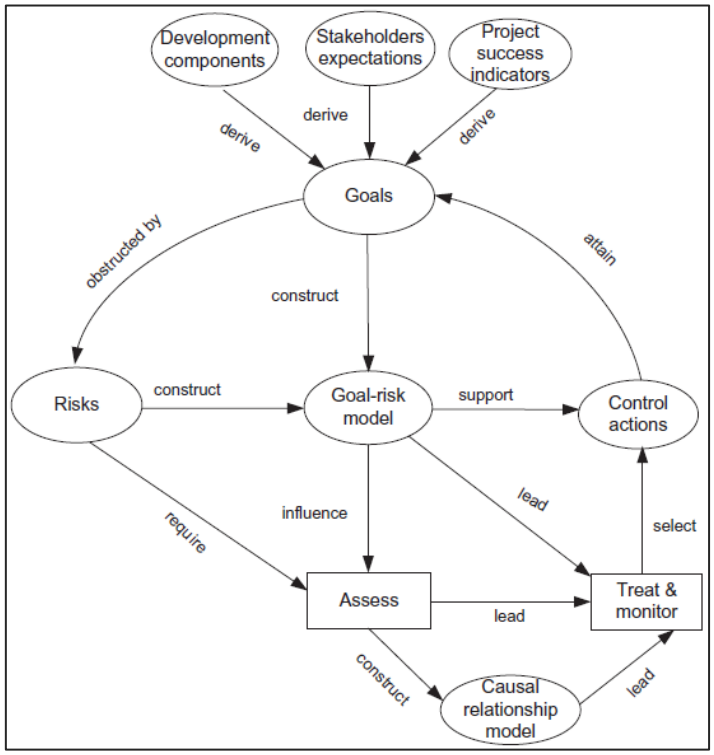

Figure 2: Conceptual view of the model (Islam *et al.,* 2014)

The model includes activities that involve all tasks required for goal-driven risk management:

1. Defining the risk management scope and boundary, schedule and resource allocation and composing a risk management team so the risk management plan could be initialised.
2. Identifying and modelling goals by focusing on the state of the development components and matching them with the project.
3. Identifying and modelling obstacles (as many obstacles as possible so the team is aware of problems from the beginning).
4. Risk assessing by estimating risk level and relevant priority.

5. Risk controlling as early as possible and monitoring the effectiveness of the control action throughout the project.

The requirements engineering phase is an early stage of the project development and includes risk management activities such as formulating goals, capabilities, constraints, system vision and requirements. Since requirements engineering and software risk management process are two different processes, it is important to emphasize that activities of the requirements engineering and risk management process are sequential and techniques used within the activities are similar. The GSRM model provides three techniques to identify and analyze goals and risks: structured interviews with closed questions, brainstorming sessions, analysis of project documents. For example, information gained from the project brainstorming session was verified during the interview session. The integration of risk management into requirements engineering provides early warnings about issues existing in the project (Islam *et al.,* 2014).

The requirement engineer`s role includes activities such as creating and managing the requirement specification by aligning the business needs to the software, establishing the bridge among business analyst, architect, project manager, and customer/user. A risk manager is a person who should have necessary knowledge about managing the project and skills to handle risks in a different project situation. Responsibilities of a risk manager include performing risk assessment and management activities.

4. METHODS REVIEW

Boehm made the theoretical foundation for project risk management with the risk-driven Spiral model, and identified ten risk items with recommendation of appropriate risk management techniques. Later Boehm extended original model in order to satisfy the objectives and concerns of the stakeholders by using the theory Win–Win model. This is a method that covers all phases of software development project, which is its main advantage, and also a traditional and relatively simplistic method. Although the Boehms method made theoretical foundation of putting risk management into a single framework, a disadvantage is that this approach requires intensive involvement of project customers/users, which is difficult to obtain in real on-going project. Managers can use the checklist on a project to identify and resolve risk items and the following set of risk-management techniques can be used in avoiding or resolving the risk source. The Boehm method was the first method of project risk management and risk items in the checklist sometimes are insufficient to cover the real situation because of continual changes in an unstable environment. Also, a disadvantage is the fact that it doesn't handle generic risk implicitly.

The Riskit method extends Boehm's approach by maintaining links between risks and stakeholders explicitly. Risk management should be based on the recognition of stakeholder`s expectations and priorities because they may have different priorities and levels of expectations. Main advantage of the method is flexibility, which means that it is originally developed for software development projects, but can be applied in other areas (marketing, business planning, etc).

The Riskit method framework shows that method can be used for any software development project, but it fails to cover small to medium sized organisations. On the other hand, a disadvantage is the fact that the method doesn't bridge the gap between risk estimation and risk metrics, which means that it is very difficult to predict the potential risk reliably. Although Kontio's Riskit is a goal-driven approach, it is not clear from where goals can originate and the risk analysis is based on scenarios which are difficult to formulate.

And while the Boehm`s method doesn't handle generic risk implicitly, Goal-driven Software Development Risk Management Model supports identification of both project specific and generic risks that need adequate treatment. This model was introduced as a goal-driven approach for risk management where risk management activities are integrated into early stages of project development and relation between project goals and risks that may obstruct these goals is established. That is the best way for selecting the adequate actions to prevent project risks because project goals need to be fulfilled in order to obtain a successful project.

The model was built with the aim of offering the solution how to integrate risk management activities into the project and it shows which techniques are needed to perform risk management activities. The approach requires intensive and active involvement of project customers/users, which is difficult to attain in real on-going project situations. This goal-driven approach is appropriate for project risk management that is well integrated into the early requirements engineering stage.

5. CONCLUSION

Software industry uses knowledge as a resource and many activities are knowledge intensive. There is the need for organizations not only to improve their ability to identify, but also to manage the risks associated with software development projects. Many factors, such as inaccurate estimation of needed resources, badly defined system requirements, unrealistic or unarticulated project goals, risks not managed, etc, need early consideration in the project development stage because of direct or indirect influence on project success.

Different authors proposed different approaches, methods and models for dealing with project risks, with variety of techniques for accomplishing the process of identifying and estimating risks in a project. There is a need for more flexible approaches to risk management which allow taking advantage of new techniques. Risk assessment is often performed once at the project development stage and then never again during the project's lifetime. The truth is that risk assessment should be revisited and risk management plan should be revised whenever something new and important about products and processes is learned.

Among many project risk management approaches, methods and models, the paper considers the Boehm method, the Riskit method and the Goal-driven Software Development Risk Management Model. The Boehm method was the first project risk management method and therefore made the theoretical foundation for project risk management. The Riskit method includes some extensions of Boehm's approach related to stakeholders involvement. Although Riskit is a goal-driven approach, it is not clear from where goals can originate. This is improved with another goal-driven approach that focuses on the factors contributing to completion of project activities and are directly linked to the project success. Because of the lack of literature with comprehensive and detailed guidelines on how to integrate risk management activities into the project at the early stages of development, the GSRM was built. The model includes activities that involve all tasks required for goal-driven risk management.

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REFERENCES

Ahmed, A., Kayis, B., & Amornsawadwatana, S. (2007). A review of techniques for risk management in projects. Benchmarking: An International Journal, 14(1), 22-36. doi: 10.1108/14635770710730919

Berg, H.P. (2010). Risk management: procedures, methods and experiences. RT&A# 2(17), Vol.1, 79-95.

Boehm, B. (1986). A spiral model of software development and enhancement. ACM SIGSOFT Software. Engineering Notes, 11(4), 14-24. doi:10.1145/12944.12948

Boehm, B. (1991). Software Risk Management: Principles and Practices. IEEE Software, 8(1), 32-41. doi: 10.1109/52.62930

Cervone, H.F. (2006). Project risk management. OCLC Systems & Services, 22(4), 256-262. doi: 10.1108/10650750610706970

Charette, R.N. (2005). Why software fails. IEEE Spectrum, 42(9), 42–49. doi: 10.1109/MSPEC.2005.1502528

Dey, P.K., Kinch, J., & Ogunlana, S. (2007). Managing risk in software development projects: a case study. Industrial Management & Data Systems, 107(2), 284–303. doi:10.1108/02635570710723859

Grant, K.P., Cashman, W.M., & Christensen, D.S. (2006). Delivering projects on time. Research & Technology Management, 49(6), 52–58.

Islam, S., Houmb, S.H. (2011). Towards a Framework for Offshore Outsource Software Development Risk Management Model. Journal of Software, 6(1), 38-47. doi:10.4304/jsw.6.1.38-47

Islam, S., Mouratidis, H., Weippl, E. (2014). An empirical study on the implementation and evaluation of a goal-driven software development risk management model. Information and Software Technology, 56(2), 117–133. doi:10.1016/j.infsof.2013.06.003

Kontio, J. (1997). The Riskit Method for Software Risk Management. Version 1.00, Technical Report,CS-TR-3782 /UMIACS-TR-97-38, Institute for Advanced Computer Studies and Department of Computer Science, University of Maryland, USA

Kontio, J., Getto G., & Landes, D. Experiences in improving risk management processes using the concepts of the Riskit method. Paper presented at the SIGSOFT'98 Sixth International Symposium on the Foundations of Software Engineering (FSE-6), November 3-5, 1998.

Schmidt, R., Lyytinen, K., Keil, M., & Cule, P. (2001). Identifying software project risks: an international Delphi study. Journal of Management Information Systems, 17 (4), 5–36.

DEFINING "SUCCESS" FOR PROJECT MANAGEMENT INFORMATION SYSTEM: A CROSS SECTIONAL STUDY

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Abstract: *This paper presents the impact of project management modules on the project information systems implementation and its success. Project management modules, which are taken into consideration, are: Demand management, Portfolio selection and analytics, Resource management, Schedule management, Financial management, Time and task management, Team collaboration, Issues and risk management, Business intelligence and reporting, Portfolio and program management. The research was conducted among 51 project portfolio managers in Serbia. Research results show different perception for Business intelligence and Portfolio selection and analytics modules implementation among project managers in profit, non-profit and public sector.*

Keywords*: Project, success, information system, modules.*

1. INTRODUCTION

Projects usually have a wide variety of objectives and limitations, involving numerous internal and external actors, and are conducted in various activity sectors. Since 1980, many academics and practitioners have agreed that project management software development is one of the most crucial elements of an organization"s success. Modern university curricula in software engineering and project management include broad categories in knowledge-based training from one point of view, and from the other point of view also the acquisition of practical skills or the ability to apply the knowledge to practical situations and problem-solving using initiative, autonomy and creativity. Thus, engineering education in general and software engineering in particular is becoming increasingly complex and requires an integrated approach to practice and non-technical skills, specifically oriented to technical competences.

Therefore, practical implementation includes project planning and control and resource allocation are widely used to create real problems and implementation procedures in the context of project management software. In accordance with the above mentioned, most of the university courses about Software Project Management contain topics about Project Management body of knowledge, planning, scheduling and control and the most widely used software for practical classes (for example Microsoft-Project and Share Point services which are related with web based approach) (Salas-Morera et al., 2013).

In this paper we discuss about software project management module application in context of project success. A positive relationship between project performance and software process standardization is expected based upon management control theory. Managerial control refers to an organization"s attempt to influence employees to behave in accordance with standardized procedures and formal rules. Most documented reports are case studies that experienced a positive relationship between software process improvement and project cost reduction. Nevertheless, some researchers have argued that the management of the project"s scope, schedule, staffing, and other resources is tied to a defined process (Liu et al., 2008).

The mediator role of software flexibility implies that software engineering needs to focus effort on software flexibility as well as standardization. Software flexibility and adaptability to company business needs does impact final project performance. Information systems project managers should not regard software flexibility as an irrelevant issue. The total software quality and stability (e.g., software features and software response time) may indeed increase the overall project cost and require additional time, as argued in some project management textbooks. In this study, however, the result indicated that software flexibility might have a positive, instead of a negative, impact. Different software development guidelines and methodologies exist to enhance software flexibility. Management must choose methodologies and approaches to enforce this quality.

2. PROJECT MANAGEMENT SOFTWARE MODULES

2.1. Demand management

Using the Demand Control Support model as conceptual framework and framework for demand creation, Pintoet al. (2014) analyzed a sample of respondents from four project intensive organizations. Their findings demonstrate that women tend to experience emotional exhaustion to a greater extent than their male counterparts. In construction industry specific attention should be given to how the need to work long hours is justified. Organizations should look to improve managerial and collegial support for construction professionals, but be careful in engaging in socializing and project team-building activities (Bowen et al., 2014). Demand management capabilities this module helps organizations accomplish the following objectives:

- Integrates project proposals, portfolio analysis, and project management
- Captures all work proposals in one place
- Guides the proposals through a multistage governance process
- Helps users make decisions about which proposals to approve
- Tracks progress on project execution until the work is completed

2.2. Portfolio selection and analytics

When project portfolio management offices act as project portfolio managers their activity patterns include handling the challenges of project portfolio management and performing characteristic managerial tasks in project portfolio management. By quantitatively analyzing project portfolio management offices in 278 portfolios, Unger et al. (2012) identify three different activity patterns, which are interpreted as distinctive roles. They highlighted a significant positive correlation of project portfolio management offices" analyzing roles on performance in terms of project portfolio management quality that is a predictor of project portfolio success. Considering different stages of the R&D project portfolio selection process a multi-stage decision framework was proposed by Abbassi et al. (2014).

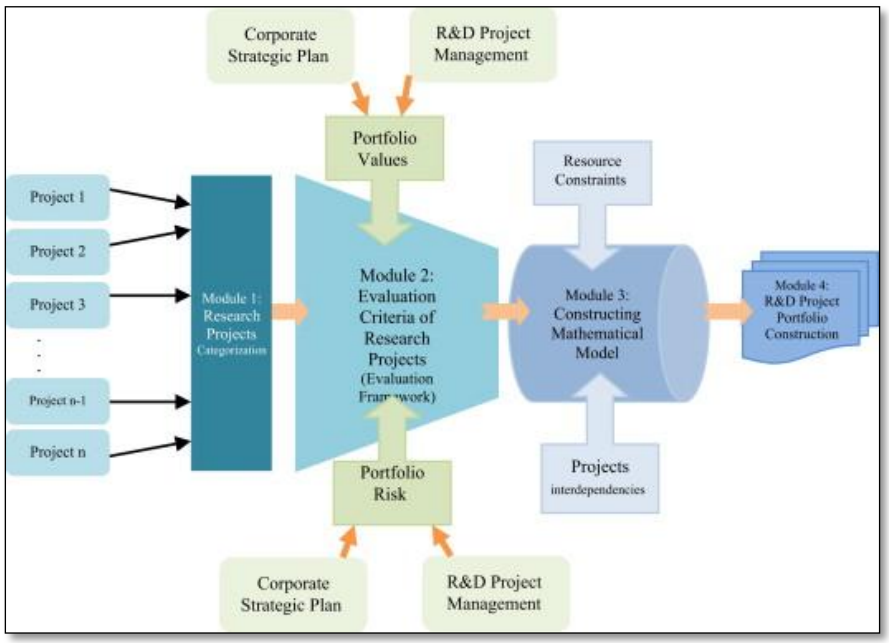

Figure 1: Multistage decision framework for R&D projects (Abbassi et al., 2014)

Adopting structured portfolio selection processes and techniques this module helps organizations accomplish the following:

- Define, communicate, and prioritize business strategy
- Score and assess competing requests from multiple dimensions
- Run what-if analysis optimization scenarios under various budgetary constraints
- Compare and contrast portfolios and gain insight through advanced analysis such as Efficient Frontier modeling

- Assess capacity and adjust project schedules to maximize resource utilization across the planning horizon
- Run and model headcount scenarios

2.3. Resource management

The objective for resource management module is to minimize the project make-span as well as the penalty cost when some projects carry higher priority. Thus, resource center is the crucial part of web based project management software. Since the problem is hard in terms of resource over location, Singh (2014) solve this problem by integrating the project priority with the activity priority, using a hybrid algorithm based on priority rules and analytic hierarchy process. On the other hand, (Obradovic et al., 2014) emphasize technical competences as a key indicator for project success according to IPMA Competence baseline. Adopting best-practice resource management techniques this module helps organizations accomplish the following:

- Consistent definition of resources - resource pool
- Assess resource availability across multiple projects - resource capacity
- Ability to “drill down” to view resource utilization

2.4. Schedule management

Whilst capturing resources can ensure that a tardy but „business-critical“ project is delivered on time, if the organization has no free resource capacity and is also not recruiting more staff, this practice harms the schedule performance of the projects deprived from resources (Yaghootkar and Gil, 2012). Adopting best-practice scheduling methodologies and tools dopting best-practice methodologies this module helps organizations accomplish the following: helps organizations achieve the following:

- Create and update schedules from the desktop or online
- Effectively control and analyze schedules
- Easily communicate schedule information

2.5. Financial management

Halawa et al. (2013) indicates that there are various methods of financial appraisal and evaluations in the investment field. The first one is called “discounting methods”, including net present value and internal rate of return; the second one is called “simple methods”, including payback period and simple rate of return; the third one is called “financial evaluation under uncertainty” and this includes break even analysis and sensitivity analysis. Key challenges that organizations face when trying to improve their financial management processes include the following:

- Standardizing cost and benefit estimates
- Project accounting and change management
- Financial visibility and insights
- Integration with LOB (line of business) systems

2.6. Time and task management

A study by the Standish Group scanned more than 8000 projects and compared their anticipated results with the real outcome. According to this study, only 16% of the projects were able to meet the goals set in terms of time, budget and quality (Hameri and Heikkilä, 2002). Time captures and project progress reporting poses several challenges to organizations, and they need to have the following characteristics:

- Time capture and project progress reporting
- Report working and nonworking time
- Capture projects, operations, and administrative time
- Recurring time periods
- Integrate with LOB systems

2.7. Team collaboration

An increasing number of companies, especially those with knowledge-intensive R&D programs, have turned to virtual project teams in recent years to generate the greatest competitive advantage from limited labor and resources. The empirical results, from a study on a sample of 75 project team members who were making full use of collaborative technologies in their project work context, not only confirmed technology acceptance model, but also demonstrate that the nature of the performed tasks positively influence perceived benefits

and user attitudes towards the use of collaboration technologies in project teams. Users with a high intention to adopt a collaboration technology in their work context, showed increased performance in decision-making or problem solving (Nikas and Argyropoulou, 2014). Effective collaboration techniques within their project portfolio management processes have following characteristics:

- Provide a central location for team collaboration
- Effectively manage a variety of content
- Simplify and enhance team communication

2.8. Issues and risk management

Sanchez et al. (2008) introduce a framework to identify risks and issues during project portfolio risk management process that helps to decrease the uncertainty of achieving the strategic goals of the organization. The final output of the framework is a portfolio risk-opportunity register, which highlights the potential events that could impact the achievement of the goals. Adopting best-practice methodologies this module helps organizations accomplish the following:

- Define a standard way to assess risk for new initiatives
- Standardize project risk collection and management
- Establish proper issue resolution and escalation

2.9. Business intelligence and reporting

Business intelligence module consists of business users and applications accessing data from the data warehouse to perform enterprise reporting, OLAP, querying, and predictive analytics. Most organizations create custom reports based according to the following factors: type of project, level of maturity, number of projects, number of employees, etc. Adopting best-practice methodologies this module helps organizations accomplish the following:

- Standard metrics for measuring performance
- Create Reports and Build Powerful Dashboards
- Create Sophisticated Reports

2.10. Portfolio and program management

Project portfolio selection is the periodic activity involved in selecting a portfolio of projects, that meets an organization"s stated objectives without exceeding available resources or violating other constraints. Some of the issues that have to be addressed in this process are the organization"s objectives and priorities, financial benefits, intangible benefits, availability of resources, and risk level of the project portfolio. Optimal portfolio selection is a major stage in the framework. Adopting best-practice methodologies this module helps organizations accomplish the following:

- Capture, Prioritize, and Select Programs
- Clarifying program and project controls to improve efficiency
- Program Delivery

3. EMPIRICAL RESEARCH

3.1. Research method and sample description

Data collection tool was questionnaire consisted of both independent and dependent variables. Independent variables were personal data of respondents: information about sex, work experience, education and position in organizational hierarchy. Dependent variables were data related to web module in organizations, obtained from the questionnaire consisted of 19 questions that offered answers evaluation from 1 (without influence) to 5 (very high influence). Representative sample consisted of 51 project managers from companies in various sectors – profit (82%), nonprofit (8%) and public sector (10%). Structure of respondent"s position in organizational hierarchy was the following: 33% from executive management level, 16% from operational management level and 51% from middle management level. Also, the sample consists of 60% males, and 40% females.

3.2. RESEARCH RESULTS AND DISCUSSION

Financial Management module is the highest ranked with score of 3.94, and the lowest is Portfolio Selection and Analytics module with score of 3.24. Beside the average value for Portfolio Selection Analytics module, only Business Intelligence module also has the average value below the total average value of all modules.

Portfolio Selection and Analytics and Business Intelligence and Reporting modules have the highest standard deviation (table 1). The key reason is that employees don"t know or don"t understand the usage of these two modules in organizations.

Table 1. Influences of the project management web modules on project management success

Project Management Modules	Average	Standard Deviation	Variance
Project and Resource Center	3.71	0.78	0.61
Time and Schedule Management	3.78	1.01	1.01
Financial Management	3.94	0.76	0.58
Business Intelligence and Reporting	3.29	1.19	1.41
Collaboration	3.78	0.88	0.77
Portfolio Selection and Analytics	3.24	1.19	1.42
Risk Management	3.65	0.87	0.75

Dominant results are indicative for Public sector (table 2). For Public sector highest value is related with time and schedule management, which means that employees in public sector appreciate most the time, but on the other hand conclusion for this module can be related that working time is different according to sector, and with many others criteria (e.g. conditions, job security, advancement, growth, power, affiliation, esteem, decision-making processes, rewarding systems, task-related rules as well as social rules, like punctuality in task completion, agreed time to read and respond to messages, respect of consensus decisions, honesty, truth, preparation for and attendance to meetings, punctuality on meetings, etc).

Also, Business Intelligence and Reporting module in Public Sector has the lowest value, which could be consequentially related with time management and critical success factors (table 3). The implementation of business intelligence and reporting does not always result in expected outcomes. This problem, called paradox of productivity (delays in the observation of an increase of productivity, poor management of business intelligence and reporting, poor qualified workforce, or the difficulty to estimate, by means of an accounting treatment, the result (profit/loss) of an investment in Business Intelligence and Reporting. Raffo, (2005) emphasize „forward-looking" decision support framework that integrates up-to-date metrics data with simulation models of the software development process in order to support the software project management control function, considering the focus on the overall decision framework using outcome based control limits, utility functions and financial performance measures (e.g. return on investment, net present value, break even point and others) which is new.

Table 2. The average value of responses regarding to the Influence of the various web modules on project management success by sectors

Influences of the various web modules on project management success:	Public Sector	Non-profit Sector	Profit Sector
Project and Resource Center	3.2	3.75	3.76
Time and Schedule Management	4.2	3.5	3.76
Financial Management	4	3.25	4
Business Intelligence and Reporting	2.4	4	3.33
Collaboration	3.4	3.75	3.83
Portfolio Selection and Analytics	3.6	3.75	3.14
Risk Management	3.4	3.75	3.67

Table 3. The average value of critical success factors and the average value of influences of the various web modules on project management success

	How often are critical success factors defined in the projects via web platform?	Influences of the various web modules on project management success
Public Sector	4	3.46
Non-profit Sector	4.25	3.68
Profit Sector	4.64	3.64

Project management software packages generally facilitate the integration of project data, the interaction with enterprise systems and the interoperability with business intelligence and reporting systems. Besides optimizing the productivity of the teams, the system allows to make better decisions, to maintain a competitive advantage and to implement an effective project management. This type of software consists of subsystems developed to treat various aspects of project management: procurement, construction, cost control and analysis, planning, quality insurance, etc.

4. CONCLUSION

Successful project management information system implementation in organizations depends on the following criteria: business process definition, maturity level of the company, number of employees, budget, number of projects, number of specific requests, etc. Difference between profit, non-profit organizations and organizations in public sector about project management system implementation could be noted in two modules - Portfolio Selection and Analytics and Business Intelligence and Reporting modules. Future consideration will include agile methodology and its application on software projects. Clients are seen to have matured in their understanding of IT projects, because maturity reveals itself in a greater understanding of the complex issues that confront IT projects and, therefore, a deep skepticism about the ability of IT departments and suppliers alone to deliver value.

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REFERENCES

Abbassi, M., Ashrafi, M., & Sharifi Tashnizi, E. (2014). Selecting balanced portfolios of R&D projects with interdependencies: A Cross-Entropy based methodology. *Technovation*, *34*(1), 54–63. doi:10.1016/j.technovation.2013.09.001

Bowen, P., Edwards, P., Lingard, H., & Cattell, K. (2014). Occupational stress and job demand, control and support factors among construction project consultants. *International Journal of Project Management*. doi:10.1016/j.ijproman.2014.01.008

Halawa, W. S., Abdelalim, A. M. K., & Elrashed, I. A. (2013). Financial evaluation program for construction projects at the pre-investment phase in developing countries: A case study. *International Journal of Project Management*, *31*(6), 912–923. doi:10.1016/j.ijproman.2012.11.001

Hameri, A.-P., & Heikkilä, J. (2002). Improving efficiency: time-critical interfacing of project tasks. *International Journal of Project Management*, *20*(2), 143–153. doi:10.1016/S0263-7863(00)00044-2

Liu, J. Y.-C., Chen, V. J., Chan, C.-L., & Lie, T. (2008). The impact of software process standardization on software flexibility and project management performance: Control theory perspective. *Information and Software Technology*, *50*(9-10), 889–896. doi:10.1016/j.infsof.2008.01.002

Nikas, A., & Argyropoulou, M. (2014). Assessing the Impact of Collaborative Tasks on Individuals‟ Perceived Performance in ICT Enabled Project Teams. *Procedia - Social and Behavioral Sciences*, *119*, 786–795. doi:10.1016/j.sbspro.2014.03.088

Obradovic, V., Jovanovic, P., Petrovic, D., Mihic, M., & Bjelica, D. (2014). Web-based Project Management Influence on Project Portfolio Managers‟ Technical Competencies. *Procedia - Social and Behavioral Sciences*, *119*, 387–396. doi:10.1016/j.sbspro.2014.03.044

Pinto, J. K., Dawood, S., & Pinto, M. B. (2014). Project management and burnout: Implications of the Demand–Control–Support model on project-based work. *International Journal of Project Management*, *32*(4), 578–589. doi:10.1016/j.ijproman.2013.09.003

Raffo, D. M. (2005). Software project management using PROMPT: A hybrid metrics, modeling and utility framework. *Information and Software Technology*, *47*(15), 1009–1017. doi:10.1016/j.infsof.2005.09.004

Salas-Morera, L., Arauzo-Azofra, A., García-Hernández, L., Palomo-Romero, J. M., & Hervás-Martínez, C. (2013). PpcProject: An educational tool for software project management. *Computers & Education*, *69*, 181–188. doi:10.1016/j.compedu.2013.07.018

Sanchez, H., Robert, B., & Pellerin, R. (2008). A project portfolio risk-opportunity identification framework. *Project Management Journal*, *39*(3), 97–109. doi:10.1002/pmj.20072

Singh, A. (2014). Resource Constrained Multi-project Scheduling with Priority Rules & Analytic Hierarchy Process. *Procedia Engineering*, *69*, 725–734. doi:10.1016/j.proeng.2014.03.048

Unger, B. N., Gemünden, H. G., & Aubry, M. (2012). The three roles of a project portfolio management office: Their impact on portfolio management execution and success. *International Journal of Project Management*, *30*(5), 608–620. doi:10.1016/j.ijproman.2012.01.015

Yaghootkar, K., & Gil, N. (2012). The effects of schedule-driven project management in multi-project environments. *International Journal of Project Management*, *30*(1), 127–140. doi:10.1016/j.ijproman.2011.02.005

RISK INDEX AS PROJECT RISK MEASURE

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Abstract: *This paper analyzes project risk, as risk has been viewed in recent years as a dimension of a project at the same level as the scope, time, and cost. The paper provides a definition of risk index as a model for assessing the project impact of various risk factors. Determination of risk index is presented through the example of construction projects. The results show that political factors are the dominant macro-level risk factors, whereas design factors prevail at the micro level.*

Keywords: *management, project, risk, risk factor, risk index*

1. INTRODUCTION

It has long been thought that a project has three dimensions: cost, time, and scope. However, in recent times, a fourth dimension – risk – has been added (Bobera, 2003). Project risk is an uncertain event or condition which, if it does occur, has either a positive or a negative effect on at least one of the project attributes, such as time, cost, scope, or quality (Project Management Institute [PMI], 2004). Therefore, it is necessary to manage project risk.

In the past decade, there has been a significant increase in the body of published work on project risk management. In her analysis of papers pertaining to project risk, published between 2000 and 2012 in four representative risk management journals, Liisa Lehtiranta (2014) found that 70% of the research deals with construction project risk, 19% with IT and software project risk, and only 11% with risks in other industrial projects and projects in general (645).

This paper: (1) lists the basic project risk causes or factors; (2) analyzes the process of project risk management; (3) defines risk index; (4) describes the method for determining the significance of risk factors and their potential impact; and (5) presents risk index determination using the example of a construction project.

2. PROJECT RISK MANAGEMENT

Project risk management is an organized process of risk identification and measurement, as well as selection, development, and implementation of risk control and monitoring options (Kerzner, 2004). Project risk management contributes to higher probability of a successful project realization – understanding of potential problems and their influence on project realization requires that activities be undertaken which will reduce a potential harmful impact of specific events on the project. This entails certain costs, which is why risk management is considered an investment. Risk management should be invested in, while observing the rule that the costs of risk must not exceed the potential benefits.

2.1. Basic project risk causes

Project management differs from management of any other process. The fact that a project has to solve an unknown problem suggests that project risk is higher than risk in other processes. The majority of risks are directly associated with a project and the activities aimed at its realization. Nevertheless, there are also indirect risks, which are the result of altered business environment of organizations.

Direct project risk causes include the following (Zayed & Chang, 2002, Nouks, 2005, Gohar, Khanzadi, & Farmani, 2012):

- Possibility that the project result will not meet the expectations;
- Refusal of project results by the users;
- Discrepancy between the required and the available resources;
- Increased project costs;
- Prolonged project duration;
- Lack of team members" experience with realization of similar projects;

- Deficiencies in technology for project realization;
- Imprecisely defined tasks;
- Inadequate software support;
- Insufficient project quality;
- Project changes;
- Insufficient safety;
- Inadequate team members‟ knowledge and skills;
- Task complexity;
- Inadequate management support.

Indirect project risk causes associated with business environment include the following (Zayed & Chang, 2002, Noks, 2005, Gohar, Khanzadi, & Farmani, 2012):
- Market changes;
- Market range and competitiveness;
- New investment options;
- Regulatory and legislative limitations;
- Erroneous market assessment;
- Inflation;
- Lack of available funds;
- Public opinion of the company brand.

Causes of task risks are task specific and can be identified and understood if each task is analyzed separately.

2.2. Project risk management processes

Even though there are many ways to structure risk management, project risk management usually involves the following six stages (PMI, 2004): 1) risk management planning, 2) risk identification, 3) qualitative risk analysis, 4) quantitative risk analysis, 5) risk response planning, and 6) risk control and monitoring.

Risk management planning is the process of developing and documenting an organized, comprehensive, and interactive risk management strategy; defining methods for risk identification and analysis; selecting, developing, and implementing risk treatment options; and planning proper resources (Kerzner, 2004). A risk management plan is a document which contains project risk management procedures during the project‟s life cycle and which summarizes the results of risk identification and assessment, response planning, and risk adjustment and control. Risk management plan can also contain risk management methodology, roles and responsibilities for risk-related activities, budget and activity schedule, description and interpretation of risk analysis methods, risk ranking criteria, type of reporting risk management activities, and the manner of monitoring those activities (Bobera, 2003). In addition to the basic plan, the following can also be defined: (1) operation plans – plans for activities conducted in case of a specific and identified risk event; (2) retreat plans – plans devised for risks which heavily impact project goals and which are activated in case a previously planned risk reduction does not produce the expected results; (3) operational reserves – additional means to be used for risk mitigation if there are changes in project scope and quality.

Risk identification implies the establishment and understanding of potential unsatisfactory project results in terms of project nature and goals, scope, time, cost, and quality. It is performed in order to create a list of risk sources and factors, as well as events which can affect goal accomplishment. Such events can disable, reduce, increase, or postpone the realization of defined goals. As the identified events can occur in a variety of ways, it is necessary to devise different scenarios for the events. Most commonly, these are basic scenarios as the most probable risk event scenarios. International standard ISO/IEC 31010 (2009) recommends using the following methods and techniques to identify project risks: brainstorming, survey, interview, checklist, preliminary hazard list, hazard and operability study, „what-if‟ analysis, scenario analysis, cause-and-effect analysis, and probability and impact matrix.

Risk analysis involves the description of identified risks, extraction of the causes, and analysis of how they influence risk (taking into consideration the existing processes, devices, or practice by which a given risk is controlled), assessment of risk occurrence probability and impact, assessment and quantification of risks, creation of priority risk list, proposals of risk response methods, and definition of parameters and metrics for risk monitoring (Savic, Stankovic, 2012). Risk assessment is performed through unified assessments of probability and impact for every risk scenario. Extensive information on the frequency and impact of hazards should be integrated and presented in a relatively simple form for easier understanding and decision making. This could be a unique numerical index, a table, a matrix, a graph, or a risk chart.

Risk analysis can be qualitative, semi-quantitative (qualitative-quantitative), quantitative, and combined. Qualitative and semi-quantitative risk analysis typically includes the following methods and techniques: survey, SWOT analysis, cause-and-effect diagram, expert assessment, the Delphi technique, preliminary hazard analysis, fault tree analysis, failure mode and effects analysis, probability and impact matrix, and multi-criteria analysis. Quantitative risk analysis typically includes the following methods and techniques: probability theory, mathematical statistics, operational research, sensitivity analysis of effectiveness indicators, scenario analysis, fault tree analysis, event tree analysis, Monte Carlo methods, and modelling and simulation methods (ISO 31010, 2009).

In order to properly utilize a risk assessment (for selecting technical and managing actions and for establishing a connection with social and administrative bodies), it is essential to know the degree of indeterminacy of the assessment. Indeterminacy of the assessment depends on the quality of the database, models, and methods of analysis used. Data indeterminacy stems from the fact that an insufficient range of real data is appended with expert assessments or opinions. Such indeterminacies can be mathematically analyzed and quantified. Model indeterminacy is always present due to partial compatibility between the real system and its model. The indeterminacies are difficult to quantify, and they are more precisely determined by sensitivity analysis.

Sensitivity of results towards a model parameter is defined as the change of risk measure with the change of unit parameter. This analysis is performed for all parameters which are assumed or known to have a high degree of indeterminacy. A model parameter with the highest influence on risk also has the highest sensitivity. The effect of indeterminacy can be reduced by means of relative risk assessment. If one and the same methodology is used to assess different alternatives, the resulting risk assessment is subject to the same indeterminacy. Thus, ranking of various alternatives provides a better risk assessment than the absolute assessment.

Use of quantitative risk assessments in practice requires risk classification. The primary problem here is the decision on risk acceptability. The decision on which risk can be considered acceptable often depends on a company"s economic capabilities. Categorization of acceptable risks is a result of expert assessment, in accordance with the framework, content, and goals of the project. In addition to ranking and evaluating risks, risk factors can also be ranked, considering their impact on project risk. Such a list indicates the most important factors of potential risks and, accordingly, the points and paths in which risk reduction measures would be the most effective.

Risk categorization is the foundation of risk response planning. Risk treatment defines activities which expand the possibilities and reduce threats to project goals. The basic risk response planning options are the following: risk avoidance (elimination of uncertainties and high risks); risk reduction (preventive reduction of potential risks); risk retention (voluntary acceptance of risk and keeping it at an acceptable level); and risk transfer (distribution or transfer of risk to other organizations, agencies, or associations).

Risk monitoring is a continual process of monitoring and assessing risk management processes by means of measuring and reporting, as well as through feedback, which initiates re-planning, reassessment, and/or management response ("*Systems Engineering Fundamentals*", 2001)

3. RISK INDEX

Risk index (R) is a model designed to assess the potential impact of various risk factors on a project. It was originally developed by Dias and Ioannou (1995) and modified by Zayed and Chang (2002). The model represents a logical, reliable, and consistent method of risk factor ranking, project evaluation, and establishment of project priorities based on risk index value.

Risk index is a function of two parameters. The first parameter pertains to risk factor or subfactor weight, and the second to the impact of the observed risk factor or subfactor on project goals. Risk index is determined separately at the macro level (management level, where environmental risks are considered) and the micro level (the level of the project itself, where immediate project risks are considered). The total risk index is the product of risk indices for the macro and micro levels of the project.

According to Zayed and Chang (2002) and Zayed, Amer and Pan (2008), risk index at specific levels is determined by equation (1):

$$R_k = \sum_{i=1}^{n} w_i E_i \,, \qquad (1)$$

where:

R_k - risk index at k^{th} level (k=1 at the macro level and k=2 at the micro level),

w_i - weight of the i^{th} risk factor/subfactor determined by the eigenvalue method,

E_i - impact value of the i^{th} risk factor/subfactor,

n - number of risk factors/subfactors.

The total risk index is calculated by equation (2):

$$R = R_1 R_2 . \quad (2)$$

3.1. Weighting

The Analytic Hierarchy Process (AHP) method is used for weighting by the eigenvalue method.

AHP was developed by Thomas L. Saaty in the 1970s. AHP provides a flexible and easily understood way to analyze and parse the decision problem. It is a multi-criteria decision-making methodology that allows subjective and objective factors to be considered in the evaluation process.

AHP method involves the following steps: (1) identification and clear definition of the overall goal (objective); (2) identification of the criteria, sub-criteria, and alternatives which satisfy the overall goal; (3) formation of the hierarchical structure; (4) performance of pairwise comparisons; (5) determination of weights of the decision elements by means of the eigenvalue method; (6) verification of the consistency of results; and (7) determination of the global priority vector.

Goal identification. The goal is to determine weights of risk project factors/subfactors.

Identification of criteria, sub-criteria, and alternatives. Risk factors are identified as criteria (e.g. at the macro level, these include policies, finances, and the market, while at the micro level – technology, resources, organization, project performance, etc.). Risk subfactors are identified as sub-criteria or alternatives (e.g. within policies, these include change in government policy or national legislation, within finances – inflation, interest rate or risk fund changes, or within technology – material risk, equipment risk, change in technology, etc.). If risk index is determined for several projects, the projects then represent alternatives.

Hierarchical structure formation. The Fuzzy AHP method presents a problem in the form of hierarchy: the first level represents the goal; the second level considers relevant criteria; the third level considers relevant sub-criteria; and the last level defines alternatives.

Pairwise comparison. Once the hierarchy has been constructed, the decision-maker determines the relative importance of the elements at each level of the hierarchy. Elements at each level are paired, taking into account their relative contribution to the elements at the first higher hierarchical level, using the 1-9 Saaty"s comparison scale, where 1 means that importance of two criteria is the same, while 9 means that one criterion is extremely more important than the other. For each level, starting from the top of the hierarchy and going down, the pairwise comparisons are reduced in the square matrix form: $A = \left[a_{ij}\right]_{i,j=\overline{1,n}}$, where $a_{ij} = 1$ for $i=j$ and $a_{ij} = 1/a_{ji}$.

Determination of relative weights. The mathematical basis for determining weights based on matrix theory has been proposed by Saaty (1980). The procedure is called an eigenvector approach, which takes advantage of the characteristics of a special type of matrix called a reciprocal matrix. The eigenvector $W = (w_1, w_2, ..., w_n)$ can be generated in different ways. The two most frequently used methods – arithmetic mean method and geometric mean method – follow below.

In the arithmetic mean method, the elements of the eigenvector are calculated as follows:

$$w_i = \frac{1}{n}\sum_{j=1}^{n}\frac{a_{ij}}{\sum_{k=1}^{n} a_{kj}}, \quad i = 1,2,...n . \quad (3)$$

In the geometric mean method, the elements of the eigenvector are calculated as follows:

$$w_i = \frac{\left(\prod_{j=1}^{n} a_{ij}\right)^{\frac{1}{n}}}{\sum_{k=1}^{n}\left(\prod_{j=1}^{n} a_{kj}\right)^{\frac{1}{n}}}, \quad i = 1,2,...,n. \qquad (4)$$

Checking results consistency. Consistency implies that the decision-making procedure involves coherent judgments in specifying the pairwise comparison of the criteria, sub-criteria, or alternatives. Consistency is determined by the consistency ratio, as given in equation (5):

$$CR = \frac{1}{RI}\left(\frac{\lambda_{\max} - n}{n-1}\right), \qquad (5)$$

where RI is a random index (Table 1), n is the number of pairwise comparison elements in matrix A, and $\lambda_{\max}$ is calculated as follows:

$$\lambda_{\max} = \frac{1}{n}\sum_{i=1}^{n}\frac{(AW)_i}{w_i}. \qquad (6)$$

Table 1: Random indices (Saaty, 1980)

n	1	2	3	4	5	6	7	8
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40

If a consistency ratio is 0.10 or less, it can be considered acceptable; otherwise, the judgments should be improved. This improvement should be made by double-checking the data entry and by omitting bad judgments which have high inconsistency ratios (Saaty, 1980).

Global priority determination. The final stage involves finding a vector of global priority. Since the successive levels of hierarchy are linked together, a global weight vector for the entire hierarchy is determined by multiplying the weight of all vectors of successive levels.

3.2. Impact assessment

The impact of the i^{th} risk factor/subfactor E_i reflects the level of project performance change in relation to that risk factor/subfactor. It is determined through the following two steps: (1) first, the qualitative impact of risk factor/subfactor at project performance level has to be determined by means of the 1-9 scale, shown in Table 2; (2) then, the qualitatively expressed risk impact has to be quantified in a 0-100 point value range, or 0-1 range, as shown in Figure 1.

Table 2: Qualitative performance scale (adapted from Zayed and Chang, 2002)

Qualitative performance scale	Abbreviation	Equivavelt numerical index
Extremaly Undesirable	ExU	1
Substantialy Undesirable	SuU	2
Moderately Undesirable	MoU	3
Slightly Unesirable	SiU	4
Neither Desirable nor Undesirable	Nei	5
Slightly Desirable	SiD	6
Moderately Desirable	MoD	7
Substantialy Desirable	SuD	8
Extremaly Desirable	ExD	9

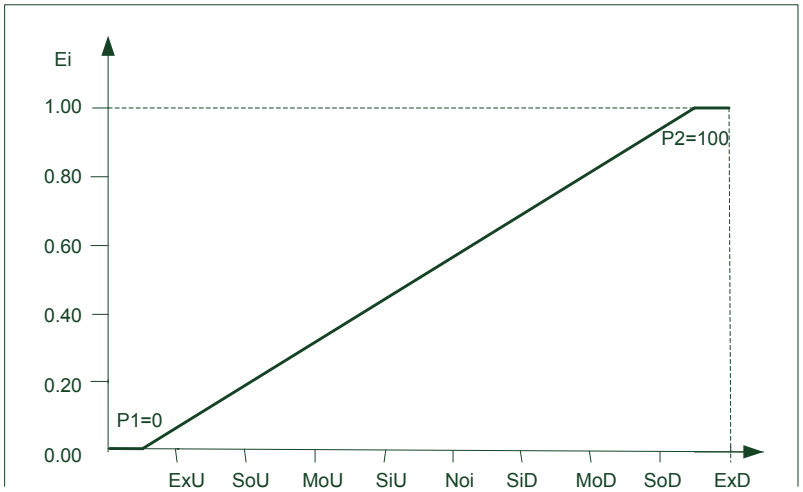

Figure 1: Quantitative performance scale (Zayed and Chang, 2002, p.12)

In Figure 1, there are three areas of risk impact. The first area is the area of acceptable risk impact, which indicates a maximum performance level (P1=0 points, or E=0); the second area is the area of linear growth of risk impact (0<P<100, 0<E<1); and the third area is the area of the highest risk impact and a minimum performance level (P2=100 points, or E=1).

3.3. Ranking

Risk factors/subfactors are ranked based on risk index values for each factor/subfactor. The factor/subfactor with a highest risk index value has the biggest impact on project quality. At the same time, risk index indicates priority actions for project risk reduction.

Based on macro, micro and total risk index values, projects can be categorized as shown in Table 3.

Table 3: Project risk categorization based on risk index

Risk index on the macro and at the micro levels	Total project risk index	Risk categorization
≤ 0.2	≤ 0.04	Low risk
< 0.2 *and* > 0.6	< 0.36 *and* > 0.04	Medium risk
≥ 0.6	≥ 0.36	High risk

The total project risk index is also the basis for ranking different projects. The project with the lowest total risk index is ranked the highest because it has the lowest risk impact on project performance.

4. CASE STUDY: RISK INDEX DETERMINATION FOR A CONSTRUCTION PROJECT

Risks are ever-present in construction project and they affect costs, time, and quality of project realization. They are unavoidable but manageable to the point of acceptable project risk. Zou, Chen and Chan (2010) say that risk management implementation "in construction projects may bring a number of benefits. Therefore it is necessary to have risk management as an integral part of a construction organization"s management practice" (854).

In order to determine the risk index, we conducted five interviews with project managers in organizations dealing with the design and realization of construction projects in Serbia. The aim of the interviews was to identify only the key risk factors/subfactors at the macro and micro levels and their significance and impact on project goals. Task, or activity, risks were not included in the survey, as they are project specific. Based on the results of the interviews, we defined factor/subfactor hierarchies at the macro and micro levels (Figure 2), created pairwise comparison matrices (Tables 4-7), determined the weights and quantified the impact (Tables 8 and 9).

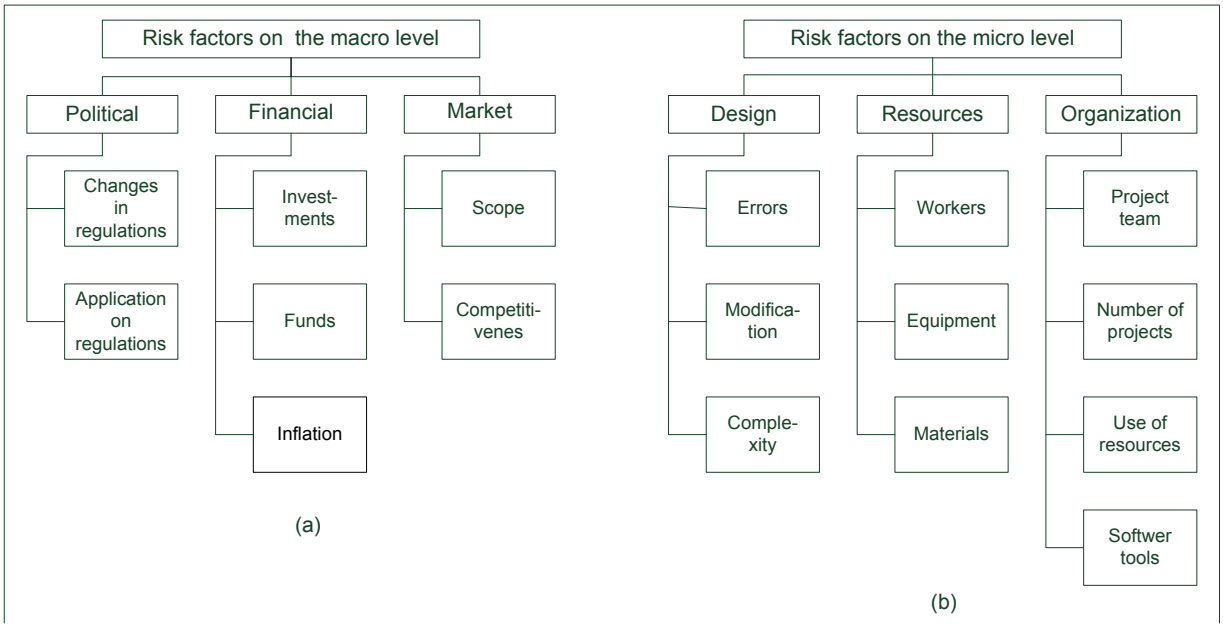

Figure 3: Risk factors hierarchy at the macro level (a) and the micro level (b)

Table 4: Pairwise comparison of factors at the macro level

	Politics	Finance	Market
Politics	1	3	5
Finance	1/3	1	3
Market	1/5	1/3	1

Table 5: Pairwise comparison of sub-factors in relation to factors at the macro level

Politics			
	Changes in regulation	Application of regulations	
Changes in regulations	1	1/3	
Application of regulations	3	1	
Finance			
	Investments	Funds	Inflation
Investments	1	5	3
Funds	1/5	1	1/3
Inflation	1/3	3	1
Market			
	Scope	Competitivenes	
Scope	1	1	
Competitivenes	1	1	

Table 6: Pairwise comparison of factors at the micro level

	Design	Resources	Organization
Design	1	3	5
Resources	1/3	1	3
Organization	1/5	1/3	1

Tabele 7: Pairwise comparison of sub-factors in relation to factors at the micro level

Design			
	Errors	Modifications	Compexity
Errors	1	3	5
Modifications	1/3	1	3
Compexity	1/5	1/3	1
Resources			
	Workers	Equipment	Materials
Workers	1	1/3	3
Equipment	3	1	5
Materials	1/3	1/5	1

Organization				
	Project team	Number of projects	Use of resources	Software tools
Project team	1	5	5	3
Number of projects	1/5	1	1	1/3
Use of resources	1/5	1	1	1/3
Software tools	1/3	3	3	1

Table 8: Weights, efects and risk index at the macro level

Factors	Factors weights	Sub-factors	Sub-factors weights	Sub-factors efects	Subfactors risk index
Politics	0.633	Changes in regulations	0.158	0.3	0.0474
		Application of regulations	0.475	0.2	0.0950
		CR=0			
Finance	0.260	Investments	0.164	0.3	0.0492
		Funds	0.028	0.2	0.0056
		Inflation	0.068	0.4	0.0272
		CR=0.0375			
Market	0.106	Scope	0.053	0.1	0.0053
		Competitivenes	0.053	0.1	0.0053
		CR=0			
CR=0.0375					
Sub-factors risk index sum					**0.2350**

Table 9: Weights, efects and risk index at the micro level

Factors	Factors weights	Sub-factors	Sub-factors weights	Sub-factors efects	Subfactors risk index
Design	0.633	Errors	0.401	0.6	0,2406
		Modifications	0.165	0.2	0,0330
		Compexity	0.067	0.2	0,0134
		CR=0.0375			
Resources	0.260	Workers	0.068	0.2	0,0136
		Equipment	0.165	0.3	0,0495
		Materials	0,027	0.2	0,0054
		CR=0.0375			
Organization	0.106	Project team	0.059	0.3	0,0177
		Number of projects	0.010	0.1	0,0010
		Use of resources	0.010	0.2	0,0020
		Software tools	0.027	0.2	0,0054
CR=0.0375		CR=0.016			
Sub-factors risk index sum					**0.3816**

The total project risk index, based on equation (2) and Tables 8 and 9, is:

$$R = R_1 R_2 = 0.235 \cdot 0.3816 = 0.0897$$

At both project levels risk is categorized as "medium risk" (R_1=0.2350, R_2=0.3816). Total risk also belongs to the category of "medium risk" (R = 0.03816). The highest risk at the macro level is caused by political and financial factors, such as: the application of regulations (0.0950), investments (0.0492) and changes in regulations (0.0474). At the micro level, the dominant risk results from errors in the project (0.2406); significantly lower risks are caused by equipment (0.0495), modifications of the project (0.0330), etc.

5. CONCLUSION

Risk management is a means of ensuring a project from potential harmful effects of certain events (within and outside of the project) on project realization. Through understanding potential problems, defining the possibilities to be monitored (or ignored) and threats to be responded to (or accepted), developing and controlling responses to potential risk, and creating the need for improvement of the project management plan, risk management contributes to the accomplishment of project goals in the best possible manner.

Risk index is a project risk measure. Its value will be more credible if the problem of project risk is considered at a large number of hierarchy levels (to activities level). This paper considered only two hierarchy levels with factor typical of all construction projects in order to show the procedure of risk index determination.

Nevertheless, every project has its own inherent risks which are to be considered when determining the risk index for a specific project.

REFERENCES

Bobera, D. (2003). Project Management. Novi Sad: University of Novi Sad and Faculty of Economics in Subotica.

Dias, A., Jr., & Ioannou, P. G. (1996). Company and project evaluation model for privately promoted infrastructure projects. Journal of Construction Engineering and Management, 122(1), 71–82.

Gohar, A. S., Khanzadi, M., & Farmani , M. (2012). Identifying and Evaluating Risks of Construction Projects in Fuzzy Environment: A Case Study in Iranian Construction Industry. Indian Journal of Science and Technology, 5 (11), 3593-3602. ISSN:0974-6846

ISO 31010 (2009). Risk menagement – Risk assessment techniques

Lehtiranta, L. (2014). Risk perceptions and approaches in multi-organizations: A research review 2000–2012 International Journal of Project Management 32 (4) 640–653. doi: 10.1016/j.ijproman.2013.09.002

Noks, S. et al. (2005). Project management - to finish the job on time and in accordance with the budget. Belgrade: Clio (translation from English).

Project Management Institute. (2004). A Guide to the Project Management Body of Knowledge (Third edition). Newtown Square, PA: Project Management Institute, Inc.

Saaty, T.L., 1980. The analytic hierarchy process. New York: McGraw-Hill.

Savic, S., & Stankovic, M. (2012). System and risk theory. Belgrade: Academic mind.

Systems Engineering Fundamentals. (2001). Virginia: Systems Management College, Department of Difense. Retrived from: http://spacese.spacegrant.org/SEModules/Reference%20Docs/DAU_SE_Fundamentals.pdf

Zayed, T., Amer, M., & Pan, J. (2008). Assessing risk and uncertainty inherent in Chinese highway projects using AHP. International Journal of Project Management, 26(4), 408–419. doi:10.1016/j.ijproman.2007.05.012

Zayed, T. M., & Chang L. M. (2002). Prototype Model for Build-Operate-Transfer Risk Assessment. Journal of Management in Engineering, 18(1), 7-16. doi: 10.1061/(ASCE)0742-597X(2002)18:1(7)

Zou, P. X. W., Chen, Y., & Chan, T.J. (2010). Understanding and Improving Your Risk Management Capability: Assessment Model for Construction Organizations. Journal of Construction Engineering and Management, 136(8), 854-863. doi: 10.1061/_ASCE_CO.1943-7862.0000175

THEORY OF COMPLEXITY AND INNOVATION PROJECTS

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***Abstract**: Complexity, as a new paradigm of scientific thought, finds its place in project management. There is a high projects failure rate, and on account of this, there are many criticisms of traditional project management. The theory of complexity takes into account the context in which a particular project is observed. Innovation projects distinguish from conventional projects primarily, by a greater degree of uncertainty and risk, and they cannot be managed in the same way as conventional projects. The aim of this paper is to consider the complexity of the project and the project environment, searching for relationship with innovation projects, and to give some helpful recommendations for project managers.*

***Keywords**: theory of complexity, project management, criticism, innovation project, uncertainty, risk, project manager*

1. INTRODUCTION

Theory of complexity brings refreshment in traditional project management. Projects have always been guided by the Newtonian paradigm, which implies linearity, determinism and predictability. Despite this, there are many examples of failed projects. Simple rules of cause and effect are not always valid, and a large number of factors affecting the complexity of the project and project environment. Like complex adaptive systems, projects constantly need to adapt to these changeable factors.

Complexity paradigm supports innovation, because there is a strong connection between chaos and creativity. Innovation projects are not structured, their future is uncertain, and traditional tools for managing conventional projects are often not helpful in their case.

In order to provide successful project management, project managers have a lot of to learn from the theory of complexity. The challenge is to manage the chaos of innovation projects, to achieve an agreement within the project team, to predict the future in unpredictable environment, and to manage the risk of innovation projects.

2. INTRODUCTION TO THE THEORY OF COMPLEXITY

Mitchell (2009) writes that “the word *complex* comes from the Latin root *plectere*: to weave, entwine” (p.4). Cooke-Davies, Cicmil, Crawford, & Richardson (2007) concluded that complexity is “generally referring back to the Latin origins of the term (*complexus*, from *complecti*) in which *com* is combined with *plectari* meaning ply or braid” (p.51). It is clear that complexity in the main implies that something is composed of many parts, and there are difficulties in understanding the relationship among them.

Stacey matrix pinpoints the differences among the terms – simple, complicated, complex, chaotic. It contains two dimensions. The horizontal axis represents the degree of certainty, and the vertical axis the level of agreement (figure 1). Certainty means that it is possible to determine the cause and consequence relationship between these two events, but also to predict the future with certainty based on previous experiences. On the other hand, the arrangement means there is a group agreement among certain questions and decisions which are under consideration.

Five fields are observed on this matrix:

- Simple (1) – Close to Agreement, Close to Certainty;
- Complicated (2) – Far from Agreement, Close to Certainty;
- Complicated (3) – Close to Agreement, Far from Certainty;

- Anarchy (4) – Far from Agreement, Far from Certainty;
- **Complex** (5) – zone of complexity, it is located at the transition between zone of stability and zone of anarchy (the so-called "the edge of chaos").

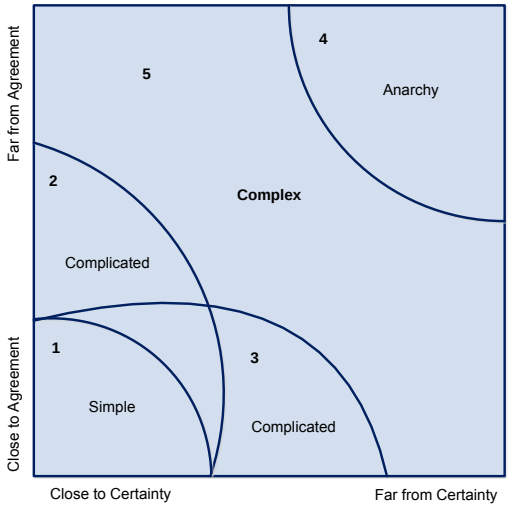

Figure 1: Stacey matrix (Zimmerman, 2001)

Classical science is based on linear systems and determinism, but simple rules of cause and effect are not always valid. Nonlinear systems make a fundamental concept of chaos theory, on which theory of complexity is based. This theory suggests that the universe is full of systems which are constantly adapting to the environment, and hence the term Complex Adaptive Systems (CAS). The rise of CAS as a school of thought took hold in the mid-1980's with the formation of the Santa Fe Institute (Dodder, Dare, 2000).

Adapting to the changes in the environment, CAS develop and evolve with it in time. Constant reorganization in finding ways for adapting to the changeable factors in the environment is present and it happens spontaneously. Systems evolve to the higher order degree through self organization. Keskinen, Aaltonen, Mitleton-Kelly, & Kauffman (2003) have explained that „complex systems are composed of numerous, varied, simultaneously *interacting parts* (or agents)" (p.7). The way in which system parts are mutually connected and the relationships among them are essential for the system's survival. Complex system isn't a mere sum of the parts, but an integrated whole in which very small changes can make huge differences in the results. Meteorologist Edward Lorenz had defined this phenomenon in 1963 as „sensitive dependence on initial conditions", that later, in 1979, called *„butterfly effect"* in one of his paper (Cooke-Davies, Cicmil, Crawford, & Richardson, 2007). Legendary, the flapping of a butterfly's wings in Brazil set off a tornado in Texas. There is high degree of connection among the agents, hence the tendency to fast and surprising behaviour changes. These changes, combined with sensitive dependence on initial conditions contribute to unpredictable behaviour in long-term. Within CAS it is still possible to spot a certain order, and certain patterns of behaviour that lead to the evolution of the system, while all details of the system cannot be fully comprehended.

3. CRITICISMS TO THE TRADITIONAL APPROACH OF PROJECT MANAGEMENT

In addition to constant knowledge improvement on project management and sophisticated development tools and project management techniques, there are still many examples of failed projects or partly unsuccessful projects (based on the following – time, costs, and quality). On account of that, there is criticism toward traditional project management.

"The paradigm of the traditional approach refers to a predictable environment, where the success of the project is attributed to adherence to pre-established standards, and failure is attributed to lack of adherence to the same standards. However, doubts have been raised about the validity of this paradigm and the implicit assumptions for the effective management of projects." (Marquees, 2012)

More attention should be dedicated to context contemplation in which the relative project is being observed. Without the corresponding project environment analysis, or even by ignoring its individuality, easily accessible, verified and "quick" solutions are suggested. However, in practice it often turns out that universal

solutions are not always the best ones, so it is preferable to apply contingency management access because the very definition of the project calls it a unique business venture.

It is often cited in literature that it is necessary to connect interior processes of a project with historical and organizational context since “no project is an island”. Engwall (2003) points out that “in order to understand the inner life of a project in depth, it also needs to be analyzed in relation to: (1) experiences from past activities; (2) politics during the pre-project phases; (3) parallel courses of events happening during project execution; (4) ideas about the post-project future; and (5) institutionalized norms, values and routines of the project’s organizational context” (p.791).

In addition to other complaints, Packendorff (1995) notices it is wrong to treat projects as means for goal attaining, and not premature organization.

4. INNOVATION PROJECTS SPECIFICATION AND RELATION TO THE THEORY OF COMPLEXITY

Complexity paradigm supports innovation. The complexity zone is to be seen on the transgression between the arrangement zone and the chaos zone on a Stacey diagram. “In the zone of complexity the traditional management approaches are not very effective but it is the zone of high creativity, innovation, and breaking with the past to create new modes of operating” (Zimmerman, 2001).

Various types of innovation projects are shown on the figure 2: technology, research, new product development projects and other projects. “Conventional projects tend to have clearly defined goals and targets. On the opposite, innovation projects might not necessarily have this detailisation. Innovation is often elusive and cannot be described before it is actually achieved” (Filippov, Mooi, 2010).

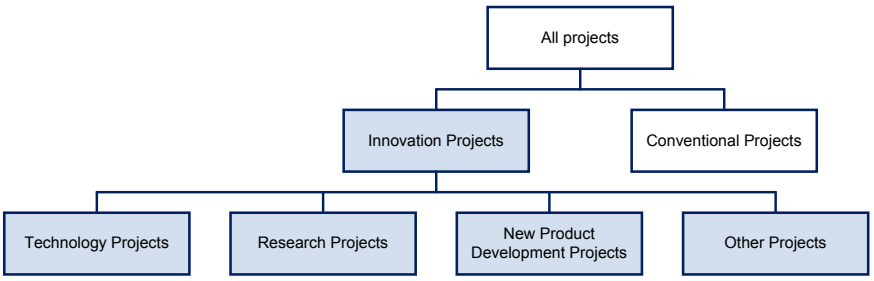

Figure 2: Classification of projects (Filippov, Mooi, 2010)

Innovation projects are distinguished from the conventional projects by its higher degree of uncertainty and risk. They cannot be managed in the same way as conventional projects since it is necessary to include more creativity when compared to standardized methods. In addition, traditional tools for managing conventional projects are often not helpful in managing innovation projects.

Learning is an another important feature of innovation projects. Harkema (2003) concluded that “learning is not focused on the procedural aspect of innovation projects, but on the relational aspect that underlies interacting people” (p.17).

5. PROJECTS MANAGEMENT, INNOVATION PROJECTS MANAGEMENT, AND COMPLEXITY

5.1 Project Complexity

Williams (1999) sees project complexity in two dimensions (figure 3): structural complexity and uncertainty.

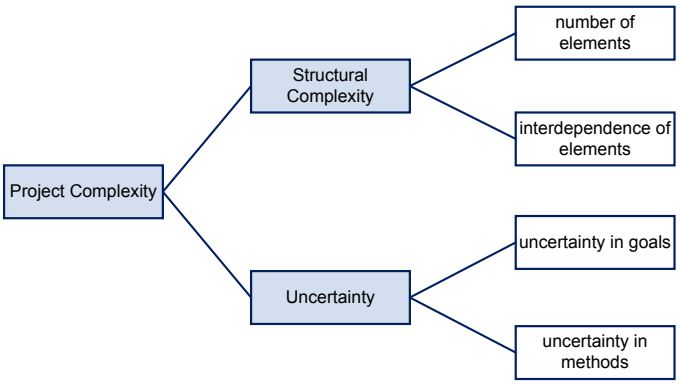

Figure 3: Project complexity (Williams, 1999, p.271)

Projects such as complex adaptive systems are comprised of a great number of elements which have a mutual interaction. Since "complexity can be characterised by two main aspects – quantitative and qualitative" (Geov, 2007, p.1), the quantity complexity aspect in the projects comes from a number of activities and different kinds of activities (for example, preparational activities, operational activities, the ones that happen on paper or in the field, etc.) These activities are mutually intertwined, so it is obvious that there is a great number of connections and dependences which are different as well. For example, in Precedence Diagramming Method (PDM) there are four types of connections: Finish-to-Start (FS), Start-to-Start (SS), Finish-to-Finish (FF), Start-to-Finish (SF). All these relations can have specific lags (such as FS2). Quality complexity aspect is the consequence of quantity aspect when due to many activities and relationships among activities in the project, perception exacerbates and behaviour of the project becomes unpredictable. Apart from the number of activities and number of connections, theirs differences are important for quality aspect of complexity, as well as variability of resources engaged in the project.

When it comes to innovation projects, the biggest problem is weak structuring. There is no previous experience in order to create something new (whether it's a new technology, a new product, or research), and because of that it is hard to know beforehand all tasks that will be undertaken on the project. Frequent changes in the project are usual, as well as the lack of understanding of their consequences.

The *butterfly effect*, known as an important non-linearity factor, is present in the management project systems. Little changes in certain phases of projects can influence the ultimate outcome. Moreover, if we repeat the same thing in a project, we won't get the same results every time. It is sometimes hard to connect cause and consequence since nonlinear behaviour is common for big projects. Apart from the great number of events and high degree of interdependence, what also influences this is organizational structure layers in the project and project relationships with other projects (Remington, Zolin, 2011).

The risk and uncertainty of the project are the highest in its initial phase (figure 4), when it is necessary to define the desired goals of the project. There are additional difficulties in risk management of innovation projects, because project risks come from different sources: management, technology and market (Stosic, Isljamovic, & Mihic, 2013).

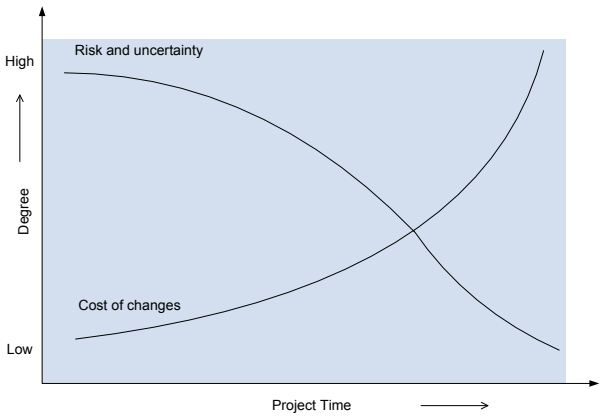

Figure 4: Impact of Variable Based of Project Time (PMBOK, 2013, p.40)

Having in mind that a great number of factors from the environment affect the project complexity and that projects can be long-lasting, it is necessary to examine the adequacy of originally established goals and redefine them. Projects are adjusted to changeable circumstances in the environment like complex adaptive systems. By changing the project goals, methods used for their achievements are changed.

In the same way that CAS behaviour cannot be predicted in a long period of time (similar to weather forecast), it is not possible to predict future occurrences in the projects whereupon its outcome is uncertain.

5.2 Environment project complexity

If project as a structure is being observed, then its closest environment is made by the people participating in its realization. It is important to consider complexity with project team where the source of complexity comes from the human factor in the first place and then from problem complexity problem which is before the team. The life cycle of a project team consists of several phases and certain patterns of behaviour characteristic to it can be seen. Life cycle of a project team consists of several phases and certain behavioural patterns characteristic for each of them can be spotted. There is the highest complexity during the storm phase, when the situation is far from agreement, precisely as it can be seen on the Stacey matrix, that is to say when the agreement among the team members cannot be achieved. Further during the norming phase and functionality phase projects team members agree, overcome conflicts, and move to the „agreement zone“.

All differences between virtual project leadership and leadership in a traditional environment aren't addressed in the PMBOK Guide (Curlee, Gordon, 2011). According to the PMBOOK Guide (2013), part X3.7 Political and Cultural Awareness, „an effective way to manage this cultural diversity is through getting to know the various team members and the use of good communication planning as part of the overall project plan“ (p. 542). But Curlee and Gordon (2011) considered that this „does not offer any practical recommendations about handling the leadership of a culturally diverse or a geographically dispersed team“ (p. 28). There is a chaotic nature of communication in a virtual project, where lines of communications are tangled and less affected by hierarchy (Curlee, Gordon, 2011), so communication plan must be more flexible and more capable for adjusting the changes. One should be particularly cautious in the case of managing the innovation projects by a virtual project team. Some authors think that virtual projects can exacerbate innovation. Chesbrough and Teece (2002) say that „loose partnerships of companies inevitably produce more conflicts of interest than do centrally managed corporations, and those conflicts can hamper the kind of complex, systematic innovation that creates valuable business breakthroughs“ (p.127).

Stakeholders of a project in accordance with standard BS ISO 21500:2012 are shown on picture 5. All of them together are in mutual interaction which increases project environment complexity. That is reflected on the project itself having in mind that it necessary to fulfil the demands and expectations of all stakeholders and oversight by neglecting any of the sides could lead to project failure.

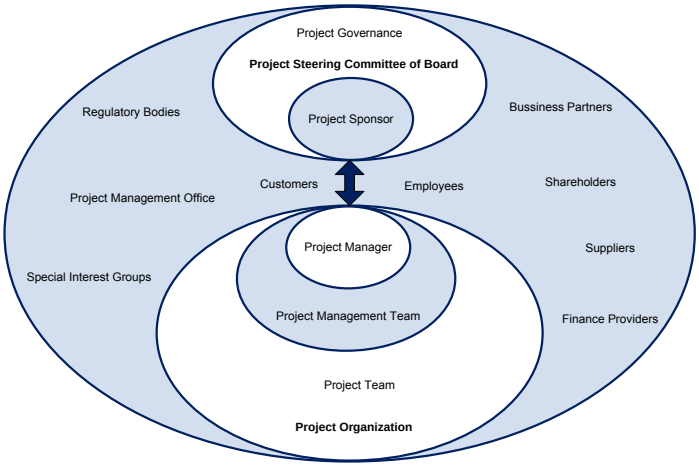

Figure 5: Project stakeholders (BS ISO 21500:2012, p.7)

Even though complexity theory does not advocate the use of any models, just by emphasizing the individuality of each project as well as the impossibility to show complexity by models and ruined picture of reality, there are several attempted models of project management when it comes to complexity.

5.3 Project management models

Depending on **project complexity** and **environment project complexity** which have previously been discussed, Jaafari (2003) suggests the following four project management models:

- Ad hoc model – project complexity and environment project complexity are low, the project management has no system approach, nor the occupation of the project manager can be recognized, decisions are made as you go along, the focus is not on long term achievements;
- Bureaucratic model – project complexity and environment project complexity are low to moderate, the approach is characteristic for projects in the public sector, the focus is not on achieving optimal project results as much as it is on administration respect;
- Normative model – it is distinguished by high project complexity and moderate environment project complexity, the modern model is usually described as the model of the best practice;
- **Creative-reflective model** – there is a high project complexity as well as very high environment project complexity, projects are not structured, the environment is changeable, study and project managers' creativity are necessary.

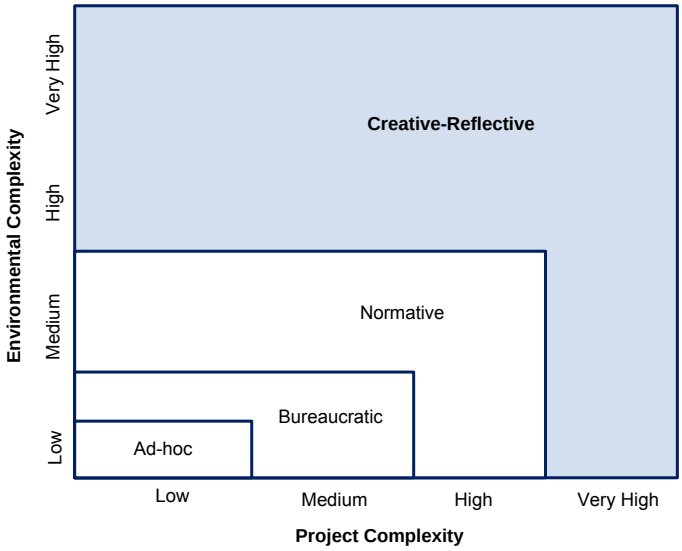

Figure 6: Schematic comparison of four models of project management in terms of complexity (Jaafari, 2003, p.55)

Basically, this classification reflects project management evolution through time in attempt to respond to ascending increase of environment and project complexity (Jaafari, 2003). In this work, the most important is the last crative-reflective model (figure 6) and here is the link with innovation projects.

6. RECOMMENDATIONS FOR PROJECT MANAGERS

The complexity paradigm challenges the conventional understanding that consensus is a good thing. It stresses the importance of expression of different opinions, debate and dialogue in order to promote the creative powers and the presentation of conflicting opinions. Depending on the level of complexity, project managers are advised to use different approaches in decision making process (table 1).

Table 1: Decisions in Multiple Contexts (Ameen, Jacob, 2009, p.14)

Context	Context caracteristics	Approach
Simple	• Repeating patterns and consistent events • Clear cause and effect relationship • Known Knowns	• Sense, categorize, respond • Ensure proper process in place • Best Practices and clear communication

Complicated	• Expert Diagnosis required • Cause and effect relationship not apparent • Known Unknowns	• Sense, Analyze, respond • Create Panels of experts • Listen to conflicting advice
Complex	• Unpredictability and competing ideas • No right answers • Unknown Unknown	• Probe, Sense, Respond • Increase level of interaction and communication • Use methods to generate ideas
Chaotic	• High turbulence • No clear cause and effect relationships • Many decisions to make and no time to think	• Act, Sense, Respond • Look for what works instead of seeking right answers • Provide clear direct communication

In the article 8.1.2.3 (PMBOK, 2013), Ishikawa cause-and-effect diagram is presented as one of the seven tools for quality management. It is used for conceptualization and presentation of relationships among the consequences given (for example, quality characterists' variation) and their potential consequences. It is based on the concept of linear systems, that is to say cause and consequence relationships. Their presentation looks like a fish skeleton (figure 7). Complexity theory pinpoints this tool's flaw. It presupposes one way causality and it doesn't include feedback from effect to causes. As it is shown on this example, classic tools for solving problems can possess flaws when observed form the complexity theory prism. It is possible to use them in certain situations, but it is necessary to develop individual tools for solving problems simultaneously.

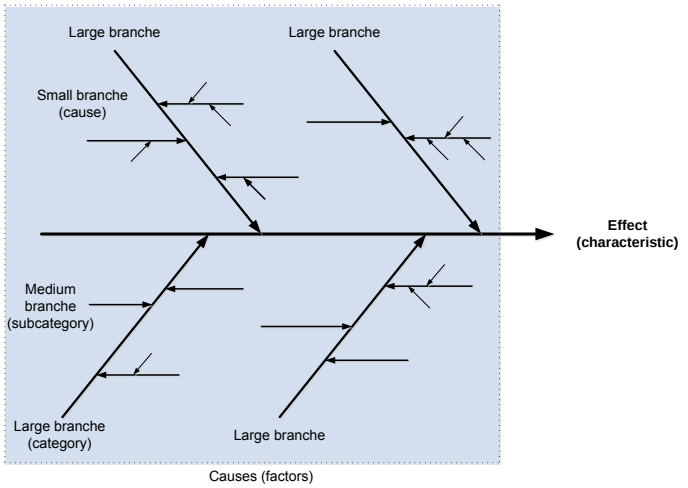

Figure 7: Ishikawa cause-and-effect diagram

In addition to standard tools, there are other tools that project managers can use to help manage the chaos and successfully manage complicated systems. For example, Ojha (2011) suggests *enneagram*, that is originally a tool for personality mapping, but also it can be helpful for project manager to find order in between chaos, by identifying underlying patterns in an organization, because „the map allows project managers to predict certain outcomes, which results in more reliable management systems" (Ojha, 2011).

A great dose of uncertainty in the process of planning the realization of the project, which applies mostly to the innovation projects, when the managers doesn't have previous experience in realization of the relative project. Therefore, the project manager should find an adequate way to treat the present uncertainty in their calculations. PERT method for time planning is suitable to use in these kinds of circumstances. It considers optimistic and pessimistic duration time of an activity in order to get the calculation of the most probable, the most expected duration. Complexity theory advocates inclusion of *fuzzy* numbers during the calculations of a *fuzzy* critical way, so it supports the application of *fuzzy* PERT method with a view to avoiding subjective evaluation of activity duration by the project manager.

In order to provide successful risk management of innovation projects, it is advisable that project managers use combination of the Work Breakdown Structure – WBS and the Risk Breakdown Structure – RBS, called Risk Breakdown Matrix – RBM (figure 8), (Stosic, Isljamovic, & Mihic, 2013). WBS is a structural diagram showing affairs and tasks which need to be performed within a project. RBS identifies project risk, which in

case of innovation project includes management, market and technology on the first level (Stosic, Isljamovic, & Mihic, 2013). RBM is a useful tool for reducing uncertainty in the initial phase of innovation projects.

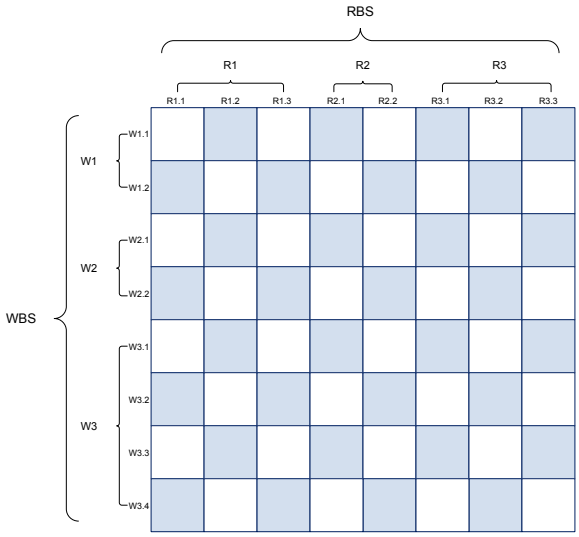

Figure 8: Simple Risk Breakdown Matrix (Stosic, Isljamovic, & Mihic, 2013)

7. CONCLUSION

In comparison to traditional project management, the advantages of incorporating complexity management in project management are significant. Closer consideration of project context is the key to successful project management. Theory of complexity teaches project managers how to deal with complexity, which comes from high project complexity and from very high environment project complexity.

The successful management of innovation projects on “the edge of chaos” is based on an optimal balance between order and chaos. When classic tools of project management are not helpful, it is necessary to develop individual tools. Complexity theory advocates inclusion of *fuzzy* numbers in project planning phase for reducing uncertainty. Risk Breakdown Matrix can be solution for risk management of innovation projects.

Further studies of these topics are related to empirical research that should analyze complexity in the field of project management innovation. Such research would be based on practice in Serbian organizations and have to analyze the key sources of complexity in the innovation projects, which come from weak structuring, great number of poorly known activities, high degree of interdependence among events, uncertain future, high degree of risk, chaotic communication among project team members, cultural and sociological differences in virtual teams, organizational structure layers in the project, project relationships with other projects, stakeholders, technology, market. The aim of this research is to modernize traditional approach of project management, to obtain benefits from the chaos, and improve the PM competencies.

REFERENCES

Ameen, M., Jacob, M. (2009). Complexity in Projects: A Study of Practitioners’ Understanding of Complexity in Relation to Existing Theoretical Models, Umeå University, Umeå School of Business and Economics, Student thesis, http://umu.diva-portal.org/smash/get/diva2:158819/FULLTEXT01.pdf

BS ISO 215000:2012 (2012). BS ISO 215000:2012, Guidance on project management, The British Standards Institution, Published by BSI Standards Limited

Chesbrough H.,Teece D. (2002). Organizing for Innovation: When Is Virtual Virtuous?, Harvard Business Review, 80 (8), 127-135

Cooke-Davies, T., Cicmil, S., Crawford, L., & Richardson, K. (2007). We’re Not In Kansas Anymore, Toto: Mapping the Strange Landscape of Complexity Theory, and Its Relationship to Project Management, Project Management Journal, 38 (2), 50-61

Curlee W., Gordon R. (2011). Complexity Theory and Project Management, John Wiley & Sons, Inc., Hoboken, New Jersey

Dodder R., Dare R. (2000). Complex Adaptive Systems and Complexity Theory: Inter-related Knowledge Domains, ESD.83: Research Seminar in Engineering Systems, Massachusetts Institute of Technology
Engwall M. (2003). No project is an island: linking projects to history and context, Research Policy, 32, 789–808
Filippov S., Mooi H. (2010). Innovation Project Management: A Research Agenda, RISUS. Journal on Innovation and Sustainability ISSN 2179-3565 – http://revistas.pucsp.br/risus, 1 (1)
Geov A. (2007). Complexity Management in Fuzzy Systems, Springer-Verlag, Heidelberg University, Berlin
Harkema S. (2003). Learning in Innovation Projects: An Approach Based on Complexity Theory, http://www2.warwick.ac.uk/fac/soc/wbs/conf/olkc/archive/oklc4/papers/oklc2003_harkema.pdf
Jaafari A. (2003). Project Management in the Age of Complexity and Change, Project Management Journal, 34 (4), 47-57
Keskinen A., Aaltonen M., Mitleton-Kelly E., & Kauffman S. (2003). Organisational Complexity, Finland Futures Research Centre, Turku School of Economics and Business Administration, FFRC Publications 6/2003
Marques L. (2012). Project management and theory of complexity, http://www.revistabsp.com.br/edicao-julho-2012/en/2012/07/20/gestao-de-projetos-e-teoria-da-complexidade/
Mitchell M. (2009). Complexity: A Guided Tour, Oxford University Press, Inc.
Ojha N. (2011, June 28-30). Modern Project Management and Chaos Theory, Tenth International Conference on Operations and Quantitative Management, Nashick, India, http://www.icmis.net/infoms/icoqm10/icoqm10cd/pdf/p442-final.pdf
Packendorff J. (1995). Inquiring into the temporary organization: new directions for project management research, Scandinavian Journal of Management, 11 (4)
PMBOK (2013). A Guide to the Project Management Body of Knowledge (PMBOK), Project Management Institute, Fifth Edition
Remington K., Zolin R. (2011). Controlling Chaos? The Value and the Challenges of Applying Complexity Theory to Project Management, in: Cooke-Davies, Terry (Ed.), Aspects of Complexity: Managing Projects in a Complex World, Project Management Institute, Newtown Square, Pa.
Stosic B., Isljamovic S., & Mihic M. (2013). Improvement of innovation project risk identification by applying RBS method, Metalurgia International; 18 (2), 161
Williams T. (1999). The need for new paradigms for complex projects, International Journal of Project Management, 17 (5), 269–273
Zimmerman B. (2001). Ralph Stacey's Agreement & Certainty Matrix, Schulich School of Business, York University, Toronto, Canada, http://216.119.127.164/edgeware/archive/think/main_aides3.html

SELECTION AND PRIORITIZATION OF CAPITAL PROJECTS IN THE PUBLIC SECTOR

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Abstract: *The article aims to discuss the project governance system as a linkage between policies and projects in order to improve success of the public investment projects in developing countries. According to many researches there is increasing number of projects that cannot satisfy the public needs and priorities. Capital projects have also suffered huge costs and time overruns. On the other hand, demand for public capital projects increases because they strive to economic and social development of one society. The key for this paradox situation is establishment of project governance system which should help allocating scarce resources to high-priority public needs. This article gives literature review and points out challenges, critical factors and key features of successful model for project selection and prioritization.*

Keywords*: capital projects, public sector, project governance*

1. INTRODUCTION

There is no doubt that projects are important part of corporate and public life. They are identified as a policy implementation tools whit the aim to contribute to resolving social and economic problems. In order to contribute to human capital improvements, many developing countries invest in infrastructure, education, healthcare and other physical assets. These countries encounter difficulties in developing and implementing public investment programs that meet their needs (Tandberg, 2014). The majority of public projects is very large and complex and requires significant resources in order to be implemented. Furthermore, public projects suffer significant political pressure and they are subjected to public scrutiny. Ad-hoc decisions, huge number of uncertainties and poor methodology encroach upon selection and realization of highly beneficial projects. There are significant inconsistencies and differences in quality between different investment proposals and in many developing countries even the costing of the projects is inadequate. It is widely known that traditional project management performance measures are no longer enough to assess one project as a successful. Nowadays, the key of project success is to create a value - to contribute to strategic goals. Identifying these projects is very difficult especially in public environment which is complex and uncertain and it deals with stakeholder management issues and political pressure. Therefore, it is highly important to select projects which are aligned with public needs and other projects within project portfolio without wasting limited resources.

A result of bad project selection and realization, lack of information, wasting of resources and lack of technical competences are low yields on the public investments. Thus, it is very challenging to ensure making consistent public investment decisions across different sectors and projects. In order to increase yields on the public and private investments there is a need to make an effort to actually invest in the investment process. For developing countries it is vastly important to provide support for carry out development projects. It is clear that investing in the investment process has a high priority and it involves non-politicized selection and prioritization of public projects as well as project monitoring, controlling and ex post evaluation.

This paper discusses some key issues and challenges related to selection and implementation process of investment projects. As we identified nontransparent, politicized and poor project selection methodology as a main cause of wasting public resources on projects with limited social value, we wanted to find out how developed countries managed to establish system for project selection which indeed contributes to country's strategy. We have pointed out above that developing countries need to invest in investment process which will ensure selection and realization of projects which create a value, in other words, developing countries need to invest in investment process which contribute to strategic goals. This linkage between public needs and project objective is project governance. Many industrialized countries have implemented effective project governance system at the top governance level which has resulted selecting the right projects. Project governance was subject to research of many authors and institutions which motivated us to write this article with the objective to present key features of well-functioning public investment process and critical factors for successful implementation of project governance. Finally, this paper should give the basis for further researches which could help build effective process of project selection and prioritization in developing countries.

2. THE VALUE OF PROJECT MANAGEMENT IN THE PUBLIC SECTOR

Dynamic and changeable environment presses organizations to undertake complex and rapid initiatives. However, despite the increasing level of investment being made by organizations in projects, a startling number of initiatives fail to deliver the expected value, never get implemented, or cost substantially more and take substantially longer than planned (Williams & Parr , 2004). For the organizations it is not just important to formulate good strategy, it is equally important to implement it. Here important role has project management. Project and project portfolios are “powerful strategic weapons” (Shenhar, Levy, & Maltz, 2001) and they are considered as critical component for linking strategy to short-term actions (Kaplan & Norton, 2008).

While in the private sector projects have the aim to deliver strategy, in the public sector they are policy implementation tools. In the public sector there is a need for improving performance and ability for successful implementation of change. These take a form of projects which should be aligned with the important priorities in the society and the needs of the users. Projects are designed with the aim of delivering economic, institutional and social development (Shiferaw & Klakegg, 2012). The governments around the world support project management in order to contribute to effective governance through transparency and accountability, efficiency and effective resource usage, improved implementation of policy and change and maintenance of public confidence (Crawford & Helm, 2009).

Many authors claim that important problem in the public sector is the fact that public investment projects are implemented without examining the public needs and priorities. As a result in the public sector there is a situation that the need for projects is increasing but on the other hand the numbers of projects which truly satisfy the public need are decreasing. The phrase used for description of these projects is “white elephant” meaning projects whose cost and subsequent upkeep is much greater to the owner than its value (Williams & Samset, 2010). However, reason for project failure is not lack of efficiency. Projects are not managed badly, what is more management and governance of projects have shown improvements in recent years.

It is emphasized that quality at entry has important role in successful project delivery whereas quality identification, preparation and appraisal have more powerful influence on project performance than key county economic variables, external factors and government consideration (The World Bank, 1996). There exist a need for alignment between organizational strategy and the project concept. Additionally, there is necessity to deal with complexity of project, his impact on other projects in portfolio, and sustainability. Public investment project failure is a consequence of poor project selection methodology as it is not developed from development policies and strategies and in some cases policy/ strategy does not even exist (Shiferaw & Klakegg, 2012). On the one hand, there is no formal and clear system for checking if and how much proposed project contributes to government strategy realization. Furthermore, there is no established system for checking the level of public needs involved in the government objectives. There are a lot of evidence that there is a low efficiency of public investment, which includes delays in design and completion of projects, corrupt procurement practices, cost over-run, incomplete projects, and failure to operate and maintain assets effectively so that the benefits are less than they should be (Rajaram, Minh Le, Biletska, & Brumby, August 2010). Consequently, in the public sector it is difficult to map public needs and priorities, and to analyze the relationship between policies and projects. As a result an argument that fiscal space allocated to public investments should enhance economic prospects is negatively affected. In the public sector, investment projects are facing with cost underestimation and benefit overestimation due to flawed information and methods or systematic skewed estimation which might be politically motivated (Williams & Samset, 2010).

It can be conclude that there has to be established link between project and policy of the country. That is the only way to select and implement projects that meet goals and objectives and expectations of key stakeholders. Traditional approach of project management is no longer enough – the only value which project could give is not only delivering planned output within cost and defined time frame. The main project’s aim is to meet strategic goals. If that is not the case, not only that project will not be implemented, it could also cause the new problems. Therefore, it is important that projects are aligned with strategy. In that way it can contribute to strategy implementation and ensure that benefits are reaped from its realization. This conclusion is confirmed by Williams and Samset (2010), who point out that planner need to have a broad and long term perspective and allow different concepts to be considered in order to succeed in strategic terms. Furthermore, planning should decide on the direction and strategic framework for a project, and anticipate difficulties that might occur, in order to make the right tactical choices.

3. LINKING PROJECTS TO STRATEGY

A result of bad project selection and realization, lack of information, wasting of resources and lack of technical competences is low yields of the public investments. In order to increase yields on the public and private investments there is a need to make an effort to actually invest in the investment process. It is already said above that one of the World Bank's research indicates that quality identification, preparation and appraisal have more powerful influence on project performance than key county economic variables, external factors and government consideration. There is a strong necessity for linking project to country's strategy or sector's strategy in sense of selecting projects which contributes to strategy realization.

Alignment of project and strategy is a role of project governance. Project governance was a subject of many authors and it is identified as a critical successful factor for the delivery of projects (Garland , 2009) and effective project governance is a key feature of successful investments (Weaver , 2007). According to Organization for Economic Co–operation and Development (OECD) public governance refers to formal and informal arrangements that determine how public decisions are made and how public actions are carried out, from the perspective of maintaining a country's constitutional values in the face of changing problems, actors and environment. Turner (2006) points out that project governance provides the structure through which the objectives are set. Main goals of effective government of project management are choosing the right projects in order to ensure that project portfolio is aligned with organizational objectives, delivering chosen projects in that way there is no wasting of project resources, and ensuring that projects are sustainable. On the contrary, poor project governance results in project that does not achieve objectives and does not satisfy public needs and priorities and as a final result does not have positive long term effect (Shiferaw & Klakegg, 2012). In brief, poor project governance leads to project failure while good project governance leads to selection and effective implementation of projects that meet the need of stakeholders.

In order to make possible and effective governance of public investment projects, structure and principles have to be defined through creating governance framework. The governance framework is documented to have vital significance for the planning and management of projects. Klakegg et al. (2012) claims that governance framework is an organized structure established as authoritative within the institution, comprising processes and rules established to ensure project meeting purpose. The governance framework needs to enable projects to be flexible in order to adapt to turbulent environment, ambiguous, fragmented and political reality of project situation. In high performing countries high-quality procedures for planning investment projects have played a vital role (Shiferaw & Klakegg, 2012). Several developed countries have started a development process to strengthen the ability to manage and control major public investment projects. In this paper we will present a short description of Norwegian project governance framework and project governance framework established by of UK's Ministry of Finance as an example of effective project governance. Additionally, these examples will help us to point out "must have features" of every project selection and prioritization process which have to be to incorporate.

The World Bank has identified eight key "must-have" features of a well-functioning public investment system. These features are investment guidance, project development, and preliminary screening; formal project appraisal; independent review of appraisal; project selection and budgeting; project implementation; project adjustment; facility operation; and project evaluation (The World Bank, 1996). Regarding to the identified features of well-functioning public investment system and previously mentioned fact that there is a need to establish formal framework for project selection and implementation, it can be concluded that the starting point for effectual project government system is creating clear development policy and strategy which is in line with public needs and priorities. Projects are initiated from the policy direction of the government formally presented in some strategic plan (Shiferaw & Klakegg, 2012). Policy and strategy are designed by the influence of public needs and priorities and government executives. While government sector is responsible for policy direction, implementation sector is responsible for transferring strategy to actions. It is important that there exist the quality assurance system, with formal criteria in order to ensure the alignment of project and objectives, as a link between the government executives and implementation sector. Strategic guidelines provide selection of investments based upon priorities of the development policy. Therefore, strategic guidelines have to be strongly associated with national and sector strategy. The formal process for project development has to be developed. Every project has to go through the first level screening in order to estimate if project meets the minimum criteria of consistency with the strategic goals of government and if project is cost effective. After first screening test, the projects which meet minimum request are subjected to further economic and financial analysis. There is a require for feasibility analysis that consists of two key components: prefeasibility study which identifies alternative projects and feasibility study which analyses the alternative strategies in depth as well as undertaking social and environmental analysis. The feasibility collects all relevant data from prefeasibility study and outlines all possible outputs and outcomes. It is important that government has formal guidance on the technical aspects of project appraisal appropriate to the technical capacity of ministries and departments. In this condition, project's social and economic value

can be evaluated. However, project's macro, sectorial and project-specific uncertainties should be included into calculations end evaluation process. Consequently, a new investment should only occur when rehabilitating existing assets is not as cost effective as undertaking investment in a new asset (Rajaram, Minh Le, Biletska, & Brumby, August 2010).

Miller and Hobbs have concluded that there is strong correlation between the variety of strategies deployed, strategic depth and project performance (Miller & Hobbs, 2005). Even though, the clear and detailed strategy has to be defined before project selection, preparation and implementation, there exist a necessity for strategic flexibility due to high uncertainty and risk of capital projects. Investment projects are very long and have critical front-end where this front-end phase of projects can last many years. Thus, capital projects have to be developed through time-dependent, non-linear and iterative process. Successful project implementation and alignment with strategy require a strong sponsor, a strong leading coalition and flexible governance structure. If projects are not embedded in institutional framework, every project success will happen by accident. Consequently, without defined methodology for project selection there is practically no chance that projects will deliver strategic values.

4. MODELS FOR SELECTION OF INVESTMENT PROJECT

In the previous section we have emphasized that project success depends on the benefits realized by the venture. In other words, project efficiency – delivering projects by using "iron triangle" (time, cost and scope/ quality), is no longer only relevant measure for judging project performance. Therefore, Zwikael and Smyrk (2012) have proposed the "triple – test" framework which identifies three levels of project success and these are: *project management success*, *project ownership success* and *project investment success*. According to this framework, on the first level efficient project delivery should be judged through evaluation of four criteria: fitness–for–purpose, the time taken, the costs incurred and triggering undesirable, unacceptable or avoidable outcomes. Project effectiveness is measured on the second level where a project success criterion is achievement of the approved business case. In this context, project effectiveness depends upon the ability to adjust to the project environment. That means that every project requires specific outcomes measures that are adapted to organizational context in which the project is taking place. On the final level - third level, determinant of project success is project investment success. Project investment success is estimated through the *Project Investment Evaluation Model (PIE)* (Zwikael & Smyrk, 2011) and it is function of *worth* and *riskiness.*

This model is a ground for developing project governance frameworks. A few industrialized countries have managed to execute project governance systems. On the other hand developing countries are still struggling with low efficiency of public investments (Era Dabla-Norris, 2011). In this paper we will present Norwegian project governance system and UK Gateway review process as examples of governance systems which ensure best practice in planning at the front end. Furthermore, we will emphasize the aspects of project governance that should be upgraded with the aim of establishing process for project selection and evaluation that guarantees the selection of right public investment projects.

The Norwegian project governance system was established in the year 2000 where the aim was to reduce cost overran through introducing control measures in order to ensure realistic budgets and good basis for project execution. Establishing project governance system was a bottom-up process within Ministry of Finance. This system has two key decision points: Quality Assurance 1 (QA1) which refers to making decision to initiate project preplanning, and Quality Assurance 2 (QA2) which refers to making decisions about financing the project. The first quality assurance system (QA1) includes a needs analysis, a strategy document, alternative analysis and overall requirements. The second quality assurance system (QA2) includes cost estimation, contract strategy and an overall project management document. The Sectorial Ministry is responsible for large investment projects and the decision-making process. There is intention to establish system where politic and administration is well divided through interplaying and understanding of both sides.

In the United Kingdom, OGC (*Office of Government Commerce*) project governance framework was also established in the top-down process through implementing the management system. The OGC Gateway™ Process is designed to provide independent guidance to Senior Responsible Owners (SRO), program and project teams and to the departments who commission their work, on how best to ensure that their programs and projects are successful (Office of Government Commerce (OGC), 2007). Projects are examined at key decision points where this process is known as Gateway review process. There are six Gateways:

- Gateway Review 0: Strategic management;
- Gateway Review 1: Business justification;
- Gateway Review 2: Procurement strategy;
- Gateway Review 3: Investment decision;

- Gateway Review 4: Readiness for service;
- Gateway Review 5: Benefits realization.

OGC Gateway Review assesses the project's viability, the potential for project success, the value for money to be achieved, and the proposed approach for achieving delivery of the project's objectives (Office of Government Commerce (OGC), 2007). The OGC Gateway™ Process is a guideline where project could be grouped in four levels by their criticality. The project board for the project with top level of criticality - "mission critical" projects- is the OGC and it has responsibility to inform the Prime Minister's office about the decisions made. Senior people use Gateway process for making decisions about "high criticality" projects. On the next level consisted of "medium-criticality" projects it is important that there exist collaboration of OGC and departments regarding available resources. "Low-criticality" projects – projects on the last level is reviewed within departments.

The Norwegian project governance system is simple, strategy and concept are chosen in early stage and the most important criteria for judging projects are cost and risk. On the other hand, the OGC Gateway™ Process provides complete guideline how to achieve project's goals and objectives, strategic assessment is repeated within the program and projects are focused on creating value for money. Some of these differences are caused by cultural differences and maturity of the frameworks (Klakegg, Williams, Magnussen, & Glasspool, 2008). Regardless of the specified differences, the both project governance frameworks embedded governance principles, such as: transparency, willingness to change, setting common and high professional standards, and external control and nonpolitical review. Their aim is to base project on needs of the users and to implement the quality assurance system where the experts will make decisions closely collaborating with the highest political level. It can be conclude that building accountable and effective public institution requires devising quality assurance system and governance frameworks.

It is clear that the project selection process should establish and incorporate standards for project estimation and selection which have to be assessable. With the aim of ensuring project social and economic value, government has to develop and implement formal and public guidelines for technical aspects of project estimation. For selection of right projects, the nature of strategic guidance, availability of sector strategies and transparency of appraisal are not the only important factors for selecting required projects. As much it is important that there exist the independent review of appraisals conducted (Era Dabla-Norris, 2011).

In this paper we used information from the report of PEMPAL (*Public Expenditure Management Peer Assisted Learning*) countries from the year 2011. According to this report, in developing countries first obstacle for developing effective project governance system is the fact that sectorial strategies do not include enough information so they are not adequate basis for project prioritization. Developing countries are also affected by the lack of formal and precise guidelines for economic analysis. Independent project assessment is one of the issues, too. The reason to claim this is the fact that only four members of PEMPAL countries have external project revision and just in two countries the Ministry of Finance has established standards for project selection and prioritization.

If we compare project selection processes in the developing countries and in the developed countries such as Norway and UK, we can claim that developing countries have to invest in creating and incorporating formal and transparent project selection process. Critical factor for successful implementation of project governance is commitment of government executives. In developing countries the often case is that the government has not implemented project governance system and projects are selected randomly or there is no formal project governance system. For successful implementation of project government system it is important to consider culture norms. That is why it is not possible just to copy entire governance system from developed country. Establishing the formal government framework is important so that stakeholders could ensure successful investment. On the other hand, donors and financial institutions have developed their own methodologies for project support. It could be concluded that county should considered the interest of all stakeholders in designing a project governance systems.

5. CONCLUSION

This paper considers issues affecting how transparent and effective model for project selection and prioritization can be set up, in circumstances where there is a great level of uncertainties, stakeholder management issues and political pressure. The aim was not to build the governance framework, but rather to point out criteria that should be incorporate in system for selecting public projects. This subject inspired many authors in the field of project management to research reasons for capital project shortfalls. We have tried to offer an insight in author's opinions and suggestions. There could be some disagreement, but one is for sure: projects have to be aligned with the top level strategy. Therefore, the first step in developing effective project

selection process is formulating strategy which reflects public's and stakeholder's needs, on both top government and sectorial level. One of the most important rules for successful strategy execution is understanding the management cycle that links strategy and operations. Even though project initiatives in developing countries fail due to lack of information in sectorial strategies, poor project governance is identified as a main cause of project strategic shortfall. In the public sector, project governance has objective to underpin strategy implementation.

We have shown that individual authors and institutional authors, such as the World Bank and International Monetary Fund claim that poor project realization is a consequence of political pressure, corrupt procurement and non-transparent appraisal standards. Capital projects are highly complex and require making judgments about future when there is only scant information. Consequently, they are suitable for political manipulation. Referring to that, quality of identification, preparation and appraisal is crucial for capital projects success. Cost and schedule underestimation and benefits overestimation result in strategic underestimation of projects in the front-end phase due to flawed information and politically motivated processes. It is clear that without good model for project appraisal and selection, every project success is accidental. Countries determined to increase yields on the public and private investments have to invest in investment process which should ensure strong linkage between the projects and strategy.

REFERENCES

Crawford, L. H., & Helm, J. (2009). Government and Governance: The Value of project Management in the Public Sector. *Project Management Journal*, 73- 87.

Era Dabla-Norris, J. B. (2011). *Investing in Public Investment: An Index of Public Investment Efficiency.* International Monetary Fund.

Garland , R. (2009). *Project Governance : A Practical Guide to Effective Project Decision Making.* London: Kogan Page Ltd.

Kaplan, R. S., & Norton, D. P. (2008). Mastering the management system. *Harvard Business Review*, 63-77.

Klakegg, O. J., Williams, T., Magnussen, O. M., & Glasspool, H. (2008). Governance Frameworks for Public Project Developement and Esimation. *Project Management Journal*, 527- 542.

Miller, R., & Hobbs, B. (2005). Governance Regimes for Large Complex Projects. *Project Management Journal*, 42-50.

Office of Government Commerce (OGC). (2007). *OGC Gateway™ Process Review2: Delivery strategy.* Retrieved from gov.uk: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/62068/Gateway_2_Workbook_Word_Template_v2.0.doc

Rajaram, A., Minh Le, T., Biletska, N., & Brumby, J. (August 2010). *A Diagnostic Framework for Assessing Public Investment Management.* Washington D.C:: The World Bank.

Shenhar, A. J., Levy, O., & Maltz, C. A. (2001). Project success: a multidimensional strategic concept. *Long Range Planning*, 699-725.

Shiferaw, A. T., & Klakegg, O. J. (2012). Linking Policies to Projects : The Key to Identifying the Right Public Investment Projects. *Project Management Journal*, 14- 26.

Tandberg, E. (2014, March 20). *Budgeting of public investments.* Retrieved from Internationam Monetary Fund: https://www.imf.org/external/np/seminars/eng/2007/ppp/pdf/et_p.pdf

The World Bank. (1996). *Evaluatin results 1994.* Washington DC: Internatioal Bank of Reconstruction and Developement.

Turner, J. (2006). Towards a theory of project management: The nature of the project governance and project management. *International Journal of Project Management*, 93-95.

Weaver , P. (2007). Effective Project Governance - Linking PMI's Tandards to Project Governance. *PMI Global Congress-Asia Pacific proceedings.* Hong Kong: Project Management Institute.

Williams , D., & Parr , T. (2004). *Enterprise Programme Management: Delivering Value.* New York: Palgrave Macmillan.

Williams, T., & Samset, K. (2010). Issues in Front-End Decision Making. *Project Management Journal*, 38-49.

Zwikael, O., & Smyrk, J. (2011). *Project Management for the Creation.* London: Spigner.

Zwikael, O., & Smyrk, J. (2012). A General Framework for Gauging the Performance of Initiatives to Enhance Organizational Value. *British Journal of Management*, S6- S22.

PROJECT MANAGEMENT ON INTERNET – BLOGGERS AS FOCUS COMMUNITY

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Abstract: *Start with "why" is guide idea of research. Blogging and bloggers are something that each manager connects almost every day. For somebody that is idea of inspiration/curiosity; for others that is idea of motivation. In the research blog posts (articles) are idea of inspiration/curiosity. The research is established with materials from referent project management journals and conferences. Our "why" means that research take a challenge to explore; who is the author of the blog that managers read weekly or with similar frequency? Furthermore, research concludes that bloggers take inspiration from both experience and research literature.*

Keywords*: Project Management, Blogging, Project Manager, Information Technology*

1. INTRODUCTION

When the Project Management Institute (PMI) was founded in 1969, the term Blog (Blogger)—as it relates to the Internet and new technology—was not yet part of the common business vocabulary. Forty years after the founding of the Institute, issues related to blogging on project management topics became popular in the internet, management, business and marketing context.

Nowadays, the Internet is a first communication tool for both life and business. The Project Management (PM) is one of the most popular topics in business part. The research take a challenge to study questions: what are the main issues in terms of project management covered by the most popular Blogs? What are the authors' profiles of Blogs articles on the project management topics? To answer these questions, researches conduct a content analysis of ten blogs articles on the PM that were published in 2013. Bloggers and blogs are just the inspiration for topics and ideas; the topics are presented with research materials from both scientific journals and conferences devoted to the PM field.

Over the last two decades the Internet has been a very important communication channel. Last several years, a list of the most popular blogs on many different topics in the Internet is published. At the beginning of 2014 the ProjectNewsToday.com Blog published the list of the 25 most popular Blogs during the last year. In that study researches analyze last ten topics from ten blogs published at the end of 2013 (a table with detailed description and links is placed in the appendix).

Presented topics are described from the perspective of drawing the points of the research literature in the field of PM which was published in last decade. A definition of the research agenda is explained in the methodology part. The following topics are covered: History of blogging and blogs; Project Management Challenges, Project Manager, Projects and Leadership, Project Management and Information Technology.

The topics are very attractive for researchers. All topics are developing/changing very fast. Each year several new models and good quality books coming on the market. Before discussing the results of the analysis and offering some recommendations, the article firstly presents short history of blogs and the author research method.

2. HISTORY OF BLOGGING AND BLOGS

History of blogging begins in 1990s; blogs are place/virtual space where people share their interest, hobbies, and thoughts online. The main goal of blogging is online self expression. During time blogging became profitable business. In the last decade very profitable sales offers in blogging business have appeared.

Except for individual use, companies also saw the value in blogging. The companies use blogs to present their leadership, social responsibility and an expertise thought. Nowadays blogs are part of company's social media channels usually for external communication.

Many different factors have contributed to growing interest/influence of blogging in the business world. For example, the evolution of search engines in the Internet, made the Internet's content an important tool for measuring the visibility of companies' brands. At the beginning, sharing a new post was much harder, but when other social networks appeared it became much easier. On the one hand social networks support promotion process of the blogs but on the other hand they give chance much bigger amount of communities can express both their interest and thoughts; that means, creating broader competition.

Project managers use the blogs to share experience, promote new book and develop new ideas. All these activities are guided with the objective of improving business environment. The blog as a tool and the blogging as a communication channel help managers to easily show their expertise and present themselves to much broader community.

Many interesting statistics and other information about the blogs and the blogging can be found at: http://socialmediatoday.com/ and http://www.jeffbullas.com/, in the references are a list of several direct links to interesting perspectives. As mentioned in the introduction and deeply presented in the methodology part; the main idea of the research is to explore: what are the main issues covered by the most popular Blogs in terms of the project management? What are the authors' profiles of the Blogs articles on the project management topics?

3. METHODOLOGY AND RESEARCH AGENDA

The research starts with an analysis of the contents of the most popular blogs of 2013. Over the last year, the blog posts (articles) have been published weekly, monthly, quarterly, or with different frequency, in a total of approximately 600 articles. Our first task is to identify, among those 600 articles, those that could be an interesting stream to follow on the PM topics. Furthermore, research will follow the framework/content of last ten topics of each blog from the list of the 25 most popular blogs in 2013. The search resulted in 100 articles, which included many different topics on the project management.

The next task was to conduct coding of the titles. The coding was guided with an idea of indentifying whether each of the 100 articles was actually concerned with the PM. The coding is important due to provide us with topics that later are describe on the basis of the referent research literature. The exact titles and the coding are presented in the appendix (Table 1.).

The summarizing of an article was decided upon reading only its title. When the title was not clear enough, the full article was explored and the final decision was made afterwards. The final database of the content analysis includes 95 articles, as listed in the appendix (Table 1.).

The next idea was to answer our second question: What are the authors' profiles of blog articles on project management topics? The research tested the following ideas. The information was collected on the 15 individuals who authored the 95 articles. Firstly, blog authors were classified according to either academic (university degree, book writers and lecturers) or professional (project managers, consultants, analysts and others) profiles. Secondly, the research explores the involvement of the authors in the general PMI or IPMA activities/certification. To do so, we built the publication profile of the 15 authors by searching for a name of each author and checking the professional web presentation. The links to 90% of authors' profiles is given in the appendix (Table 1.) 05.03.2014 year (Date when links are checked). The research question/concept (the author profile) is explored and presented briefly, due to limits of the conference paper requirements. In the following chapters the answers on the first research question and the topics that bloggers mostly discuss at the end of 2013 are presented.

4. PROJECT MANAGEMENT CHALLENGES

The project management (PM) concept characterizes many challenges. In chapter we focus on: complexity, risk and uncertainty (Lechler, Edington, & Gao, 2012; Jaafari, 2001; Loch, DeMeyer, & Pitch, 2006; Saynisch, 2010; Shore, 2008; Maylor, Vidgen, & Carver, 2008).

How will the world develop in the future? The answer would require a special prize. What is more, the answer for the question which techniques will contribute to the future development of the world is quite obvious – the PM is both current and future business advantage. Therefore, the complexity of projects is constantly increasing (Saynisch, 2010). At the same the world is time rapidly growing and developing. Hence, business complexity follows those trends and classical knowledge loses ability to master —complexity" challenge (Cicmil, Cooke-Davies, Crawford, & Richardson, 2009).

New lights are already with us; both new technologies and social improvements are proposing different ways to overcome or simplify current and future challenges (Saynisch, 2010). The different research subjects from

both the natural and social science (e.g. evolutionary and chaos theory, self organization, synergetic, brain research, social systems theory, theory of complex systems, etc.) gives managers new alternatives to find better solutions (Saynisch, 2010). In the studies (Saynisch, 2010) the world class researches in the modern natural and social scientific theories take the challenge to recommend new models as they define —Beyond Frontiers of Traditional Project Management". Thus, the research target was the applicability of modern theories in the PM context.

The current classical PM knowledge is structured on —mechanical, mono causal, non dynamic (static), linear structure and a discrete view of human nature and societies and their perceptions, knowledge, and actions. It works on the basis of reductionist thinking and on the Cartesian/Newtonian concept of causality (the mechanistic science)" (Saynisch, 2010). Therefore, the classical PM needs both new assumptions and paradigms for future development of society.

A contingency approach could be an alternative for decreasing complexity in the PM practice. Therefore, the idea of contingency approach is opposite of almost Tayloristic model —one-size-fits-all" to management practice. The contingency idea gives freedom to the managers to explore entire situation or a project challenge context (Maylor, Vidgen, & Carver, 2008). Moreover, to understand better and simplify the PM complexity it could be divided according to structural (number of elements and interdependence of elements) and uncertain issues (goals and methods) (Williams, 2002).

In the recent research (Lechler, Edington, & Gao, 2012), there are discovered both risk and uncertainty of the PM concept. The researchers discuss the challenge as dilemma of definition between those two topics (Lechler, Edington, & Gao, 2012). The importance in a context of educating project managers is especially emphasized (Lechler, Edington, & Gao, 2012).

The projects are unique by definition and project uncertainties are imminent, regardless how much information is collected before a project is proposed (Hubbard, 2007; Sydow & Staber, 2002). When the economist debate on the uncertainties; they conclude it is the necessity for the possibility of convenience. Hence, with reference to several studies, the uncertainties are not inevitably defined to pessimistic issues, sometimes interpreted as synonyms for risk (Jaafari, 2001; Loch, DeMeyer, & Pitch, 2006; Lechler, Edington, & Gao, 2012).

The PM methodology endeavor many tools for both predicting and counting the project risk, but in the case of the uncertainties alternatives are very narrow and often just negative opportunities are visible (Lechler, Edington, & Gao, 2012).

5. PROJECT MANAGER

The earliest human societies, as Greeks, Romans and Egyptians used the PM techniques to build both working and living environment. The researches Walker and Dart (2011) take up that issue and present the following examples: the Great Wall in China, the pyramids and magnificent urban structures such as temples, administration palaces etc. Moreover, the researchers create an idea of similarities in style, order, decisions and compare ancient leaders and contemporary managers: focus of the leaders in Roman time was on —get things done"- focus of the contemporary managers is on optimization and efficiency.

First lights on the PM topic came from construction, shipbuilding, aerospace and manufacturing projects as cases of projects - they attract a —scientific" view on operations management influence (Walker & Dart, 2011; Turner, Huemann, & Keegan, 2007). Therefore, those projects could be defined as —engineering" type of projects. Hence, even in contemporary practice of the PM that early start style is recognizable.

Outsourcing is an idea that has very positive influence on developing the PM practice. Moreover, it interesting is that the idea is with us from the Romans projects practice - they used to outsource most of maintenance and construction work to private companies (Walker & Dart, 2011). Furthermore, knowledge management and knowledge sharing alike have some lights in Romans the PM practice (Walker & Dart, 2011). Both the outsourcing and knowledge management models shift very positively the contemporary PM leadership practice.

Nowadays, we are dealing with constantly changing business environment. Changes in culture and technology have revolutionized opportunities for the PM techniques and it is necessary to develop to take up new challenges (Walker & Dart, 2011). The PM environment is different than classical day-to-day operations environment (Turner, Huemann, & Keegan, 2007). Over last 20 years the PM literature have changed attention from technical to people oriented, especially in classical human resource management context (Turner, Huemann, & Keegan, 2007). Moreover, the development of both technology and power/information sharing give an additional shift in the PM practice and science (Walker & Dart, 2011).

6. PROJECTS AND LEADERSHIP

Practice of the PM in the 21st century is facing a challenge of doing business in very dynamic and fast changing environment (Tyssen, Wald, & Spieth, 2013). Implementation of the PM methods is growing almost in any industry (Sydow, Lindkvist, & DeFillippi, 2004; Bakker, 2010). The course change from standard to temporary organizations is one of main discussion streams in the PM literature and the practice (Tyssen, Wald, & Spieth, 2013).

The standard (contemporary) organizations setting assumption is somewhat stable and continuous organizational environments. The temporary organizations require flexibility, cross-disciplinary integration, short-term orientation, limited duration, unique in terms of tasks etc. (Tyssen, Wald, & Spieth, 2013). Therefore, a leadership approach of 21st century needs to change and adapt in order to serve better new business challenges.

Contemporary leadership theories are focused on relationships, interaction and subjective perception (Yukl, 2012; Bluedorn & Jaussi, 2008). Temporary leadership may require a different paradigm as a result of different business environment and perception of the leadership alike, as important factors for project success (Tyssen, Wald, & Spieth, 2013).

The temporary organizations require a different team approach. General team characteristics are similar as in the contemporary organization but the team approach is different. A team is a unit of two or more employers, who are capable and have the same purpose, mission, objectives, and expectations (Lussier & Achua, 2009). The team approach of the temporary organizations requires —carrying out time-limited undertakings and disperse upon completion; paving the way for a joint course of action with the goal of completing a non-routine task; often accompanied by non-routine processes and uncertain working conditions; whereas complexity in terms of roles and participant backgrounds is often caused by a variety of different experts working together" (Tyssen, Wald, & Spieth, 2013). Therefore, the temporary team deals with higher uncertainties and risks in terms of tasks, activities and processes.

Most of the PM literature is based on assumptions from construction/engineering industries. The main ideas are focused on —planning" and —structuring" (Zwikael & Unger-Aviram, 2009). The PM concept in the last several decades slowly has been changing the course of both the practice and the literature to a broader concept. New concepts draw the new models with softer leadership style and it requires further studies (Tyssen, Wald, & Spieth, 2013).

Five main characteristics of the temporary organizations are: *Temporariness; Unique Outcome; Missing/Ambiguous Hierarchies; Heterogeneity of Team Members; and Changing Work Teams* (Tyssen, Wald, & Spieth, 2013). Hence, one of main questions for further research is: how does leadership take place in these new environments?

7. PROJECT MANAGEMENT AND INFORMATION TECHNOLOGY

The histories of development of the Project Management (PM) and Information Technology (IT) show significant relationship and influence on each other. The PM started to shift the market after establishing the PM associations in 1960s. The PM and the IT subjects connect points for many other business and academic areas, as finance, construction, marketing, sociology, culture, politics etc. (Rivard, & Dupré, 2009). Moreover, in January 2006, between 15-20% of members in the PM association (PMI) were coming from IT industry or working in companies that produce software (Rivard, & Dupré, 2009). However, nowadays popularity of the information technology projects (ITP) is decreasing due to low success of implementing and general crisis on the market (Pratt, 2012). Additionally, education of ITP manager is one challenge in the ITP subject (Pratt, 2012). The PM knowledge base needs to adapt both new skills and techniques in order to serve the ITP requirements (Pratt, 2012).

An initial company's reaction or action on the changes at the market is research projects (R&D). As a consequence of the R&D project companies build new services, models and innovative solutions (Brocke & Lippe, 2013). The R&D projects are usually organized as collaborative research projects between academic, public and business partners (Brocke & Lippe, 2013). Moreover, in the study (Rivard, & Dupré, 2009) is presented a content analysis of the Project Management Journal (PMJ) from 1988 to 2005. The outsourcing projects as a subject is not covered and the authors recommend the topic as a gap for future research.

Currently, multi partnership on the R&D projects between above mentioned partners is very common. Reasons for collaboration are different: economical, scientific, innovative and social (Todeva & Knoke, 2005; Etzkowitz, 2003). Therefore, many stakeholders show interest to fund these R&D projects (Brocke & Lippe, 2013).

8. CONCLUSION

The described topics are presented in three thematic parts of the article. Firstly, research start with an historical overview of both terms the project management and the blogs/blogging. Secondly, research describe challenges which each of the topics faces in contemporary business environment. Lastly, research present short answer to the interesting question: What are the author profiles of Blogs articles on the project management topics?

The third part of the article or the above mentioned question opens many different opportunities for exploring. The research uses an alternative and in short presents that the authors of blog articles are both very experienced and business oriented. Furthermore, power of both bloggers and blogging is constantly growing (many examples of powerful influence of blog posts (articles) on different companies‘ campaigns could be easily found on the market). Therefore, research calls researchers to come with more creative ideas and bring new paradigms from emerging blog business.

The research literature is rich with many different topics. Both practice and science are agreed that experience is very important characteristic of the project manager or a project management researcher. Building the profile of the most popular blog authors draw a new picture on type of information that could be read in the blogs in future. The topics covered in the research are the most popular topics covered by bloggers at the end of 2013. As a result of research conceptualization in general terms and research requirements to create a new research in accordance with referent literature; blogger posts are alike the inspiration source for the research.

The reader could ask now at the end: Why does the research focus on topics such as Project Management and Information Technology, Projects and Leadership, Project Manager, Project Management Challenges; it is a result of the bloggers posts which are focused also on the topics at the end of 2013, as presented in the table 1. in the appendix and in the methodology chapter. The research conclusion is guided from the perspective of closing the answers on the main research paradigm. The main research paradigm follows the concept that each topic is presented from the perspective of leading challenges that researchers found in referent PM research literature. Therefore, the summary of each study topic is formed as a chapter of the research and its conclusion is back on the research questions and the summary of beginning idea of the research.

The research has a vision that the article is just the beginning of exploring the challenge. Exploring many other aspects similar to blogs (e.g. websites, news, slideshare, linkedin, etc), researchers found it very inspiring.

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REFERENCES

Bakker, R. (2010). Taking stock of temporary organizational forms: A systematic review and research agenda. International Journal of Management Reviews, 12(4), 466–486.

Bluedorn, A. C., & Jaussi, K. S. (2008). Leaders, followers, and time. Leadership Quarterly, 19(6), 654–668.

Cicmil, S., Cooke-Davies, T., Crawford, L., & Kurt R., (2009). Exploring the Complexity of Projects: Implications of Complexity Theory for Project Management Practice, Project Management Institute.

Hubbard, D., (2007). How to measure anything: Finding the value of intangibles in business. Hoboken, NJ: Wiley.

Jaafari, A., (2001). Management of risks, uncertainties and opportunities on projects: Time for a fundamental shift. International Journal of Project Management, 19, 89–101.

Lechler, T., G., Edington, B., H., & Gao, T., (2012). Challenging Classic Project Management: Turning Project Uncertainties Into Business Opportunities, Project Management Journal, Vol. 43, No. 6, 59–69.

Loch, C., H., DeMeyer, A., & Pitch, M., T., (2006). Managing the unknown: A new approach to managing high uncertainty and risk in projects. Hoboken, NJ: Wiley.

Lussier, R., N., & Achua, C., F., (2009). Leadership: Theory, application, and skill development. Mason, OH: South-Western.

Maylor, H., Vidgen, R., & Carver, S., (2008). Managerial Complexity in Project-Based Operations: A Grounded Model and Its Implications for Practice, Project Management Journal, Vol. 39, Supplement, S15–S26.

Pratt, D., (2012). The IT Project Management Answer Book, Management Concepts Press.

Rivard, S., & Dupré, R., (2009). Information Systems Project Management in PMJ: A Brief History, Project Management Journal, Vol. 40, No. 4, 20–30.

Saynisch, M., (2010). Mastering Complexity and Changes in Projects, Economy, and Society via Project Management Second Order (PM-2), Project Management Journal, Vol. 41, No. 5, 4–20.
Shore, B., (2008). Systematic Biases and Culture in Project Failures, Project Management Journal, Vol. 39, No. 4, 5–16.
Sydow, J., & Staber, U., (2002). The institutional embeddedness of project networks: The case of content production in German television. Regional Studies, 36, 215–227.
Todeva, E., & Knoke, D., (2005). Strategic alliances and models of collaboration. Management Decision, 43(1), p.123–148.
Turner J., R., Huemann, M., & Keegan, A., (2007). Human Resource Management in the Project-Oriented Organization, Project Management Institute.
Tyssen, A. K., Wald, A., & Spieth, P., (2013). Leadership in Temporary Organizations: A Review of Leadership Theories and a Research Agenda, Project Management Journal, Vol. 44, No. 6, 52–67.
vom Brocke, J., & Lippe, S., (2013). Identifying and Managing Creative Tasks in Collaborative IS Research Projects, Project Management Journal, Vol. 44, No. 6, 94–113.
Walker, D., & Christopher J. D., (2011). Frontinus—A Project Manager From the Roman Empire Era, Project Management Journal, Vol. 42, No. 5, 4–16.
Williams, T., (2002). Modelling complex projects. Chichester, UK:Wiley.
Yukl, G., A., (2012). Leadership in organizations. Upper Saddle River, NJ: Prentice Hall.
Zwikael, O., & Unger-Aviram, E., (2009). HRM in project groups: The effect of project duration on team development effectiveness. International Journal of Project Management, 28(5), 413–421.

http://socialmediatoday.com/mikevelocity/1698201/blogging-stats-2013-infographic
http://www.jeffbullas.com/2012/08/02/blogging-statistics-facts-and-figures-in-2012-infographic/
http://www.jeffbullas.com/2011/09/16/past-present-and-future-of-blogging-3-infographics/

11. APPENDIX

Coding summary: Project Success, Value of Value, Project Management Office, Project Team, Project complexity, Leadership, Project Management Careers, Project Management Training, Project Management Challenges, Social Media in Project Management, Online Project Management Software, Agile Project Management, Project Strategy, Project Failing, Project Management and Learning, Project Stakeholders, Pilot project, Big Picture, Project Lifecycle, Project Elements, Project Management Models.

Table 1. Presentation of research links, topics coding system, and blog author's profile

Blog name, blog topics	Coding of topics	Description of author profile
1. Herding Cats 1. Probability of Project Success. 2. 8 Reasons Why Estimates Are Too Low 3. Quote of the Day 4. How Not To Develop What "Done" Looks Like 5. Project Management and the Three Body Problem 6. A Seat At The Table 7. Seven Immutable Activities of Project Success 8. Elements of Project Success 9. Quote of the Day 10. Quote of the Day	Project Success. Project Success. Project Success.	Link to linkedin profile: http://www.linkedin.com/in/glenballeman?trk=btn_typepad Very Experienced Business oriented Professionals Book writer Business degree
2. PMI Blog - Voices on Project Management 1. Determining the Value of Value 2. Running a Marathon, Running a Project 3. The Must-Haves of Establishing a PMO 4. Setting the Stage for Order 5. Multi-Project Schedule Planning, Part II 6. Ways to Build Strong Project Teams 7. Dealing with Difficult People 8. Tips for Sustainable Change Management 9. Translation Series: "Gen Y: Driving Lessons Learned" 10. Bloggers Sound Off: Navigating Complexity	Value of Value. Project life cycle Project Management Office (PMO) Multi-Project Planning Project Team Project Team Change Management Project complexity	Certificated Experienced PMI Blog Professional association Professionals Business degree
3. QuantmLeap 1. Some Notes re. Complex Systems 2. Why We Need Bureaucracy 3. Project Status Report You Are Not Likely to Come Across – Part 3 4. My Core Values 5. On Leaders and Leadership 6. A Note to Employment Agencies 7. Quote of the Day – About Bureaucracy 8. Doing Agile vs Being Agile 9. 10-Point Checklist for Assessing the Believability of a Claim 10. Quote of the Day – About Freedom	Complex Systems Need Bureaucracy Project Status Core Values Leadership Project team Bureaucracy Agile project M	Link to linkedin profile: http://au.linkedin.com/in/shimmarom Certificated Experienced Business oriented Business degree

4. Arras People - How to Manage a Camel 1. Q&A Project Management Careers: The Counter Offer 2. Adventure, Project or Business as Usual (BaU)? 3. It's in my cover letter 4. What does project management mean to me? 5. Tailoring for Specific Roles 6. A Date with Dennis Lock 7. Top Ten Tips for Becoming a Successful Project Manager 8. Project Management Gif Party 9. Psychology and Project 10. Management Project Management Rowing Boat Challenging UK Government	Project Management Careers Successful Project Manager Psychology and Project Management	Link to profile: http://www.arraspeople.co.uk/about-arras-people/more-about-arras-people/ Experienced Business oriented Professionals Certificated Business degree
5. Virtual Project Consulting 1. Do you know the ROI on your Corporate Training? 2. Nelson Mandela – One of the Biggest Leaders in Modern History 3. Project Management – Challenges we look forward to 4. A Project Turn Around – it's all about Relationships 5. Expand Your Business Potential at the Microsoft Convergence Conference 6. What does Project Management mean to me – a Project Manager's sermon 7. How Social Media is bringing Project Managers together 8. Practical use for Social Media in Project Management 9. Practical use for Social Media in Project Management 10. Practical use for Social Media in Project Management	Project Management Training Leaders, Leadership Project Management – Challenges Project Relationships Project Management Careers Social Media in Project Management	Link to profile: http://www.virtualprojectconsulting.com/about/ Experienced Business oriented Professionals Certificated Business degree
6. Zilicus 1. Online Project Management Software 2. Why Project Risk Management Tool Is, Must-Have For Organizations 3. Lesser Chaos, Better Project Resource Planning 4. 16 Things That a Good Project Manager Knows and Practices Regularly 5. Early Preview of Online Project Management 6. Agile Project Management, 7. Project management software, 8. Improve Work Management and Project Collaboration	Online Project Management Software Project Risk Management Project Resource Planning Preview Project Management Agile Project Management Project Collaboration	Link to profile: http://www.zilicus.com/aboutus/team/ Experienced Business oriented Professionals Business degree
7. The Tao of Project Management 1. No Win/No Lose 2. Appearing Foolish 3. Owning or Owned 4. Gentle Intervention 5. Creative Energy 6. Disturbing Wisdom 7. Meditation 8. The Root of Things 9. Virtuous Leadership 10. Doing Little	Project Strategy Leadership	Link to profile: https://www.blogger.com/profile/01209241018488058934 Experienced Professionals Business degree Book writer Business degree
8. ProjectManager.com 1. Project Manager Career Boost 2. The Pros and Cons of Remote Project Management 3. Playing the Blame Game 4. Why Your Project Might be Failing 5. Why You Need Online Project Management Software 6. 5 Reasons to Keep Learning 7. What Sort Of Team Do You Have? 8. Top 10 Team Building Ideas 9. Tips For A Stress-Free Vacation 10. How To Reduce Time on Projects	Project Manager Career, Playing the Blame Game Project Failing, Online Project Management Software Project Management and Learning, Project Team Time Management on projects	Link to profile: http://www.projectmanager.com/about-us.php Experienced Business oriented Professionals Business degree
9. Ron Rosenhead 1. They threw it' away 2. Are lessons learned – not really? 3. Are people skills the final project management frontier? 4. Strategies for Project Sponsorship 5. Stop that project roll out – ensure you pilot it first. 6. Getting more for less requires engagement to succeed. 7. ~~"~~The perception is different from the reality" 8. We'll learn from that – but will you and will the company? 9. How often do you take the helicopter view? (Big picture) 10. What does project management mean to me?	Project Management and Learning People Skills, Project Team, Project Stakeholders Pilot project Big Picture, Project Manager Career	Link to profile: http://www.ronrosenhead.co.uk/about/ Experienced Business oriented Professionals Business degree
10. Mike Clayton	Project Lifecycle	Link to profile:

1. Project Lifecycle – just for fun 2. Project Planning Poster 3. Simplifying Project Complexity 4. Project Definition: The Layers of an Onion 5. Comparing My Eight Steps 6. Eight Steps to deliver on budget, on target and on time 7. Six Project Management Modes 8. What is a Project Manager? 9. How to Manage a Great Project 10. Periodic Table of Project Elements	Project Planning Project Complexity Project Definition Project Management Modes Project Manager Great Project Project Elements	http://www.linkedin.com/in/mikeclayton Experienced Business oriented Professionals Business degree Book writer

ASPECTS OF PUBLIC RELATIONS AND FINANCIAL MODELS WITHIN NGO'S

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Abstract: *This document presents a unique paperwork on the basics of project and program management in NGO's. Purpose of this research is to present main issues of PR and finance in such organizations, with main focus on student organizations. The lack of formal documents with scientific approach considering online public relations and funding in non-profit organizations motivated three authors to use their experience in non-profits. The aim of this paperwork is to combine different sources of theoretical knowledge in basics of program and project management, online PR, and organization activities and funding of non-profit organization, creating inimitable paperwork useful for people working in non-profits.*

Keywords: *program management, project management, public relations, NGO, finance*

1. INTRODUCTION

The modern era of Project Management began in the 1950s but Project Management techniques can be found as far back as the days of the pyramids.

In the 1950s, businesses such as GE and DuPont realized there were benefits to organizing work around projects and communication was needed across various functional departments and units. There were a number of informal techniques and tools in use, but —projects‖ tended to ad hoc. Tools such as Gantt charts (Henry Gantt (1861-1919) were in use but Gantt charts were not enough to ensure proper control and ensure completion of projects on time and on budget.

During this time period, two mathematical project-scheduling models were developed:

- "Critical Path Method" or CPM
- "Program Evaluation and Review Technique" or PERT
- PRINCE 2

These tools and techniques as well as a number of others spread quickly as businesses looked for new ways to manage large and complex activities, evolving into project management, as we know it today (Anheier, 2010).

2. PROJECT MANAGEMENT

Project management is the process and activity of planning, organizing, motivating, and controlling resources to achieve specific goals. A project is a temporary endeavor designed to produce a unique product, service or result with a defined beginning and end (usually time-constrained, and often constrained by funding or deliverables), undertaken to meet unique goals and objectives, typically to bring about beneficial change or added value. The temporary nature of projects stands in contrast with business as usual (or operations), which are repetitive, permanent, or semi-permanent functional activities to produce products or services. In practice, the management of these two systems is often quite different, and as such requires the development of distinct technical skills and management strategies. If some non-profit organization, such as student organization is project oriented, it is doing its purpose through such projects, where each project has the personal goal that is not connected to the other project (Applied Agility, 2010).

3. PROGRAM MANAGEMENT

Program management or program management is the process of managing several related projects, often with the intention of improving an organization's performance. In practice and in its aims it is often closely related to systems engineering and industrial engineering.

The Program Manager has oversight of the purpose and status of all projects in a Program and can use this oversight to support project-level activity to ensure the overall program goals are likely to be met, possibly by providing a decision-making capacity that cannot be achieved at project level or by providing the Project Manager with a program perspective when required, or as a sounding board for ideas and approaches to solving project issues that have program impacts. Typically in a program there is a need to identify and manage cross-project dependencies and often the PMO (Program or Project Management Office) may not have sufficient insight of the risk, issues, requirements, design or solution to be able to usefully manage these. The Program manager may be well placed to provide this insight by actively seeking out such information from the Project Managers although in large and/or complex projects, a specific role may be required. However this insight arises, the Program Manager needs this in order to be comfortable that the overall program goals are achievable.

There are two different views of how programmes differ from projects.

On one view, projects deliver outputs, discrete parcels or "chunks" of change; programs create outcomes. On this view, a project might deliver a new factory, hospital or IT system. By combining these projects with other deliverables and changes, their programs might deliver increased income from a new product, shorter waiting lists at the hospital or reduced operating costs due to improved technology. Most of non-profit organizations (student organizations) that are project oriented are actually program oriented. Some of these organizations are ESTIEM (European Students of Industrial Engineering and Management), BEST (Best European Students of Technology), AIESEC, etc.

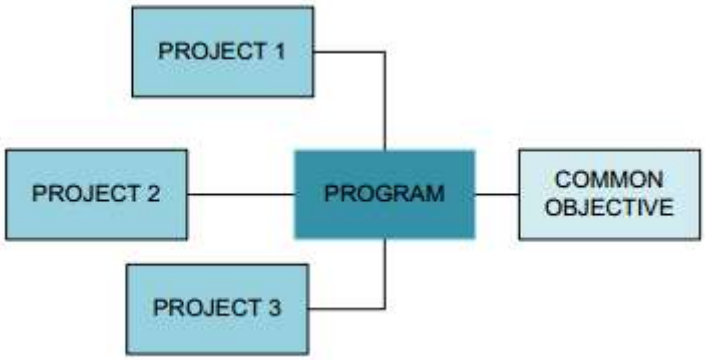

Figure 1. Program management and its connection to projects (Zambruski, 2007)

There are many important things when we talk about managing projects and programs, but there are three factors that are really crucial for the success of the project/program: time, resources and scope and those factors form, so called “Project Triangle” (Zambruski, 2007).

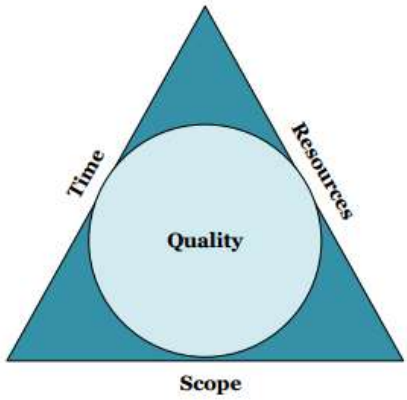

Figure 2. Project triangle (Zambruski, 2007)

Beside project triangle, there are many other things that could help follow the success of the project. Some of those things is a project life cycle.

Project life cycle is —a collection of generally sequential and sometimes overlapping project phases whose name and number are determined by the management and control needs of the organization.

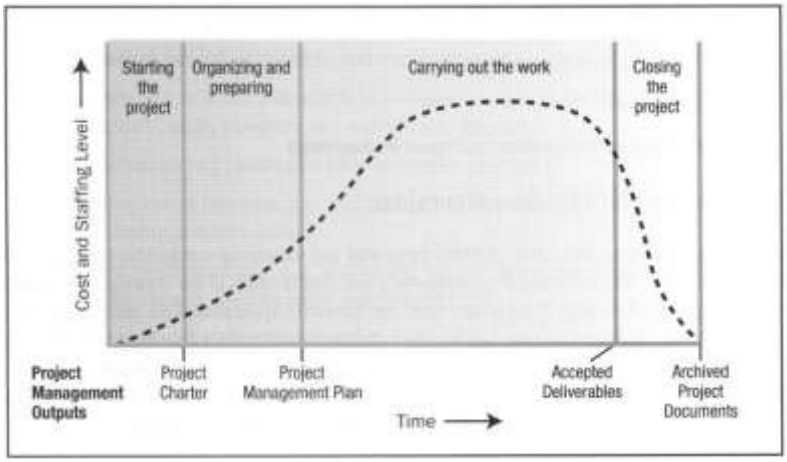

Figure 3. Typical costs and stuffing levels across the project life cycle (Zambruski, 2007)

4. WHAT MAKES A GOOD PROJECT?

There are four yardsticks to measure the quality of a project:

- Is it relevant? Does it really tackle the problem it sets out to address? If the problem, for example, is that the children in the village can't read, is a new school the best answer, or should one look at the parents' attitude to education, the shortage of teachers, the lack of money in the village's budget, the need for labor in the fields, or the government's lack
- of investments in the social sector? Does the project have a credible "entry point"?
- Is it feasible? Is it likely to achieve its objectives? What risks does the project face? What resources – financial and human - does it have? How realistic is it?
- Is it cost-effective? What is the relationship between the cost of implementing the project and its expected benefits? Is there a strategy that would have achieved the same results at lower costs? For example, sending all the children in the village who can't read to an expensive boarding school would probably improve their literacy, but the cost would be immense, and the impact on the community would be very destructive. So building a school might be a more cost-effective strategy.
- Is it sustainable? Can it go on delivering its benefits after the external assistance has come to an end? For example, with there be teachers for the school, money to pay them, parental support, good educational policies from the government – long after the school has been built, and the project has closed down? (Participant's Workbook, 2012)

5. STAKEHOLDER'S ANALYSIS

The "stakeholders" in a project are all the people or organizations who either stand to be affected by the project, or who could "make and break" the project's success. They may be winners or losers, included or excluded from decision making, users of results, or participants in the process. Stakeholders analysis is the mapping of a project's key stakeholders, who they are, what interests they have in the project (positive or negative), and how these interests can affect a project, "make or break" it.

Such a mapping activity will help you identify:

- Which individuals or organizations to include in your "coalition" or network
- What roles they should play, and at what stage
- With whom to build relationships, which relationships to nurture
- Whom to inform and consult about the project

You can use a matrix that would look like the table on the next page.

Table 1. Stakeholder analysis (Participant's Workbook, 2012)

Infuence/Importance	High influence	Low influence
High importance	**Stakeholders who can gain or lose a lot from the project, *and* whose actions can affect the project's ability to meet its objectives** These actors are powerful – you need to develop good relationships	**Stakeholders who stand to gain or lose a lot from the project *but* whose actions cannot affect the project's ability to meet its objectives** These actors lack power – but you need to make sure their interests are fully represented
Low importance	**Stakeholders whose actions can affect the project's ability to meet it's goals, *but* who have little to gain or lose from the project** They may be a source of risk, unpredictable, so keep an eye on them!	**Stakeholders who have little to gain or lose from the project, *and* whose actions have little influence on the project** Just keep them informed.

6. PROJECT STRATEGY

First of all, you need to determine **who is going to benefit** from your project, who will be its beneficiaries. Can you be precise: how many, where are they to be found, what are their social, economic and cultural characteristics? Then ask yourself who will be your partners, not only at the local, but also at the national level. If you have done the stakeholders analysis, the answers should be obvious. Create a network, integrating beneficiaries and partners, that is, make sure they talk to each other. Decide on their roles: how will you communicate with them? What are the lines of authority (this is especially important if you work with other groups who share your objectives, but whom you don't control – they have their own funding and staff)? Who takes decisions? Do you need a steering committee to bring everyone to the table?

Then you need to decide on a **project approach**. There are two types of approach, and they each require a very specific project design. *Direct* support (DS) is one type of intervention, and it means that the project works directly with the beneficiaries (e.g., children, their families, a group such as landmine victims) through the provision of services such as education and training, health care, or construction of shelter. Many projects, however, choose a second type of intervention, called institutional development (ID). Examples are the strengthening of NGOs or government institutions so they can deliver better services to the target group, those children, families or landmine victims. In that case, the NGOs or the government (for example, the national mine action center) are the direct recipients of the project, but the beneficiaries ultimately are the people who get improved services. The advantage of those "ID" projects is that they have a multiplier effect, as eventually more people will be reached. But if the proper institutions are not there to be strengthened, or if they are not interested, direct support may be preferable (Niven, 2008).

7. PROJECT PREPARATION

Before starting a project's preparation, it is important to fully understand the terms which are commonly used in any given project development and implementation. As far as European Union projects are concerned, in here we will use the definition available in Aid Delivery Methods: Project Cycle Management, a manual released by the European Commission in March 2004. The main objective concerning this manual is identification of project intensions. At the beginning of a project's preparation, the project leader should have a clear idea of the problematic situation that needs to be addressed, the improved situation to be reach and the stakeholders who will be directly involved.

Every project can be presented as a sequence of consecutive phases:

1) **The Concept Phase** – During this phase, the complete concept of the project is developed.
2) **The Analysis Phase** – The project's specific objectives, expected results, activities as well as the analysis of the risks which can affect its implementation are defined.
3) **The Planning Phase** – Stakeholders are identified as well as the project's beneficiaries and specific target groups which will be addressed by the project. Furthermore, the resources (financial and human) the project requires should be identified in addition to clear coordination and management arrangements as well as monitoring and evaluation systems.

4) **The Implementation Phase** – The project becomes operational and activities are executed.
5) **The Evaluation Phase** – The implementation of the project's activities is monitored through indicators that have been developed during the planning phase. It is continuous process which might lead to adjustments before a final evaluation, at the termination phase.
6) **The Termination Phase** – The initial assumptions are compared with the project's actual outcomes in order to evaluate the project results and impact and draw recommendations for future actions.

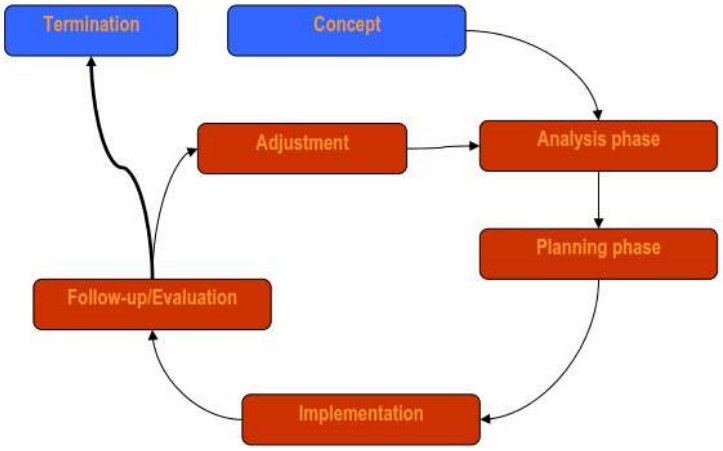

Figure 4. Preparation process in NGO's projects (Participant's Workbook, 2012)

8. MODERN NEEDS OF THE NGO

With the technology development and new business models, NGO's have found a new ways of doing their activities successfully and more efficiently. Viral marketing, but also online public relations have become a standard for this type of organizations, and not to mention companies. Online PR is taking a bigger part of the whole PR by giving better and faster results of promoting the organizations. For example, ESTIEM LG Belgrade (student's organization) has become one of the most recognizable and most active local groups, thanks to the online PR, which has made this organization more attractive to every stakeholder, including companies, institutions such as universities, government, students, etc. Why is this important?

Almost every student organization depends on some institution, because they are non-profitable. That's the reason why NGO's has to have a good PR strategy, focusing on modern aspects of promoting the organization that will bring the organization to the main sponsors, that will provide a donation to the organization. Those sponsors could get in return different types of promotion, getting active in some activities, etc. But there are some sponsors, such as some public institutions that give a funds without reaching for something in return.

9. MODERN ASPECTS OF PUBLIC RELATIONS IN NGO'S

Public relations are the practice of managing the spread of information between an individual or an organization and the public. The term "Public Relations" is often misunderstood especially because people tend to associate it exclusively to media relations. Public relations have started out as media relations, but in the recent years, they have become much more. And, with the introduction of many Internet services, it has also become clear that public relations deserve to be named "communications".

When making a difference between Offline and Online public relations (PR), it is very important to clear out the difference between the terms „Offline" and „Online". Offline addresses the traditionalll way of communicating with target audiences - using traditional, well-established communication channels like printed material (newspapers, magazines), television and radio, press conferences and special events. With the introduction of mainstream Internet usage, there has been a shift of focus for all communication activities, and with the growing popularity of social media, the Internet has taken a primary channel for communicating different messages.

Today, Online Public Relations represent a way of creating identity, and building and increasing the image and reputation of specific subjects through selected Internet channels: social media and networks.

Non-profit organizations have similar goals in promotion and PR just like profit organizations. Creating visibility, building loyalty and trust through positive image and reputation, and creating a stable system of interactions with target audiences with a fail-safe key in crisis situations. Online PR, through a strategic use of social media capacities, helps the members of the non-profit sector to be on the same level (or on a higher one) comparing to entities with profit. By active listening, and conversation encouragement, an active online presence is built, that after some time clearly leads to the accomplishment of PR (and promotion) goals.

Social media defines online media, like text, photos, and messages or video that is social in nature. In other words, media that starts conversations, encourages people to pass it on to others, and finds ways to travel on its own. Social media as a tool cannot be used as a whole. It has to be strategically analysed, and then the right mix of social media tools is to be selected. Creating the social media mix starts with understanding two groups of tools it offers: blogging platforms and social networks.

A shorthand term that means „Web log“ is an online, chronological collection of personal commentary and links. Easy to create and use from anywhere with an Internet connection, blogs are a form of Interne publishing that has become an established communications tool. Bloggers (blog authors) review products, services, public images, they write about organizations and individuals, and address the popular problems and trends. Non-profit organizations often have a similar mission and vision with specific bloggers, and that is a niche that should be recognized and tapped into.

A branch of public relations named „Community management“ is a new trend using the potential of the digital business world. Social networks are a subset of social media, Internet communities allowing interactions between users through a specifically, and in many cases functionally oriented, interface. They allow users to have personal profiles, get in touch with friends, colleagues, acquaintances and business contacts, and share relevant textual and multimedia content with them. On the other side, organizations and specific individuals use different social networks for creating a loyal fan base, conversations, feedback systems, and fail-safe tool in crisis. Top 10 most used social networks in 2014 are respectively Facebook, Twitter, LinkedIn, Pinterest, Google Plus+, Tumblr, Instagram, VK and Flickr.

Using the potential of social networks is done through constant activity on organization’s profile pages. Starting, developing, and sustaining the conversation with different members of the target audience enables the creation of a dynamic feedback system, loyalty building, and image and reputation development. Besides reaching the traditional public relations goals, Online PR for non-profit organizations works in the fundraising sphere, events promotion sphere, and as active contributing factors to advocacy and recruiting and engaging volunteers.

Enormous success of online public relations, created a huge amount of interactions on social networks. In the manner of good PR practice, interaction on social networks should be continuous, on-time and useful for our audience. Therefore, that kind of demand created a new job position in PR sectors called community manager. The purpose of community manager is to monitor, participate and engage on social networks of his company. This position does not have non-working days, according to successful implementation of constant interaction. Also, one of the most important parts of community management is careful monitoring of social networks, not only those on which one organization presents itself, but every network that has potential customer or audience.

Although everything above is particularly important for a community manager to do, without engagement, none of those activities will have visible improvement of communication. The engagement is the activity that creates a community around the organization, a wide group of people committed to an organization. And it’s about building communities which really means building relationships. The engagement is an activity that requires the most time spent on this position, but the only one that gives positive result on communication organization towards its audience.

For non-profits, good community manager is essential part of online public relation. Due to exponential growth of internet users, and lack of finance, internet with the social networks gives sustainable solution for communication between organization and people in both ways. To attract people to hear them, community manager usually post interesting news, encourage interaction with comments and mutually sharing. Community manager is the person, who has to present his company to people as their friend, with all its virtues.

As every process in management, evaluation presents an important segment in detecting the strength of simpact on public relation. Evaluation of online PR effects is much easier due to huge amount of online tools

for tracking and monitoring. A number of good keyword research tools are available without charge. Leading free tools include Google Keyword Tools and SEO Book keyword tool.

Online public relations have a traditional purpose when talking about non-profit organizations. The goals of public relations concerning identity, image and reputation are achieved through regular communication with all of the target audiences .What differs the Online public relations of non-profit organizations from the profit ones, is the unique nature of the community management. Combined with the interactive approach to dynamic social networks maintenance, it creates a good environment for fundraising and advocacy activities, approaches, and systems for volunteer management. (Đorđević and Ignjatović, 2012)

10. FINANCING OF NGO'S

NGO funding can vary by source, terms, and the type of organization funded. There are several different kinds of foundations and individual donors who provide NGO financing. Some give donations while others reward funds via a grant application process.

Two overarching types of NGO financing are restricted and unrestricted funds. Restricted funds must be earmarked for a specific purpose as dictated by the donor. The only typical requirement for unrestricted funds is that they be used to help the NGO accomplish its mission.

Restricted funds are often specific to a type of project or other need that is outlined during the grant application process. Typically the overall required focus is dictated by the donor, while the NGO can determine the specifics that apply to its particular needs. There may also be restrictions as to how or when the money will be spent once it is awarded.

Unrestricted funds can be an important part of NGO financing as they may be used to fill whichever need is most urgent. Often they will be used to cover non-specific operational and other ongoing costs that are usually difficult to fund with grant money. Common sources of unrestricted funds include donations from the general public, money earned by the NGO selling products or offering services, and institutional funding.

Self-financing is one of the options that a nonprofit organization has to develop a more diverse income stream. It can also help to support programs and cover expenses that donors and grant makers do not want to fund (Zarinpoush, 2006).

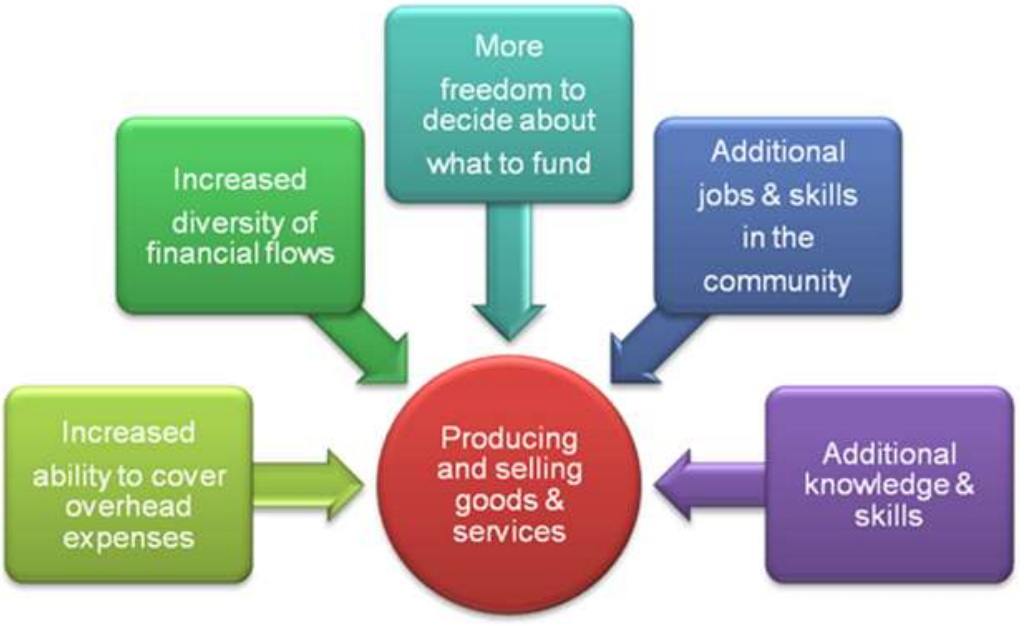

Figure 5. Benefits resulting from self-financing (The Sustainable NGO, 2014)

The universities encourage student organizations to raise funds and sell their projects to the local companies, enabling them to contribute to the University's rich environment.

Self-financing require preparatory work, necessary before the organization can decide whether selling projects and services for a profit is an option that has chances to succeed.

The preparatory work involves market research and analysis of core competence. The preparation requires special knowledge and skills from those that will conduct these activities.

Figure 6. Preparatory work that NGOs will have to perform (The Sustainable NGO, 2014)

In the time of economic crisis, government grants budgets are reduced, as well as municipalities. Funding from universities and faculties do not have to be reduced compared to the previous years, but certainly the financial situation of the organization may be affected, if the faculty budgets are reduced as consequence of lover government dotation to the university.

Therefore, it is necessary to find companies and individuals willing to invest in student organizations and their projects, which benefit both NGO, by receiving more funds, and companies, by recruiting new interns or employees and through marketing and promotion in the public and especially at the university level among students and professors (Rouson, 2010).

11. CONCLUSION

It is predictable that, within the next decade, the Internet will exist as a seamless fabric of classic networks and networked objects. Content and services will be all around us, always available, paying the way to new applications, enabling new ways of working; new ways of interacting; new ways of entertainment; new ways of living. In such perspective, the conventional concept of the Internet as an infrastructure network reaching out to end-users' terminals will fade, leaving space to a notion of interconnected "smart" objects, forming pervasive computing environments. The Internet infrastructure will not disappear. On the contrary, it will retain its vital role as global backbone for worldwide information sharing and diffusion, interconnecting physical objects with computing/communication capabilities across a wide range of services and technologies.

All of that affected on the activities of the NGO's that are mostly project or program oriented, which means that they have various types of projects focused on one or more target groups. Those organizations must have a strong connection, but also a balance between public relations and finance. Only with the good balance of those two departments, organizations will manage to get bigger and attractive to its stakeholders. Beside everything, this paperwork has focused on financial and PR activities, but every NGO should have other departments such as human resources, corporate relations and others in order to have a strong organization.

REFERENCES

Anheier, H. K. (2000). Managing non-profit organisations. Civil Society Working Paper series, 1. Centre for Civil Society, London School of Economics and Political Science, London, UK.

Applied Agility (2010). An Introduction to Project Management – A Useful Tool for Non-Profits. Retrieved from www.appliedagility.com

Đorđević, M., Ignjatović, M. (2011). The impact of online PR on non-profit organization. Symorg 2012.

Niven, P. R. (2008). Balanced Scorecard For Government And Nonprofit Organizations. John Wiley & Sons, Inc.

Participant's Workbook (2012). How Project Management Can Be Used in Your Nonprofit.

Rouson, B. (2010). Business Planning for Nonprofits. Enhance 2(1).

The Sustainable NGO. (2014, 05 14). NGO Self Financing: Benefits and what is involved. Retrieved from The Sustainable NGO: http://www.thesustainablengo.org/improving-financial-viability/self-financing-selling-products-and-services

Zambruski, M. S. (2007). A standard for enterprise project management. CRC Press.

Zarinpoush, F. (2006). Project Evaluation Guide For Nonprofit Organizations. Canada: Imagine Canada.

QUALITY MANAGEMENT

SERVICE QUALITY IMPROVEMENT: THE BUSINESS PROCESS MANAGEMENT APPROACH

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Abstract: This paper is primarily focused on investigation of issues related to application of business process management (BPM) approach in the service organizations. Almost every management model, including the one related to business processes, has been originally created for the manufacturing industry. In order to successfully implement these models in the service industry it is important to understand how services are different from manufacturing activities. Proper comprehension is possible only once the identification of services, their classification and characteristis are addressed. The central piece of the paper examines implementation stages of the BPM and analyses the possible challanges that service organizations can face based on the expirience of a business unit of a UK service organization. Examples of BPM practice in service organizations are rare in the literature and mostly based on short analyses of case studies. For that reason, the value of this work lies in the combined study of theoretical background and practical challanges related to basic issues that service organizations have to consider when they are establishing a system for improvement of business processes.

Keywords*: quality management system, service, business process management*

1. INTRODUCTION

In the recent decades, attention of experts in the particular fields of management has been increasingly shifting from manufacturing to service sector. Starting from 1970s the issue of implementation of management models that were crafted for the so called “hard” industries in service companies has been addressed ever more. Consequently, today it is possible to detect, both in academic literature and business practice, development and evolution of numerous process management and quality improvement models that are specifically designed for requirements of the service industry.

An important feature of the service industry is that, thanks to its resources and expertise, it provides its users with considerably better capabilities to satisfy their needs than they could do on their own. Some of these needs (i.e. long-distance communication) can only be satisfied by large enterprises that possess necessary technology and knowledge (for the mentioned need those could be postal services, mobile phone operators or internet providers). Particular service industries owe their entire existence to own superiority (speed, price, high quality, convenience) over the independent realization of tasks. On the other hand, a significant number of services is devoted to satisfying certain psychological and physiological needs, such are needs for entertainment, sport, culture, religion etc.

Service sector has expanded greatly in the last few decades. In the USA, for example, around 23 million people were employed in the service industry in 1945, while there were 18,5 million people working in manufacturing. In 1997, there were already 100 million people working in services and only 25 million in manufacturing. That means that roughly 80% of employees outside of agriculture were actually working in the service sector. (Fitzsimmons and Fitzsimmons, 2001)

In Serbia, the ratio is also changing in favour of the service industry, though still considerably below the American level. This paper analyses how some of the key concepts of business process management can be utilized for quality improvement of service activities.

2. SERVICE PROPERTIES

2.1. Basic distinctions between manufacturing and provision of services

One of the main conceptual issues with implementation of process approach is process classification. For the purpose of this paper it is significant to consider distinction between **product** and **service** types of processes (Melan, 1992).

There is a considerable number of differences between manufacturing and provision of services. Boone and Kurtz (1998) have defined the following important criteria for making the distinction:

- **Users' needs** – it is much more difficult to identify and measure them in case of provision of services than it is with the production of goods.
- **Tangibility/Intangibility** – in contrast to goods, that are tangible, services are intangible even when they are visible to the user. Quality of goods can be measured using specifications, while quality of service is often determined by subjective measures of a user (i.e. past experiences – good or bad). User can possess goods, while he may only remember the service. Goods can be returned or replaced, while only ramification for poorly provided service can be apology or some sort of compensation.
- **Schedule of production and consumption** – services are "created" and consumed simultaneously, while production of goods must precede the consumption. Furthermore, many services have to be provided when it is convenient for the user. Service can't be stored, inventoried or inspected, like it is the case with goods, before it comes in contact with the user. Because of that, it is important to devote more effort to training and "building-in" quality into service processes.
- **Presence/absence of a user** – users are frequently present, even involved in the process of service provision, while production of goods is mostly performed far away from them. Users of fast-food restaurants are good example of that. They order food, take it to their table, consume it and afterwards take care of waste, dishes and cutlery. A more sophisticated example of user participation can be found in education (previous knowledge and students' effort are contributing in many ways to the output of the education's "production system") and health care (output of the "production system" is affected by the capability of a patient to recognize and communicate symptoms to a doctor, as well as his ability to act in line with the given instructions).
- **Labour or capital intensive** – services usually demand exercise of work, while production requires investment of capital as well.
- **Output durability** – tangible outputs of manufacturing are lasting, while only memory and consequences remain after a provision of service. That means that results of services perish considerably faster.
- **Consistency of quality** – services are frequently more inconsistent in quality than manufactured goods. Considering that service quality depends mostly on the person that is providing it, the competence, physical and psychological wellbeing can be decisive factors.

According to the same source, service market is affected by the following factors:

- changes in regulations,
- privatization,
- lowering standards of professional associations,
- technological innovations, including computerization and telecommunication developments,
- establishment of profit centres for services in manufacturing companies,
- financial pressure on social and non-profit organizations to discover new sources of income,
- globalization of service industries,
- expansion of leasing and renting business,
- emergence of a new group of entrepreneurial and innovative managers,
- development of quality initiatives, especially in the service industry.

2.2. Definitions, classifications and characteristics of services

There are many definitions of services. The following ones can be highlighted as frequently quoted in the literature:

"Services are intangible tasks that satisfy the needs of consumer and business users." (Boone and Kurtz, 1998)

"Service is an act that takes place in direct contact between the customer and representative of the company that is providing the service." (Zeithaml and Bitner, 1990)

"Service is an act or an action that provides benefits to a customer, by realizing changes that are convenient for the service recipient." (Zeithaml and Bitner, 1990)

"Service industries" include:

- transportation (railway, air transportation, bus lines, metro, truck transportation, pipelines),
- activities of public enterprises (phone connections, delivery of all sorts of energy, water supply and sanitation),
- trading (food, cloths, cars, department stores),
- financial services (banks, insurance, investments),

- mediation business (real estate business, visa application, marriage proposals),
- hospitality industry (restaurants, hotels, motels),
- news media,
- marketing services (advertising),
- health care (hospitals, ambulances, retirement homes, childcares, medical labs, health tourism),
- education and training services,
- personal services (amusements, laundry and cleaning, beauty salons, barber shops),
- professional services (lawyers, consultants, private medical and dental practice),
- renting (apartments, rent-a-car),
- product, machine, building maintenance (car repairs, painting),
- state-controlled public services (defence, health care, education, social care, municipal services),
- non-profit organizations (Red cross, religious institutions, army).

Purposefulness of services is determined by their characteristics that user (client) recognizes as useful. Evans and Lindsay (2005) distinguish several important dimensions of services:

- **time** - how long user has to wait for a service and how much time does the provision of service take,
- **timeliness** - will a service be provided at the arranged time,
- **completeness** - i.e. are all pieces that were ordered delivered,
- **courtesy** - it relates to the attitude and behaviour of the personnel that is providing a service,
- **consistency** - is service provided every time and to every customer in the same way (robots can almost always replicate actions in the same manner, but people can't)
- **accessibility and convenience** - is there an easy access to services,
- **accuracy** - was the service provided in the right way,
- **responsiveness** - how fast can personnel react to unexpected problems,
- **numerical accuracy** - i.e. how accurate is the transfer of assets in the bank,
- **cleanliness** - i.e. how clean are hotel rooms.

According to the same source, additional characteristics of services that can sometimes be crucial are of:

- **psychological nature** - i.e. appreciation of regular customers, beauty of the environment (landscape, interior of a restaurant), comfort,
- **technological nature** - i.e. transmission without interference (related to phone, TV and radio transmissions),
- **ethical nature** - i.e. truthfulness of information from commercials, no discrimination of customers (respecting religious, national and sex differences, providing equal treatment to people with a disability etc.),
- **legal nature** - assuring that all obligations are fulfilled (i.e. travelling tours should be done on time and include visits to all locations that were previously promised).

Differences between manufacturing and service organizations have led to creation of specific management. Many service organizations, such as airline companies, banks and hotels, have excellent quality assurance systems (Filipović & Đurić, 2009). Most of them are based on the business experience from the manufacturing industry and, therefore, is more product- than service-oriented. For example, quality assurance systems of hotels are frequently limited to technical standards, such are the ones related to furnishing and maintaining rooms. It is much harder to establish standards for intangible characteristics of quality. Often, they are set in arbitrary manner and later tested in practice. Having in mind that work and behaviour of workers, as well as the speed of service provision, are key determinants of users' perception of quality, it is clear that two most important components of quality systems in the service industry are employees and informational technologies. Certainly, this doesn't mean that these factors aren't important in the manufacturing industry, but simply that they are vital for service industry just like production technologies are in the manufacturing.

3. BUSINESS PROCESS MANAGEMENT IN SERVICES

3.1. Stages of BPM implementation

BPM is becoming popular in companies as a holistic management tool for achieving and sustaining corporate success. However, applying BPM in whole organization is not a simple task. The very implementation is usually divided into five main phases (Rosemann, 2008).

First, **it is necessary to create awareness of the BPM methodology and potential benefits of its implementation**. In many instances, insufficient understanding of the BPM concept can be identified as an obvious cause of unsuccessful implementation of BPM. This can be explained by already present high level

of organizational activity, previous commitment to some other methodology of organizational engineering or, commonly, to lacking of initiatives for change or improvement. Sometimes, it occurs that even proponents of this concept lack in knowledge about methods, assets and issues related with the BPM. Overall, lacking of awareness can be assigned to insufficient training in most of the cases. Once the training is properly organized, it represents the best instrument for creating, enhancing and sustaining the awareness of the concept and its importance.

Second, **previously mentioned awareness and comprehension of BPM must be transformed into a real desire for actual adoption of the concept**. This is a critical phase and it demands presence of drivers (i.e. introduction of a new, large system or merging of organizations) and a leader – at least one person with strong commitment to the concept. These can be found in various organizational departments and hierarchical levels of the company. Initiative can emerge from IT department, HR department, business improvement teams or internal stakeholders, such are line and executive managers. One of the biggest obstacles is the fact that BPM doesn't have its typical "home" inside of an organization.

Next, **if the initiative for adoption of the concept was accepted, individual projects for quality improvements have to be set up, executed and monitored within the BPM**. It is recommendable to ensure early that visible results are achieved, especially those that can be used for promotion and development of the concept within the organization. This is usually the phase in which organizations develop organizational capabilities for implementation of BPM and faith that it will yield expected results (Tregear, 2005). Individuals are, at first, fascinated with BPM. They explore the potential career opportunities related to development of concept and later, mostly unofficially, take ownership over it.

Fourth, **if individual projects were successful, organization will seek for the opportunities for further expansion of BPM.** Individual BPM projects will be combined into centralized BPM program that will be in charge of the whole organization. At this stage, the overall BPM methodology has to be fully designed. Methods, techniques and tools have to be specified, established, documented and maintained, accompanied always by appropriate communication. One of the most significant issues at this point is development of BPM strategy that should contain the specification of activities planned for the following 3 to 5 years.

At the end, in the final stage of the change, typical scenario includes establishment of centralized group for BPM. This group needs to have precisely defined internal roles related to the company wide BPM implementation. In this way, BPM-related values will be created and will affect the overall system of values.

3.2. Example of usage of BPM for quality improvement in service industry

Some basic principles of BPM will be analyzed on the example of a large enterprise that is in the business of servicing of capital equipment. This company has over 4000 employees in 50 different locations all over the United Kingdom and more than 24000 across Europe, Asia and Africa. The study was conducted on one of the six business units that is in charge of delivery and service within the particular region. (Lee & Dale, 1998)

Company started its BPM journey by adopting the following definition: "BPM is about measuring core processes, analyzing what works and what doesn't, and improving them". Simply put, the concept was related to "waste elimination and adding value".

By analyzing the internal documentation of this service organization, it is possible to notice that there are three crucial factors affecting the success of BPM implementation:

- Process discipline - imply accurate and consistent application of business processes in the whole organization and constant monitoring of performances;
- Process improvement – improving business processes that includes:
    - ensuring that processes are designed from the customer's perspective,
    - using benchmarking,
    - practicing continuous improvement activities,
    - practicing improvement though breakthroughs, and
    - insisting on quality of information;
- Cross-process integration - user-oriented process management and integration of improvement initiatives in a way that will make them visible to users.

BPM is a helpful instrument for improving processes that are crucial for achieving company's objectives. This organization possesses a set of standard processes in its business architecture and they are supported by BPM principles that are complied with rules of pervasiveness, ownership, documentation, measurement and inspection. (Zairi, 1997)

This organization is assuring compliance with these rules in the following way:

- **Pervasiveness** - understanding BPM principles throughout the whole organization,
- **Ownership** - every process must have appointed owner who will review process performances and be responsible for its continuous improvement,
- **Documentation** - each process has to be modelled from the beginning to the end and have standards for documentation defined in a way that will correspond to the needs of all process users; this includes in-process control measures, documentation and information usage procedures, management controls, as well as a description of process realization,
- **Measurement** -indicators that are used for process measuring are classified into cost, quality and time parameters. All key processes are monitored by usage of indicators related to flow and outcome of the process. Measurements are performed in the critical stages of the process in order to ensure that user requirements are met, mistakes avoided, variations reduced, time of the cycle improved and productivity boosted,
- **Inspection** - process owners have to monitor performances, identify gaps through regular reviews and close them. This principle is related to the need for reduction of variations as well.

BPM approach in the organization includes also understanding of connections among different functions and initiatives. They are another source for the improvement that can be achieved using:

- investments in technology,
- factual approach to decision making,
- simplification, and
- innovation.

Processes in this organization share characteristics with ones that Mitchell (1991) described in his work:

- „they have customers (internal or external), they have defined outcomes and there are users for those outcomes“,
- „they can cross organizational boundaries“ .

The study of BPM practice in this business unit has shown that there is an active effort for maintaining process discipline. The most of the key processes are documented, measured, controlled and owned. However, there is a difference in the level to which a discipline is present. Out of five principles of BPM, measurement is applied in the most vigorous way. It is easy to spot that there are too many measures in the business unit, which is obstructing managers to apply them effectively. Principles of pervasiveness and documentation are not applied, even though they are necessary for application of measurement and control - before simplification and improvement of the process, it has to be understood and documented.

All of the key processes tend to be owned but with variations in the level of documentation. For that reason, some processes are fully documented, some partially and some are not at all. Service engineers that work in self-managing work groups (“SMWG”) are the most advanced in the level of application of BPM principles. Every group has managed to successfully establish ownership over the key processes for which they were responsible, document them and have them inspected bi-monthly by line-managers. Processes are measured during the monthly service reviews and their key measures are presented on quarterly tracking chart as part of a visible management system. Despite this, there are great variations in application of the concept between different self-managing work groups. This leads to conclusion that individual and team motivation are important factors that can influence the effectiveness of implementation.

When asked about the reasons for problems related with the inconsistent application of principles, some of process owners complained that there wasn’t enough time for realization of “demanding” process or that they couldn’t deal with the process simplification because of the overload which is created during the process realization. It is clear that the organization needs better cross-process integration and more effort in improvement activities.

Matrix organization form that is in between functional and process orientation is present both on the organizational level and on the level of the business unit. For complete adoption of process approach it is necessary to secure strong leadership and change of organizational culture. Another challenge is the presence of isolated departmental teams that work according to own procedures and have job attitude that makes understanding and communication in the organization even more difficult.

This and other studies dedicated to BPM implementation in service organizations are missing an adequate process description which would provide better insight on the practical implications of the concept application in the specific circumstances.

4. CONCLUSIONS

There is a significant number of differences between manufacturing and provision of services that has created a need for adjustment of existing and development of new BPM approaches specifically for service activities. Effective creation and adoption of these methodologies depends on proper understanding of essential differences between products and services and resulting consequences.

Some of the most important criteria for distinction are users' needs, tangibility, schedule of production and consumption, presence/absence of a user, labour/capital investments, output durability and consistency of quality. It is also important to have in mind that service market is affected by specific circumstances that are frequently different from the ones related to goods. Even the very category of the services is today covering considerably broader field of activities than it was the case before.

Adoption of BPM throughout the organization usually implies five particular stages. Firstly, the awareness of the BPM methodology and its potential benefits has to be created. Secondly, consciousness and understanding of BPM have to be transformed into a desire for application of the concept. Thirdly, if initiative for change is accepted, individual quality improvement projects within the BPM have to be established, executed and monitored. It is preferable to strive for results that can be achieved fast and be useful for the promotion and expansion of the concept in the organization. After that, if individual projects are successful, organization will explore how to use BPM idea further and, finally, create a centralized BPM program that is in control of all projects and is responsible for bringing the maximum value to the organization. In the final phase, organization creates centralized BPM group that works on incorporating BPM-related values to the overall culture of organization.

These general stages of BPM implementation are, however, influenced to a great extent by the particular nature of services. Analysis of the business unit of an international UK service organization has shown that there are certain critical factors, principles and rules in the BPM approach that should be considered in the BPM implementation.

This organization that is working on delivery and service for its customers has defined the BPM concept as "elimination of waste and value adding activity". The implementation experience of this company has shown that there are three crucial factors for successful adoption of BPM: process discipline, process improvement and cross-process integration. The organization utilizes a set of standard processes that are supported by BPM principles, which are in compliance with the rules of pervasiveness, ownership, documentation, measuring and inspection. Processes in this organization are set in a way that every process has its customers (internal or external), precisely defined outcomes and freedom to exceed organizational boundaries if it is needed for effective functioning.

One of the conclusions that emerged during the implementation of the concept is that process has to be understood and documented before it is simplified and improved. Establishment of ownership over the key processes, their documentation and bi-monthly inspections are some examples of good practice. Processes should be measured during the regular service reviews and their key measures monitored using the visual tools of quality management.

By analyzing the studies on BPM implementation in the service industry, it can be noted that critical factor of success is always the improvement program that is based on clear categorization of processes.

REFERENCES

Becker, J., Kugeler, M., & Rosemann, M. (2003). *Process Management: A Guide for the Design of Business Processes*, Berlin, Germany: Springer-Verlag.

Boone, L. E., & Kurtz, D. L. (1998). *Contemporary Marketing Wired* (9th ed.), Fort Worth, Texas: The Dryden Press.

Cianfrani, C. A., Tsiakals, J. J., & West, J. E. (2002). *The ASQ ISO 9000:2000 Handbook*, Milwaukee, Wisconsin: ASQ Quality Press.

Evans, J. R., & Lindsay, W. M. (2005). *The Management and Control of Quality* (6th ed.), Mason, Ohio: Thomson South-Western.
Filipović, J., & Đurić, M. (2009). Osnove kvaliteta, Serbia, Belgrade: FON.
Fitzsimmons, J. A., & Fitzsimmons, M. J. (2001). *Service Management - Operations, Strategy and Information Technology* (3rd ed.), New York, New York: McGraw-Hill International Edition.
Lee, R. G., & Dale, B. G. (1998). Business process management: a review and evaluation, *Business Process Management Journal*, 4(3), 214.
Melan E.H. (1992). *Process Management: Methods for Improving Products and Service*, New York, New York: McGraw-Hill.
Mitchell R.W. (1991). *An Introductory Guide to Writing Business Processes and Procedures*, UK, London: Rank Xerox Ltd.
Rosemann, M. (2008). *The Service Portfolio of a BPM Center of Excellence*, BPTrends, Retrieved from www.bptrends.com.
Radović, M. M., Karapandžić, S. Z. (2005) *Inženjering procesa*, Serbia, Belgrade: FON.
Tregear, R. (2005). *BPM Capability and Credibility*, BPTrends, Retrieved from www.bptrends.com.
Zairi, M., (1997). Business process management: a boundaryless approach to modern competitiveness. *Business Process Management*, 3(1), 64-80.
Zeithaml, V. A., Parasuraman, A., & Berry, L. L. (1990). *Delivering Quality Service*, New York, New York: The Free Press.

CORRELATIONS OF RESTRUCTURING ENTERPRISES PERFORMANCE AND ISO 9001 CERTIFICATION

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Abstract: *The popularity of documented quality management systems in accordance with ISO 9001 standard is evident in many countries. Implementation and certification to ISO management system standards should be observed in relation to economic performance of the company. The aim of this paper is to explore correlation between business performance of Serbian enterprises in the restructuring process and ISO 9001 certification. Main hypothesis of paper has been proved, as existence of statistically significant difference in business income per employee between enterprises with and without ISO 9001 certificate.*

Keywords: *Restructuring, business efficiency, business performance, standardization, ISO 9001*

1. INTRODUCTION

The implementation of management systems, in accordance to requirements of international standards, reflects a socially responsible company and positively affects both image and reputation of the company. According to ISO/IEC (2004) and CEN (European Committee for Standardization, 2013), standard is: 'a document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context'. The development of international standards is based on the results related to science, technology and experience. The ISO 9001 is a generic standard and, as such, it can be implemented in all organizations regardless of their size, activities or organization method. The ISO 9001 standard defines quality management system requirements, but fails to define the method an organization should or could use to meet such requirements. Sukhija (2009) indicates that ISO 9001 standard enables companies to create their own quality management systems.

Basic idea followed by the authors of ISO 9001 standard is that, in order to successfully manage an organization, it is to be managed and run systematically and transparently. Eight principles of the Quality Management System standards (QMSs) ISO 9001 are the following: customer focus, leadership, involvement of people, a process approach, a system approach to management, continual improvement, a factual approach to decision making and mutually beneficial supplier relationships (ISO, 2005). Based on ISO 9001 (ISO, 2009):

- *customer focus* typically leads to ensuring a balanced approach between satisfying customers and other interested parties
- *leadership* typically leads to: considering the needs of all interested parties; creating and sustaining shared values; fairness and ethical role models at all levels of the organization; establishing trust and eliminating fear, providing people with required resources; training and freedom to act with responsibility and accountability; inspiring, encouraging and recognizing people's contributions.
- *involvement of people* typically leads to people freely sharing knowledge and experience and openly discussing problems and issues.
- *a process approach* typically leads to evaluating risks, consequences and impacts of activities on customers, suppliers and other interested parties.
- *continual improvement* typically leads to providing people with training in the methods and tools of continual improvement.
- *a factual approach to decision making* typically leads to ensuring that data and information are sufficiently accurate and reliable.

ISO 9000 series standards present useful guide for (Thorpe & Sumner, 2004): clarification on what quality management includes, system approach and process approach in the organization management, development of policy and objectives of quality, defining the top management role within the quality management system, defining the importance and types of documentation used in the quality management

process, relations with other management systems and basis for relations between the quality management system and the excellence module.

Contemporary certification is a procedure in which the 'third party', certification body (registrar), issues a document (certificate) confirming that a product, process or management system meets the necessary requirements (Hesser, Feilzer & De Vries, 2007). The quality management system certification proves that the organization is provided with the whole, consistent and (sufficiently) well documented quality management system. Certified quality management system does not necessary means that the organization provides high quality products or services. The certification is voluntary and is under no power by the International Organization for Standardization ISO. The organization may decide to implement the quality management system according to the requirements of ISO 9001 standard, but not to adhere to certification of its own quality management system.

2. OVERVIEW OF LITERATURE ON FORMALIZATION OF AN ORGANIZATION

Even though the formal process of adopting ISO standards is widely accepted and well-known method of formalization of an organization, it is not the only one. According to Mintzberg, there are three ways to increase formalization within an organization (Mintzberg, 1979): **Formalization by job**, where the specifications refer to work performed by an employee at the specific work position, which results in more precise ***job descriptions***; **Formalization by work flow**, where the specifications refer to the work activity process, which results in more precise description of ***standard work procedures***; and **Formalization by general rules**, where the specifications refer to general instructions and regulations not specially aimed at job descriptions or standard work procedures, which results in ***general regulations***, such as dress codes at work or rules of using the internal forms. Standards used to achieve the above mentioned practically may be but don't have to be in written form. Right example may be an organization with specific ethical behavior standard – even though the standard is not written, everyone is aware of it, it is always being communicated and applied in practice in the same way, and therefore behavior related to ethical issues within an organization is formalized (Burton, 2011). Jones (2000) specifies six principles that may help us recognize highly formalized organizations: Duties, responsibilities and deciding authorities are clearly defined; Rules, standard work procedures, job descriptions and norms are used for the control of behavior and relations between roles within an organization – logic of suitability dominates in the organization; Formalized organizations are based on a principle of legitimate rational authority; Organizational positions are filled based on technical competencies of workers, and not based on social status, friendships or inheritance; Positions within an organization are organized hierarchically so the inferior position is controlled and supervised by the superior one; Administrative decisions and rules are created in written form.

3. RESEARCH HYPOTHESIS AND METHODS

Subject of analysis presented hereafter refers to restructuring enterprises in Serbia, and the aim of the analysis was determination of correlation between holding a certificate of conformity with ISO 9001 standard and business results achieved by such enterprises. Taking that into consideration, we can present the base hypothesis of this paper **H1**: There is statistically significant difference in business quality measured in income per employ between a group of restructuring enterprises holding ISO 9001 standard certificate and a group of enterprises with no ISO 9001 certificate.

For collecting data on restructuring enterprises in Serbia we used the data issued by the Privatization Agency and the Business Registers Agency. Using the documentation analysis method, we have selected relevant data for our analysis. Based on the collected data, there are currently 178 enterprises in restructuring process in the Republic of Serbia.

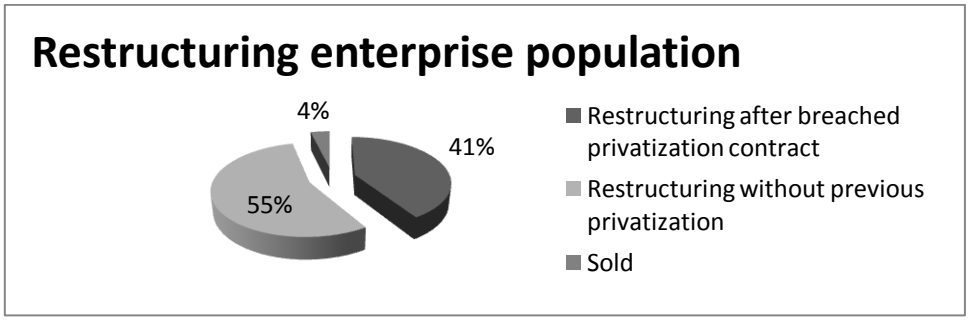

Figure 1: Restructuring enterprises according to 2013 data

Total of 76 enterprises have entered the restructuring process following the termination of privatization contract, whereas the rest of enterprises have never been privatized. Only 7 of the restructuring enterprises have been sold, 3 of which are in business today, whereas 4 have gone bankrupt.

4. RESULTS

Collected data have firstly been analyzed by descriptive statistics method, following the exclusion of enterprises outliers from the population, with annual profit per employee exceeding RSD 30 million, and annual loss per employee exceeding RSD 30 million. Based on the assumption that, due to size of the sample following the exclusion of outliers (N = 168), the observed parameter is normally distributed, such collected data are later analyzed by parametric methods.

Data presented in figure 2 indicates the number of restructuring enterprises in Serbia meeting ecological requirements under law, as well as whether an enterprise holds certificate of quality management system in accordance with ISO 9001. It is clear that the highest number of enterprises meets the ecological requirements, whereas a few enterprises hold ISO 9001 certificate. Considering the fact that certain number of enterprises failed to meet ecological requirements, it can adversely affect them in terms of attracting investors.

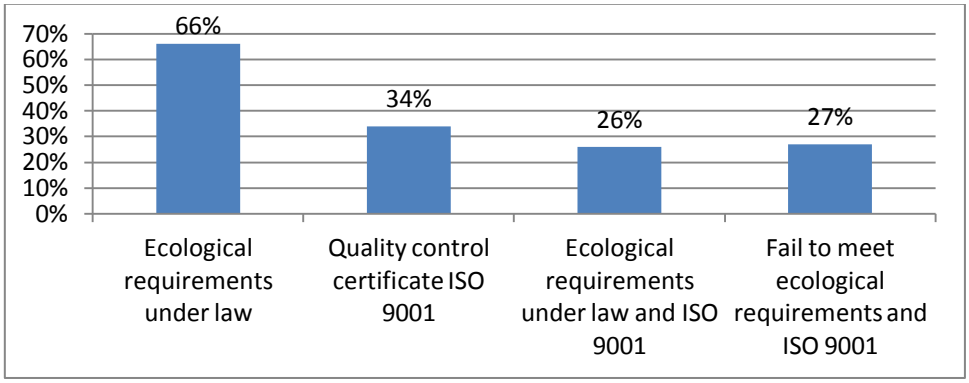

Figure 2: Having a certificate and meeting ecological requirements

Table 1 indicates descriptive statistics of the observed enterprise population. As indicated, intermediate values as well as standard deviations of income per employee are always higher in the previous three years in restructuring enterprises holding ISO 9001 certificate.

Table 1: Descriptive statistics

Indicator / Holding ISO 9001 certificate		N	Intermediate Value	Standard Deviation	Standard Deviation – Intermediate Value
2010 income per employee (in RSD 000)	No	109	1004.35	1862.33	178.38
	Yes	57	1953.58	3489.94	462.25
2011 income per employee (in RSD 000)	No	109	1041.38	1510.78	144.71
	Yes	57	1720.68	2836.13	375.65
2012 income per employee (in RSD 000)	No	108	1141.22	1543.60	148.53
	Yes	57	1721.44	2040.04	270.21
Income per employee (in RSD 000) 2010-2012	No	108	3205.52	4597.48	442.39
	Yes	57	5395.71	7748.97	1026.37

Table 2 provides parametric statistics analysis of intermediate values for income per employee in the past three years, as well as three-year period in total. F statistics value in the first column regarding the income per employee in 2010 indicates that the observed parameter has no equal variance in the two observed groups of enterprises, and in the relevant column the t statistics value of -1.92 with significance of .059 indicates that we may not claim statistically significant differences ($p<0.05$), but we can do that with $p<0.1$, which practically means that there are 10 or less percent of probability that our results were produced as a consequence of coincidence. The following two columns providing monthly income per employee in 2011 and 2012, as well as the fourth column providing collective indicator for three relevant years, all have the F statistics value referring to equal variances in parameter values in enterprise groups with and without ISO 9001 certificate, whereas values and significance of t-statistics indicate statistically significant difference in

parameters ($p<0.05$) in all of the three observed cases. Thus, it could be concluded that the hypothesis **H1** stated at the very beginning of the paper has been proved.

Table 2: t-test of intermediate values of income per employee

Levene's Test of Variances			T-Test for Equality of Intermediate Values						
	F	Sig.	t	Degrees of Freedom	Sig.(2-side)	Difference in Intermediate Values	Difference in standard deviations	95% of Confidence Interval	
								Bottom	Top
2010 income per employee - Assumed difference in variances	8.74	.00	-1.92	73.08	.059	-949.23	495.48	-1936.70	38.23
2011 income per employee- Assumed equality of variances	1.69	.195	-2.02	164	.045	-679.30	336.96	-1344.64	-13.95
2011 income per employee - Assumed equality of variances	.596	.441	-2.05	163	.042	-580.23	283.28	-1139.59	-20.85
Income per employee2010-2012 Assumed equality of variances	2.338	.128	-2.28	163	.024	-2190.19	961.68	-4089.15	-291.23

5. DISCUSSION AND CONCLUSIONS

Holding a certificate of conformity with ISO 9001 standard is not legally binding but does present certain advantage. When exporting or entering foreign market, domestic enterprises often feel the need to implement this standard and have ISO 9001 certificate. On the other hand, as previously indicated (Mijatović, Čudanov & Jaško 2012), standardization and formalization in organizations is not necessarily limited by certification motives according to the international standard requirements. In order to find solution for matching problems organizations might consider other ways of standardization - ad-hoc de-facto standardization (de Vries, 1999; Hesser, Feilzer & De Vries, 2007; de Vries, 2010) can be one of the possibilities. The obtained results indicate that business of the enterprises holding formal certificate ISO 9001 as measured in income per employee is better compared to the group of enterprises with no ISO 9001 certificate. The results are statistically significant ($p<0.05$), except for the 2010 records with $p<0.1$. Conclusion that may be reached is that better regulated organizations, having progressed with the restructuring process and obtaining higher income per employee tend to enter the quality management system certification process according to the ISO 9001 requirements. Considering the fact that according to the ISO 9001 requirements quality management system fosters engaging all of the employees within an organization, it may result in higher value generated by the employees. On the other hand, information and methods used in this paper fail to provide the possibility for the noticed relationship between the formal ISO 9001 certification and income per employee in a restructuring enterprise to be interpreted as causality in any direction. In the following researches special attention is to be paid to other factors indicating a relationship between a restructuring enterprise business performances and certification according to the standard ISO 9001.

LITERATURE

Blokdijk, G. (2008). ISO 9000 ISO 9001 100 Success Secrets; The missing ISO 9000 ISO 9001 ISO 9001 2000 ISO 9000 2000 Checklist, Certification, Quality, Audit and Training. Australia: Emereo Publishing.

Burton, J., Obel, B., &DeSanctis, G. (2001). Organizational Design: A Step-by-Step Approach. New York: Cambridge University Press.

Dahlgaard, J.J., Kristensen, K., & Kanji, G.K. (2007). Fundamentals of Total Quality Management. London & New York: Taylor & Francis

De Vries, H. (1999). Standardization – a Business Approach to the Role of National Standardization Organizations. Hamburg, Germany: Kluwer Academic Publishing

De Vries, H. J. (2011). Implementing Standardization Education at the National Level (March 19, 2011). ERIM Report Series Reference No. ERS-2011-007-LIS. Available at: http://ssrn.com/abstract=1795817 [last accessed 30th Sept.2013]

European Committee for Standardization (2013). Glossary. Available at: http://www.cen.eu/boss/Pages/glossary.aspx#s [last accessed 30th Sept.2013]

Heleta, M. (2008). Menadžment kvaliteta. Beograd: Univerzitet Singidunum.

Hesser, W. & Inklaar, A. (1998). An Introduction to Standard and Standardization. Germany: DIN, Deutches Institut fur Normung
Hesser W., Feilzer A & De Vries H. (Ed.) (2007). Standardization in Companies and Markets Hamburg: USA: Helmut Schmidt University
International Standardisation Organisation (ISO):2009, Management system standards - cathalog, Retrieved June 10,2011, from http://www.iso.org/iso/iso_catalogue/management_standards/
SRPS ISO 9000:2007 (2007), Sistemi menadžmenta kvalitetom – Osnove i rečnik, Beograd, Srbija:Institut za standardizaciju Srbije
Jones, G.R. (2000). Organizational Theory Design and Change. Upper Saddle River, USA: Prentice Hall
Kresse, W., &Fadaie, K. (2004). ISO Standards for Geographic Information. Germany: Springer – Verlag Berlin Heidelberg New York
Mintzberg, H. (1979). The Structuring of Organizations: A Syntesis of the Research. New Jersey: Prentice Hall
Mijatović, I., Čudanov, M. & Jaško O. (2012), Development of Co-Operation Based Company Standards - Case of Inovative Practice in Public Service Companies. Proceedings of the XIII International Symposium SymOrg 2012 - Innovative Management and Business Performance. ISBN 978-86-7680-255-5. June 5 - 9, 2012, Zlatibor, Serbia pp. 1641-1648
Pfiefer, T. (2002). Quality Management: Strategies, Methods, Tehniques. Germany: Carl Hanser Verlag
Ping, W. (2011). A Brief History of Standards and Standardization Organizations: A Chinese Perspective. Hanolulu: East-West center
Singhal, D., & Singhal, K.R. (2008). ISO 9001: 2000 Quality Management System: A Reference Guide. New Delhi: PHI Learning Private Ltd.
Sukhija, R. (2009). Quality Management: An Excellence Model. New Delhi: Global India Publication Pvt Ltd.
Thrope, B., & Summer, P. (2004) Quality Management in Construction. Burlington, USA: Gower publishing Company

ANALYSIS OF THE EXPERIENCES IN THE IMPLEMENTATION OF AN INTEGRATED MANAGEMENT SYSTEM

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Abstract: *In addition to quality, enterprises give more and more attention to aspects such as environment, occupational health and safety, food safety and other management systems. Addressing all the relevant stakeholders' concerns, many enterprises have implemented integrated management system (IMS) in order to overcome the problems resulting from multiple management systems, to create competitive advantages and to achieve sustainable development.*

This paper aims to examine and compare both benefits and problems that are expected from implementation of an integrated management system (IMS) for enterprises. The benefits and problems were generated through analysis of experiences in the implementation of integrated management system pointed out in literature by different authors in this field. Additionally, benefits and problems that were practically proved are singled out from those that are stated as author's opinion or expectation. This examination and comparison can give a valuable insight into overall effectiveness of integrated management system implementation.

Keywords*: integrated management system, benefits, difficulties*

1. INTRODUCTION

Globalization and increased focus on sustainable development bring in new stakeholders and their needs that enterprises need to satisfy (Abrahamsson et al., 2010). In order to satisfy stakeholders' needs and thus create competitive advantages and achieve sustainable development, many organizations have implemented quality (ISO 9001), environmental (ISO 14001) and occupational health and safety (OHSAS 18001) management systems, which has become a widespread practice around the world in recent years (Esquer-Peralta et al., 2008; Jørgensen et al., 2006; Rocha et al., 2007). To meet these requirements, each management system demands a lot of documentation, written procedures, checking, control forms and other paperwork (Karapetrovic & Jonker, 2003). In practice, it has been proved that it is difficult to handle separate management systems, where the major problems for organizations to operate multiple management systems are complexity of internal management, lowering of management efficiency, incurring cultural incompatibility, causing employee hostility, and increasing management costs (Zeng et al., 2007). Undoubtedly, at the operational level, organizations strongly desire to integrate these systems, due to not only these difficulties encountered in managing different management systems separately, but also because of the important advantages gained from the integration. Hence, there is a trend towards implementing an integrated management system (IMS) (Jørgensen, 2008; Salomone, 2008). Integration normally leads to a strong and comprehensive management system (Karapetrovic & Jonker, 2003). Different management systems which have similar implementation procedures should be integrated to improve performance (Wilkinson & Dale, 1999). As it is stated by Zutshi & Sohal (2005), the imperative is to integrate management systems to one system in order to achieve full realization of the potential benefits of each individual system. Many empirical studies have documented the benefits and problems achieved by companies that implemented an integrated management system. The general impression from studies carried out is that there are more benefits than downsides and problems when management systems are integrated (Karapetrovic, 2002).

2. MANAGEMENT SYSTEMS INTEGRATION

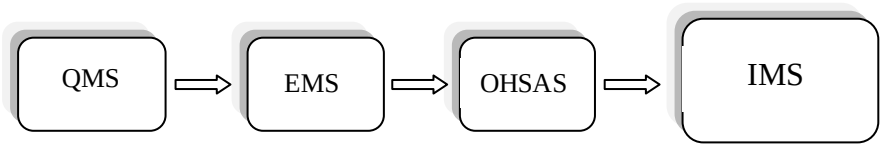
According to Karapetrovic (2003), an integrated management system is conceptually seen as a set of interrelated processes that share the same resources (personnel, information, materials, infrastructure and finance), to achieve goals aimed at meeting numerous of stakeholders' needs. Therefore, anything that could affect operating results and stakeholder satisfaction has to be within the system. Hence, the IMS should integrate all the current formalized systems that focus on quality, environment, occupational health and safety, food safety etc.

Implementation of IMS can be carried out through two approaches of integration (Zivkovic et al., 2010):

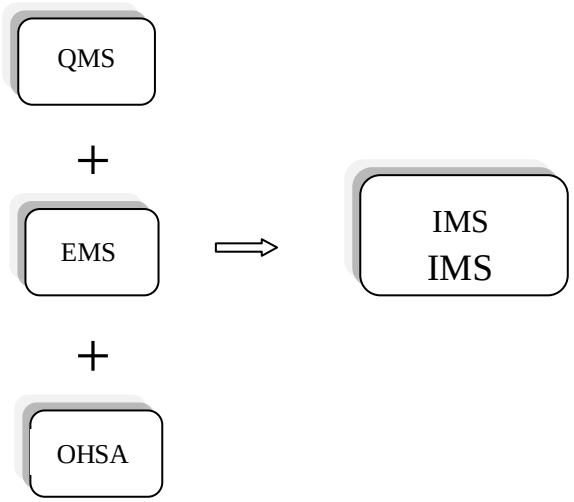
- Integration of requirements of different standards,
- Integration of management systems.

Integration of requirements of different standards is conducted through the consideration of similar or compatible requirements of different standards and integration of one part of documentation in the IMS. This approach involves consideration of the common requirements of the standards as the basis for design and implementation. It is possible, within this approach, to distinguish three approaches:

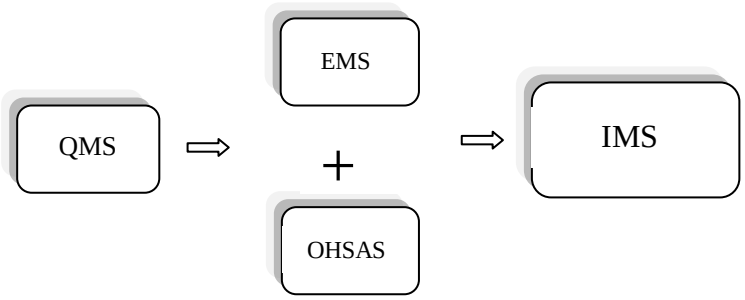
Sequential approach - involves successive application of different management systems - management system is established first, then other management systems are establish, one by one:



A parallel approach - refers to the simultaneous application of two or more management systems:



A combined approach - a combination of the previous two approaches - two or more management systems are upgraded to the already implemented management system:



Integration of management systems is carried out through the identification of requirements of various stakeholders and then through analysis of products and processes of designing and integrating these systems into the existing management system. The basis of this approach is stakeholders' requirements, system approach and the existing management system of the company.

If the company decides to integrate management systems, it is necessary to decide to what extent, that is, to choose the level of integration, which depends on the complexity of the existing management system and reasons for the integration. There is no unique level of integration model that could be applied, but many authors have defined different levels of integration. It is shown in Figure 1, where the level 0 means that there is no integration, and level 3 means the full integration.

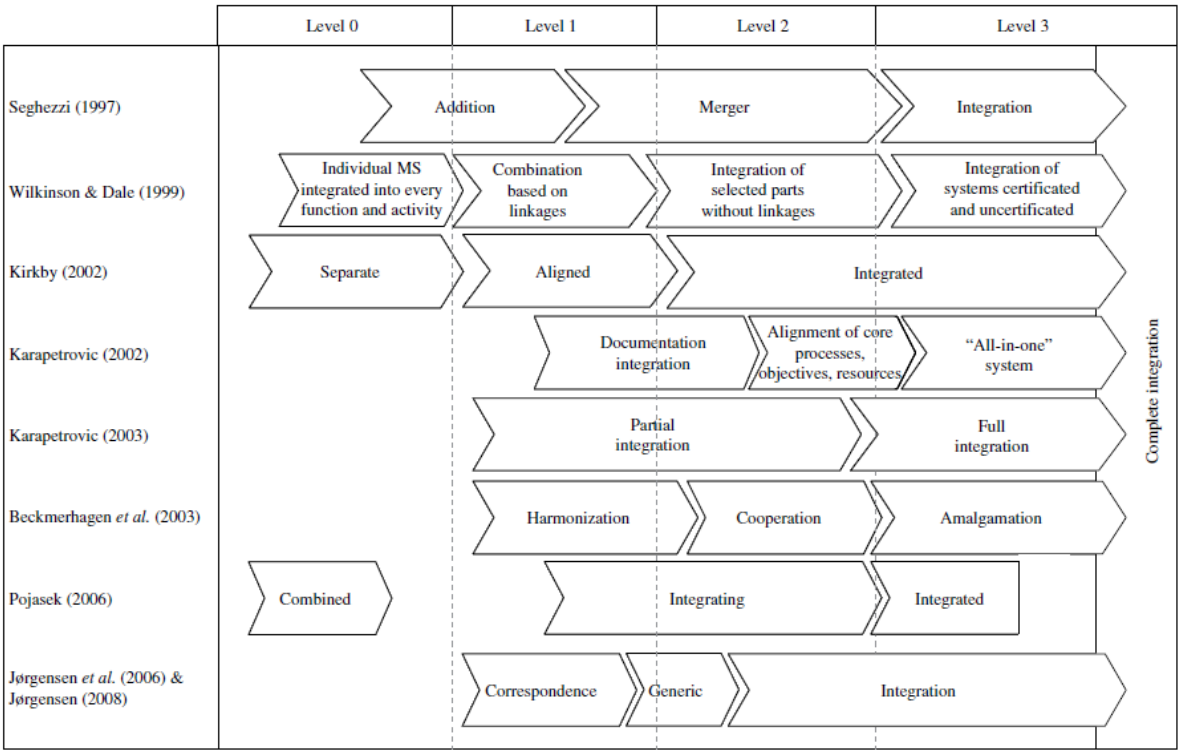


Figure 1: Levels of integration according to different authors (Bernardo et al., 2009)

Generally, there are the following three levels of integration (Zivkovic, 2012):

- The highest level - Implementation of the requirements of management systems into the existing management system of organizational system. Recognizes the existence of management systems as a basis for full integration.
- Intermediate level - Implementation of requirements of standards and designing the relevant management system of organizational system that does not recognize the existence of the management system and leads toward two parallel management systems.
- The lowest level - A variation of the previous levels of integration that is deepened in the case of the further implementation of requirements of other standards. Involves the implementation of the requirements of the relevant standard and design of observed management system, with or without its integration with existing, pre-designed management system. Does not recognize the existence of basic management system and usually leads to several parallel management systems.

Organizations decide to integrate management systems because of a number of reasons. The list of advantages and difficulties of IMS implementation is given below.

3. BENEFITS AND DIFFICULTIES IN MANAGEMENT SYSTEMS INTEGRATION

The purpose of this paper is to make an overview of benefits and difficulties in integration of management systems. We have drawn this overview from the existing literature on the subject. Table 1 shows the benefits of IMS as perceived by different authors, while difficulties in integration are presented in Table 2.

All the benefits, drown out the existing literature, could be classified into six groups: improvement of processes effectiveness and efficiency, improvement of human resources management, improvement of relations with stakeholders, improvement of the company's reputation, competitive advantage and market share increase, more comprehensive compliance with laws. It is obvious from the table that the first group of benefits (improvement of processes effectiveness and efficiency) is the most cited.

Table 1: Benefits of IMS implementation

Benefits		Supporting literature
Improvement of processes effectiveness and efficiency	Lower operating costs	Brecka (1994), Terziovski et al. (2003), Casadesus and Karapetrovic (2005), Karapetrovic et al. (2010), Moljevic et al. (2013), Suditu (2007)
	Decreased management cost	Zeng et al. (2011), Olaru et al. (2014), Moljevic et al. (2013)
	Reduced wastage	Brecka (1994), Terziovski et al. (2003), Casadesus and Karapetrovic (2005), Karapetrovic et al. (2010), Moljevic et al. (2013)
	Decreased paperwork	Zeng et al. (2011), Olaru et al. (2014), Moljevic et al. (2013)
	Time saving	Olaru et al. (2014)
	Improved efficiency and productivity	Brecka (1994), Terziovski et al. (2003), Casadesus and Karapetrovic (2005), Karapetrovic et al. (2010), Asif et al. (2010), Olaru et al. (2014)
	Decreased complexity of internal management	Zeng et al. (2011), Olaru et al. (2014), Moljevic et al. (2013)
	Simplified certification process	Zeng et al. (2011), Olaru et al. (2014), Moljevic et al. (2013)
	Facilitates continuous improvement	Zeng et al. (2011), Olaru et al. (2014), Moljevic et al. (2013)
	Clearer responsibilities and relationships	Olaru et al. (2014)
Improvement of relations with stakeholders		Moljevic et al. (2013), Suditu (2007), Asif et al. (2013)
Improvement of human resources management	Increase in employee motivation, awareness and qualifications	Moljevic et al. (2013), Suditu (2007)
Improvement of the company's reputation	Improvement of company's image	Moljevic et al. (2013), Suditu (2007), Asif et al. (2013)
	Creation of a better company image among employees	Moljevic et al. (2013), Suditu (2007), Asif et al. (2013)
Competitive advantage and market share increase	Competitive advantage	Moljevic et al. (2013), Suditu (2007), Asif et al. (2013)
	Improvement of market place	Moljevic et al. (2013), Suditu (2007), Asif et al. (2013)
	Gained new customers/higher satisfaction of existing ones	Moljevic et al. (2013), Suditu (2007), Asif et al. (2013)
More comprehensive compliance with laws	Better evidence of legal compliance	Moljevic et al. (2013), Suditu (2007), Asif et al. (2013)

Problems that may arise in the integration process can be related to two phases: problems that arise during IMS designing, and problems that arise during IMS implementation, where both the phases carry similar number of problems.

Table 2: Difficulties in IMS implementation (adopted from Asif et al., 2009)

Difficulties		Supporting literature
Problems in IMS designing	Unavailability of formal standard for integration of management systems	Labodova (2004)
	Unavailability of common denominator (common characteristics)	Karapetrovic (2002)
	Different scope of individual systems	Wilkinson and Dale (2001), Zeng et al. (2007)
	Different structure of individual systems	Karapetrovic (2002), Seghezzi (2000)
	Lack of understanding of the relevant individual management system	Karapetrovic (2002), Bernardo et al. (2008)
	Risk of not assigning the right level of importance to each function (such as quality, environment, and health and safety)	Salomone (2008)
	Misunderstanding of integration concepts	Salomone (2008), Wilkinson and Dale (2001)
Problems in IMS implementation	Employees' resistance during integration (due to loss of individual functions)	Karapetrovic (2002), Matias and Coelho (2002), Zutshi and Sohal (2005)
	Inadequate audit methodologies	Karapetrovic (2002)
	Reduced flexibility	Crowe (1992)
	Insufficient financial resources	Zutshi and Sohal (2005)
	Lack of information and knowledge of how to integrate systems	Salomone (2008), Zeng et al. (2007), Zutshi and Sohal (2005)
	Cultural aspects (requires cultural transformation)	Jorgensen et al. (2005), Wilkinson and Dale (1999), Zeng et al. (2007)
	Lack of human resources	Asif et al. (2009), Simon et al. (2012)
	Lack of motivation	Asif et al. (2009), Simon et al. (2012)

4. CONCLUSION

The analysis shows that organizations which implemented IMS gain significant operational, financial and marketing benefits. IMS integrates all business components in order to reduce documentation, to reduce costs, to increase profitability, to eliminate problems of responsibilities and relationships, to direct focus on business goals, to improve internal and external communication, to facilitate the process of training and to increase competitiveness.

Although ISM implementation can bring in many advantages, it is very important for companies to be aware of the possible problems that can occur within the process of integration. Thus, the analysis also points out the difficulties which organizations should take into consideration before processing standard integration. These difficulties are related to the risk of creating parallel system separately, excessive documentation, different scope of individual systems, insufficient financial resources, etc.

Highlighting benefits and problems in IMS implementation can give a basis for improvement of integration process of management systems, such as quality management systems, environmental management systems, occupational health and safety management systems (ISO 9001, ISO 14001, OHSAS 18001) and etc.

REFERENCES

Abrahamsson, S.,Hansson, J., & Isaksson, R. (2010). Integrated Management Systems – advantages, problems and possibilities, 13th Toulon-Verona Conference

Asif, M., Bruijn, E.J.D., Fisscher, O.A.M., Searcy, C., & Steenhuis, H.J. (2009). Process embedded design of integrated management systems. International Journal of Quality & Reliability Management, 26(3), 261-282.

Asif, M., Fisscher, O.A.M., Joost de Bruijn, E., & Pagell, M. (2010). An examination of strategies employed for the integration of management systems. The TQM Journal, 22(6), 648-669.

Asif, M., Searcy, C., Zutshi, A., & Fisscher A.M.,O. (2013). An integrated management systems approach to corporate social responsibility. Journal of Cleaner Production, 56 (1), 7-17.
Beckmerhagen I, Berg H, Karapetrovic S, & Willborn W. (2003). Integration of management systems: focus on safety in the nuclear industry. International Journal of Quality and Reliability Management 20(2), 209–227.
Bernardo, M., Casadesus, M., Karapetrovic, S., & Heras, I. (2009). How integrated are environmental, quality and other standardized management systems? An empirical study. Journal of Cleaner Production, 17(8), 742–750.
Bernardo, M., Casadesus, M., Karapetrovic, S., & Heras, I. (2008). Management systems: Integration degrees empirical study. Proceedings of the 11th Quality Management and Organizational Development Conference, Helsingborg, Sweden
Brecka, J. (1994). Study finds that gains with ISO 9000 registration increase over time. Quality Progress, 27(5), 18-20.
Casadesus, M., & Karapetrovic, S. (2005). The erosion of ISO 9000 benefits: a temporal study. International Journal of Quality and Reliability Management, 22(2),120-136.
Crowe, T.J. (1992). Integration is not synonymous with flexibility. International Journal of Operations & Production Management, 12(10), 26-33.
Esquer-Peralta, J., Velazquez, L., & Munguia, N. (2008). Perceptions of core elements for sustainability management systems (SMS). Management Decision, 46(7), 1028–1037.
Jørgensen, T.H. (2008). Towards more sustainable management systems: Through life cycle management and integration. Journal of Cleaner Production, 16(10), 1071–1080.
Jørgensen, T.H., Remmen, A., & Mellado, M.D. (2005). Integrated management systems – three different levels of integration. Journal of Cleaner Production, 14(8), 713-22.
Jørgensen, T.H., Remmen, A., & Mellado, M.D. (2006). Integrated management systems-three different levels of integration. Journal of Cleaner Production, 14(8), 713–722.
Karapetrovic, S. (2002) Strategies for the integration of management system and standards. The TQM Magazine, 14(1), 61-67.
Karapetrovic, S. (2002). Strategies for the integration of management systems and standards. The TQM Magazine, 14(1), 61-7.
Karapetrovic, S., & Jonker, J. (2003). Integration of standardized management systems: Search for a recipe and ingredients. Total Quality Management and Business Excellence, 14(4), 451–459.
Karapetrovic, S., Casadesus, M., & Heras, I. (2010). What happened to the ISO 9000 lustre? An eight-year study. Total Quality Management & Business Excellence, 21(3), 245-267.
Kirkby A. The one-stop shop. Qualityworld; January 2002. p. 2–4
Labodova, A. (2004). Implementing integrated management systems using a risk analysis based approach. Journal of Cleaner Production, 12(6), 571-80.
Matias, J.C.D.O., & Coelho, D.A. (2002). The integration of the standards systems of quality management, environmental management, and occupational health and safety management. International Journal of Production Research, 40(15), 3857-66.
Moljevic, S., Rajkovic, D., Maric, B., Medakovic, V., & Djurdjevic, S. (2013). Integrated Systems Management in Small and Medium Enterprises. Annals Of Faculty Engineering Hunedoara – International Journal Of Engineering, Tome XI, Fascicule 4, ISSN 1584-2673.
Olaru, M., Maier, D., Nicoara, D., & Maier, A. (2014). Establishing the basis for development of an organization by adopting the integrated management systems: comparative study of various models and concepts of integration. Procedia - Social and Behavioral Sciences, 109 (2nd World Conference on Business, Economics and Management), 693 – 697.
Pojasek R. (2006). Is your integrated management system really integrated? Environmental Quality Management, 16(2):89–97
Rocha, M., Searcy, C., & Karapetrovic, S. (2007). Integrated sustainable development into existing management systems. Total Quality Management & Business Excellence, 18(1/2), 83–92.
Salomone, R. (2008). Integrated management systems: experiences in Italian organizations. Journal of Cleaner Production, 16(16), 1786-806.
Salomone, R. (2008). Integrated management systems: Experiences in Italian organizations. Journal of Cleaner Production, 16(6), 1786–1806.
Seghezzi H. (1997). Business concept redesign. Total Quality Management, 8(2&3), 36–43.
Seghezzi, D. (2000). Total management systems – why and how. Proceedings of 44th European Quality Congress, Budapest.
Simon, A., Karapetrovic, S., & Casadesu´s, M. (2012). Difficulties and benefits of integrated management systems. Industrial Management & Data Systems, 112(5), 828-846.
Suditu, C. (2007). Positive and negative aspects regarding the implementation of an integrated quality, environment, health, and safety management system. Annals of the Oradea University, Fascicle of Management and Technological Engineering, Volume VI (XVI).

Wilkinson, G., & Dale, B.G. (1999). Integrated management systems: an examination of the concept and theor. The TQM Magazine, 11(2), 95-104.
Wilkinson, G., & Dale, B.G. (2001). Integrated management system: a model based on total quality approach. Managing Service Quality, 11(5), 318-30.
Wilkinson, G., & Dale, B.G. (1999). Integrated management systems: An examination of the concept and theory. The TQM Magazine, 11(2), 95–104.
Wright, T. (2000). IMS – three into one will go! The advantages of a single integrated quality, health and safety, and environmental management system. The Quality Assurance Journal, 4(3), 137-42.
Zeng, S.X., Shi, J.J., & Lou, G.X. (2007). A synergetic model for implementing an integrated management system: an empirical study in China. Journal of Cleaner Production, 15(18), 1760-7.
Zeng, S.X., Shi, J.J., & Lou, G.X. (2007). A synergetic model for implementing an integrated management system: An empirical study in China. Journal of Cleaner Production, 15(18), 1760–1767.
Zeng, S.X., Xie, X.M., Tam, C.M., & Shen, L.Y. (2011). An empirical examination of benefits from implementing integrated management systems (IMS). Total Quality Management & Business Excellence 22 (2), 173-186.
Zivkovic, N. (2012). Integrisani sistemi menadžmenta. Elektronsko izdanje.
Zivković N., Mijatović I., Janićijević I. (2010). The Role of Design and Development Process in Integration of Management Systems, et al., Technics Technologies Education Management, 5(1), 88-99
Zutshi, A. & Sohal, A.S. (2005). Integrated management system – The experience of three Australian organisations. Journal of Manufacturing Technology Management, 16(2), 211-232.
Zutshi, A. and Sohal, A.S. (2005). Integrated management system: the experiences of three Australian organisations. Journal of Manufacturing Technology Management, 16(2), 211-32.

CONCEPTS OF STANDARDS AND STANDARDISATION IN PUBLIC ADMINISTRATION JOURNALS

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Abstract: We examined the ways how ISO and other standards were used in papers published in four leading journals of public administration and analyzed perceptions of these standards by scholars. Results of our study show that they rarely use the concept of management system standards in researches published in journals of public administration, which particularly stands for ISO standards (ISO 9000, ISO 14000, ISO 26000, ISO 27000 and other ISO standards families). Specific standards were mentioned in very few articles, generally without greater importance assigned. One of the possible reasons for this is that the practitioners have been less introduced with standards or they simply do not understand the role and benefits of ISO and other management system standards in public administration. This paper also presents examples of the most commonly used terms, related to standards in journals of public administration.

Keywords: *standards, management system, standardization, public administration, journals*

1. INTRODUCTION

Public administration is "often regarded as including also some responsibility for determining the policies and programs of governments. Specifically, it is the planning, organizing, directing, coordinating, and controlling of government operations."[1] M. Holcer (2011) defined public administration as information and implementation of public policy. There are four values that are fundamental to understanding the administrative systems: political responsiveness, organizational efficiency and effectiveness, individual rights, and social equity. (Murray, 2006) Public administration is the management of affairs of the government at all levels-national, state and local. (Basu, 2004)

Since public administration is the only study that studies government in all its aspects (and not just from disciplinary defined angles), it is fundamentally an umbrella discipline. Public administration's object of study, government, is also of interest to scholars in other social sciences, to political officeholders, to career civil servants, to corporate executives, and to citizens.".(Raadschelders, 2011)

The ISO standards (ISO 9000, ISO 14000, ISO 26000, ISO 27000 etc.) are widely implemented in public institutions in all countries but results show that scholars have less believed in standards or they simply do not understand the role of standards as "de facto" or "de jure" standards. It could be a new hypothesis for researches. We also analyzed other "de facto" standards (Standardization carried out by parties other than Formal Standardization Organizations (Hesser W., 2007)) but the results were not much different. "The aim of ISO is to promote the development of uniform standardization so as to achieve a situation in which goods and services can be exchanged freely on an international level" (Hesser W., et. al, 2007).

The aim of this paper is to analyse of presence of term of standard and provide key insight in scholar's perception of standards. Paper is organised in three main parts: research methodology including data collection and data analysis. An analysis was performed to understand the perception of standards by scholars.

2. CLASSIFICATION OF STANDARDS

De Vries (1999) cited, in Hesser W. (2008), classified standards as: basic standards; requiring standards; and measurement standards. Basic standards provide general descriptions and requiring standards define requirements for an entity or relations between entities. Measurement standards provide methods to be used in checking whether the criteria given in requiring standards are met. In this category, requiring standards

[1] http://www.britannica.com/EBchecked/topic/482290/public-administration prezeto 17.08.2012

include: compatibility standards; quality standards; and interference standards. Compatibility standards are used for fitting interrelated entities to one another to enable them to function together; quality standards define the requirements for entity properties to have minimum levels of quality; and interference standards set requirements regarding the influence of an entity on other entities such as safety, health and environmental requirements.
The ISO standards (ISO 9000, ISO 14000, ISO 26000, ISO 27000 etc.) are widely implemented in public institutions in all countries but results show that scolars have less believed in standards or they simply do not understand the role of standards as “de facto” or “de jure” standards. It could be a new hypothesis for researches. Authors also analyzed other “de facto” standards (Standardization carried out by parties other than Formal Standardization Organizations (Hesser W. 2007)) but the results were not much different. “The aim of ISO is to promote the development of uniform standardization so as to achieve a situation in which goods and services can be exchanged freely on an international level” (Hesser W. et. al, 2007).

3. RESEARCH METODOLOGY

3.1 Data Colection

Subjects of work were the electronic articles of public administration and the Internet browser was a main tool for researching. The data were collected from the Internet using KOBSON browser, and relevant papers were published between 2000 and 2013. Key search words were: standard, stadndardization and ISO. All 67 papers used in analysis are from the four leading journals of public administration which have impact factor greater than 0.9. including:

1. “Public adminstration” (IF=1,026)
2. “Public administration review” (IF= 0,9)
3. “Journal of Public Administration Research and Theory/J PART” (IF=1,951)
4. “Regulation and Governance” (IF=1,625)[2].

3.2 Data analysis

The articles are divided into three categories (Figure 1):

Category (I) The frequency of occurrence of word “standard”,
Category (II) Citing specific standards (refer to ISO or other standards) and
Category (III) The article is concerned with the certain standard

The idea was that the papers be classified into three categories depending on whether the word "standard" was only mentioned as part of the text without reference to a specific standard (n-number of words greater than 3). Second, if the article cited certan standard in any context (e.g. ISO). Third, if the whole paper examines the standard in any form. The articles published between 2000 and 2014 were taken into consideration.

4. RESULTS

It has been found that the practitioners didn’t explore and use standards, particularly ISO management system standards. The results are shown as the percentages in Figure 1, and Table 1 including descriptions of individual papers.

Table 1: Number of papaers used in analysis

Journal name	**Number of papers used in analysis [1]**	**[%]**
Public administration	33	49%
Public administration review	19	28%
Journal of Public Administration Research and Theory	10	15%
Regulation & Governance	5	7%
Total	**67**	**100%**

The results showed that researchers generally little studied standards in the journals of public administration. Because of that, it cannot be single out as the significant trend of occurrence of the term "standard" in the

[2] It should be noted that the authors of this study were analyzing only the articles that had been given access to over KOBSON portal. (www.kobson.nb.rs)

text. Therefore, we decided to comment on the individual papers, and to make some conclusions about scholar's perception of standard. The survey showed that most of the articles (61%) belonged to category (I), where the "standard" was mentioned in various contexts, including:

1. National/International standards (Rothstein, 2004) (Schrank, 2013);
2. Principles of standards (Brereton and Temple, 2002);
3. Service standard (Boyne, 2003);
4. Service standard initiative (Torres, 2005);
5. Standards of operation (Vigoda, 2000);
6. Quality standards/standards of quality (Schiavo, 2000), (Torres, 2005) (Verdun, 2012);
7. Set of standards (Karsten et. al, 2010);
8. Quality management standard (Macadam and Walker, 2003);
9. Standardized assessment tools;
10. Standard performance indicators;
11. Organizational standards;
12. Developing standard;
13. Certification standards (Doelle et. al, 2012);
14. Public standards (Allmendinger, 2003);
15. Standard operating procedures (William L. Waugh Jr., Gregory Streib, 2006);
16. Risk management standards (Rothstein, 2004) etc.

*Example of "service standard":"…perhaps because comprehensive data on local service standards have become available only in recent years" and "…inspectors' views about ability to improve were shaped by authorities *existing* service standards, as reflected in the core service performance scores." (Andrews et. al, 2005)

**Example of "standard of operation":" The environment of PA had started to change and called for establishing new standards of operation in the public services of western societies" (Vigoda, 2000)

***Example of "organizational standard": "Organizational standards or guidelines, although commonly applied in public sector organizations…" (Dahl, et. al 2006)

****Example of "developing standard": "Helen Gunter's criticism on our proposal for developing standards for the publication of school performance indicators…". (Karsten, Visscher, 2010)

*****Example of "certification standard": "Like other forest certification standards and hard law forest practice regulations, it allowed for on-the-ground flexibility with respect to how these outcomes were to be achieved". (Doelle et. al, 2012)

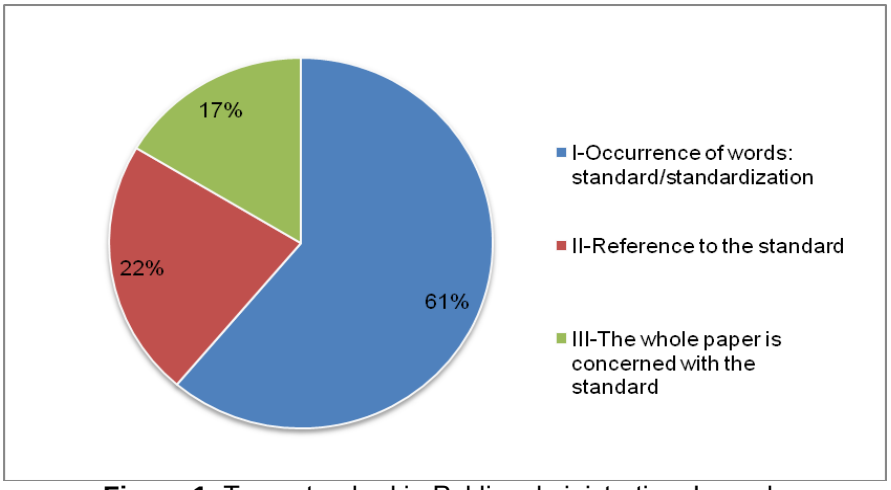

Figure 1: Term standard in Public administration Journals

This finding suggests that the individual practitioners have understood the concepts of standard and there were technical terms used in connection with standardization but it did not refer to any specific standard. It has showed that use of the term “standard” is popularized and these findings lead to the following conclusion: 1. Scholars are not familiar with the specific standards, 2. Scholars do not believe that certain system management standards (or other standards) are relevant. 3. Scholars perceive definition of "standard", in different ways. In the Table 2, it is shown that the scholar’s perception of standard is the highest in “Public administration” journal.

In the „Public administration“ journal, which dealt with the quality standards in public administration, was not included standard ISO 9001. The article showed „cultural differences in the usage of the concepts of servise quality standards between the UK experience and the Italian“ (Schiavo, 2000). In the whole paper, authors didn't mention any specific standard of management systems, especially, keeping in mind that in the same period of time it was the first edition of ISO 9001:2000.The same situation was in the article by L. Torres, 2005. There wasn’t any sign of ISO 9001 too.

The papers that mentioned a specific standard (II-Citing specific standards) have represented 22% of total, only 15 papers of total 67 analyzed. The most common were ISO (International Organization for Standardization) standards (Gunter, 2010), (Torres et. al, 2011) mainly ISO 9000 (Mcadam, Walker, 2003), (King et. al, 2004), (Milakovich, 2006), ISO 14000 (Doelle et. al, 2012), (Bovaird, Russell, 2007) and ISO 31000 (Ferreira Da Cruz, Marques, 2012) as far as the of management systems. This fact demonstrated that the knowledge of specific standards was used in the right context, but only as secondary/incidental information. (Milakovich, 2006) Also, it was mentioned that standards such as „The Food standards“ (Tomlinslon, 2010), (Schofield and Shaoul, 2000), (Rothstein, 2004), „Common Language Standard - CLS“-compatibility standards, (de facto standard) (Dahl, Hansen, 2006), standards of the National Committee for Quality Assurance (PCMH standards) (Klein et. al, 2013) and „de jure“ standards such as „NFPA 1600 - the international standard for emergency management programs“ and EMPA standards (Waugh Jr. and.Streib, 2006)

The last but not the least category is Category III-The article is concerned with the certain standard, where the authors dealt with standards in articles (17%). The one example was in paper by Korego et al., 2010, talking about how non-compliance with OSHA standards changes as an establishment undergoes repeated inspections and what the implications are for regulatory enforcement. It is about interference standards. It was one of the few papers in four analyzed papers which dealt with issues of non-compliance with the requirements of the U.S. standard, including inspection checks, as far as occupational injuries. Nor in this paper it didn’t mention occupational health and safety management system standard (OHSAS 18001).

Another example (Skov, 2006) was the article, which dealt with compatibility standards as a softer program and its speed of application, ie. standard diffusion through a certain period of time. This paper considered the speed of acceptance of this standard, depending on many factors, but it didn’t emphasize any certain standard, for example ISO 27001 (Information security management) which is necessary to support this standard due to successful diffusion. It is about compatibility standards. The same example is the article by Potoski, 2001, which studied competition for industrial development, creates a “race to the bottom” in which states relax their environmental standards to avoid losing businesses to states with more “business-friendly” regulations. The article presented the reasons why the states exceed the USEPA standard but it was interesting that nowhere was mentioned ISO 14000 standards (Environmental management). It is about interference standards

In another article (Karsten, 2010), the policy context of this development, in the education sector, is analyzed in conjunction with the problems associated with the public reporting of school performance indicators. This is followed by a discussion of the need for an accepted set of publication standards. The aim of this article is to initiate a debate about whether international consensus can be reached on the content of such a set of standards, and whether a particular set of standards is applicable in and relevant to other countries. This is the case where generic set of de facto standards is a model with the defined rules for writing “report cards” in primary schools. Likewise, there weren’t used any of management system standards (For example: ISO 9000, ISO 14000, ISO 26000, ISO 27001).

Also, there was one part of the article (Waught and Streib, 2006) where was mentioned NFPA 1600 standard (The international standard for emergency management programs). Autors said: „Standards have made it difficult for public officials to ignore the need to invest in programs to address hazards and these standards have also made it easier to hold public officials accountable when they do not address known risks and prepare for disasters reasonably“. It is much more difficult to claim ignorance of risks when the standards identify potential hazards and provide assessment procedures. Standard ISO 31000 was exempted in this paper.

Klein et al, 2013, in the article talked about PCMH standards by The National Committee for Quality Assurance. “As a private organization, it maintains a unique governance role because it develops its own standards and accreditation guidelines for many government (and private) health care initiatives: medical homes, accountable care organizations, disease management, and even health plan evaluations, among other offerings. Practices can also apply to other organizations such as the Joint Commission and the Accreditation Commission for Health Care, which have also crafted recognition standards for medical homes”. This was an example of “de facto” standards and only one part of article wrote about it without explicitly citing of system management standards.

Hence, all the examles above indicate that standards so far have studied rarely by practitioners and scholars, especially management system standards. Perhaps they thought that these standards were outdated or not interesting for a science or they haven’t seen the potential importance and role of standards in public services.

5. CONCLUSION

Conclusions were identified from citations in these articles and in review articles. Standards were obviously understood as set of norms, guidelines, and rules by the authors (Category III) (Noordegraaf et. al, 2014), (Alvarez and Hall, 2008). The articles of the third category (III) didn’t relate to the ISO standards and 22% of papers only mention some of the ISO standards (Category III and Category II). Also, they didn’t write about terms “de facto” or “de jure” standards, differences between them or any examples. The reason for this could be that they thought that these standards were outdated, uninteresting for a science or they don't see the importance of role of standards in public services. The overall conclusion is that researchers in journal of public administration didn’t address standard as a specific problem. This paper has researched and showed date but not the reasons why it was the case.

It should be noted that there are the limitations in this research such as the number of analyzed journals, lack of access to all articles over the internet, unspecified areas of public administration and the journals with impact factor (IF). It would be suggested direction for future research. More broadly, questions remain about the extent to which the conclusions presented here apply to other public areas such as: education, health care, police service and judiciary. The answers to such questions will help scholars and policy-makers to understand how the quality and standards are perceived and used in public administration. There is the possibility of conducting research among researchers about what they think about the standards and application of standards in their field and then compare those results with the present.

REFERENCE

Amy Verdun, Experimentalist governance in the European Union: A commentary Regulation & Governance (2012) 6, 385–393

Andrew Schrank, From disguised protectionism to rewarding regulation: The impact of trade-related labor standards in the Dominican Republic, Regulation & Governance (2013) 7, 299–320,

David B. Klein, Miriam J. Laugesen, Nan Liu, The Patient-Centered Medical Home: A Future Standard for American Health Care?, Public Administration Review Volume 73, Issue s1, pages S82–S92, September/October 2013,

De Vries, H. J., 1999. Standardization: A Business Approach to the Role of National Standardization Organizations, Boston: Kluwer Academic Publishers.

E. Vigoda, 2000, Are you being served? The responsiveness of public administration to citizens' demands: An empirical examination in Israel, Public Administration, Vol. 78, No 1., pp. 165-191

George A. Boyne, What is public service improvement?, Public Administration Volume 81, Issue 2, June 2003, Pages: 211–227

Gundar J. King, Edvins Vanags, Inga Vilka and David E. McNabb, Local government reforms in latvia,1990–2003: transition to a democratic Society, Public Administration Volume 82, Issue 4, Article first published online: 16 DEC 2004

Helen M. Gunter, Public Administration Volume 88, Issue 1, pages 113–117, March 2010, The standards challenge: a comment on karsten et al.

Henry f. Rothstein, Participative risk regulation And the reform of the UK food safety Regime, Public administration Volume 82, Issue 4, pages 857–881, December 2004

Henry Rothstein, Olivier Borraz, Michael Huber, Risk and the limits of governance: Exploring varied patterns of risk-based governance across Europe, Regulation & Governance (2013) 7, 215–235

Hesser W., Feilzer A& De Vries H., (Ed.), (2007), Standardization in Companies and Markets, Hamburg: USA: Helmut Schmidt University

I. J. Tomlinson, Acting discursively: the development of uk organic food and farming policy networks, ublic Administration, Volume 88, Issue 4, pages 1045–1062, December 2010

Kilkon Korego, John Mendeloff, Wayne Gray, The role of inspection sequence in compliance with the US Occupational Safety and Health Administration's (OSHA) standards: Interpretations and implications, Regulation & Governance (2010) 4, issue 1, 48–70

Lourdes Torres, Service charters: reshaping trust in government: the case of Spain, Public Administration Review, Vol. 65, No. 6 (Nov. - Dec., 2005), pp. 687-699

Lourdes Torres, Vicente Pina and Ana Yetano, Performance measurement in Spanish local governments. A cross-case comparison study, Public administration, Volume 89, Issue 3, September 2011, Pages: 1081–1109,

Luca lo Schiavo, "Quality standards in the public sector: differences between Italy and the UK in the citizen's charter initiative", Public Administration, Volume 78, Issue 3, Autumn 2000, Pages: 679–698

M. Milakovich -, Comparing bush–cheney and clinton–gore performance management strategies: are they more alike than different?, Public Administration, Vol. 84, No. 2, 2006 pp. 461–478

Marc Holzer, R. W. (2011). *Public administration: An itroduction.* New York.

Matthew Potoski, "Clean Air Federalism: Do States Race to the Bottom?", Public Administration Review, Vol. 61, No. 3 (May - Jun., 2001), pp. 335-342

Meinhard Doelle, Chris Henschel, Jennifer Smith, Chris Tollefson and Adam Wellstead, New governance arrangements at the intersection of climate change and forest policy: institutional, political and regulatory dimensions, Public Administration Vol. 90, No. 1, 2012, pp. 37–55

Meinhard Doelle, ChrisHenschel, Jennifer Smith, Chris Tollefson and Adam Wellstead, New governance arrangements at the intersection of climate change and forest policy: institutional, political and regulatory dimensions, Public Administration Volume 90, Issue 1, pages 37–55, March 2012

Michael Brereton and Michael Temple, The new public service ethos: an ethical environment for governance, Public AdministrationVolume 77, Issue 3, Article first published online: 17 DEC 2002

Mirko Noordegraaf, Martijn van der Steen, Mark van Twist, "Fragmented or connective professionalism? Strategies for professionalizing the work of strategists and other (organizational) professionals", Public Administration, Volume 92, Issue 1, pages 21–38, March 2014

Nuno Ferreira Da Cruz and Rui Cunha Marques, Mixed companies and local governance: no man can serve two masters, Public Administration, Volume 90, Issue 3, pages 737–758, September 2012

Philip Allmendinger, Mark Tewdwr-Jones and Janice Morphet, Public scrutiny, standards and the planning system: assessing professional values within a modernized local government, Public Administration Volume 81, Issue 4, Article first published online: 25 NOV 2003

Poul Skov Dahl and Dasper m.Hhansen, Diffusion of standards: the importance of size, region and external pressures in diffusion processes, Public Administration Volume 84, Issue 2, pages 441–459, June 2006,

R. Michael Alvarez and Thad E. Hall, Building Secure and Transparent Elections through Standard Operating Procedures, Public Administration Review, Vol. 68, No. 5 (Sep. - Oct., 2008), pp. 828-838

Rhys Andrews, George A. Boyne, Jennifer Law and Richard M. Walker, External Constraints on Local Service Standards: The Case of Comprehensive Performance Assessment in English Local Government, Public administration Volume 83, Issue 3, August 2005, Pages: 639–656

Richard Schofield and Jean Shaoul, "Food Safety Regulation and the Conflict of Interest: The Case of MeatSafety and E. Coli 0157", Public Administration, Volume 78, Issue 3, pages 531–554, Autumn 2000

Rodney Mcadam and Timothy Walker, An Inquiry into Balanced Scorecards within Best Value Implementation in UK Local Government, Public Administration Volume 81, Issue 4, December 2003, Pages: 873–892

Rumki Basu, (2004), Public administration: Concepts and Theories, Sterling publishers, New Delhi, pp. 1-37

Sjoerd Karsten, Adrie j. Visscher, Anne Bert Dijkstra, René Veenstra, Towards standards for the publication of performance indicators in the public sector: the case of schools, Public Administration Volume 88, Issue 1, pages 90–112, March 2010

Tony Bovaird, Ken Russell, Civil service reform in the UK, 1999–2005: revolutionary failure or evolutionary success?, Public Administration, Volume 85, Issue 2, June 2007, Pages: 301–328,

Viklund Mattias, Dissertation for the Degree of Doctor of Philosophy, Ph.D. Stockholm School of Economics 2003,

William L. Waugh Jr. and Gregory Streib, Collaboration and Leadership for Effective Emergency Management, Public Administration Review, Vol. 66, Special Issue: Collaborative Public Management (Dec., 2006), pp. 131-140

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CRITICAL ANALYSIS OF THE ISO METHODOLOGY FOR ASSESSING THE ECONOMIC EFFECTS OF STANDARDS

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Abstract: *The impact of standards on modern business is evident. However, it is not easy to provide objective evidence of their effect on economic performances of company. This paper provides some aspects of critical analysis of the ISO Methodology 2.0 for assessing primarily the economic benefits of standards. This ISO Methodology and many case studies, in which ISO approach to assessment of economical benefits of standard is explained, are publicly available on the official ISO website. The main intentions of the authors of this methodology and case studies are to justify the use of standards in company through the achievement of certain economic benefits within it. However, the dynamics of business activities and many influential internal as well as external factors that affects business performance cause that determination and measuring of single and specific influence of standard implementation to specific business performance are complex and need more sophisticated approaches.*

Keywords*: Standards, ISO Methodology, Economic Benefits*

1. INTRODUCTION

Standardization has been crucial for the development of the industrial society. The rapid progression of the globalized and increasing complex knowledge economy not only demands new standards, but it also challenging the form of standardization (Blind 2004). Understanding of different aspects, concepts, complexity and technological, economic and social implications of standards and standardization is complex task. The job of standardization is a hard job (*Kondo, 2000*). The majority of studies on standards and standardization are based on experiences and practice of developed countries and technology advanced companies. Many authors have dealt with problems of economic benefits of standards and the economic benefit of standards seems to be widely acknowledged within scientific authors (see more in David (1987), Tassey (2000) and Blind (2004)). David (1987), Tassey (2000) and Blind (2004), even, proposed a categorization of standards based on the economic problem they solve. Later some writers have extended the number of categories of standards to this (Tassey 2000, Blind, 2004):

- Compatibility and interface standards
- Minimum quality and safety standards
- Variety-reducing standards
- Information and measurement standards.

Leaving aside the perspective of the individual actors and taking a comprehensive macroeconomic view, it is evident that standards help to reduce costs of transactions between the different actors and therefore the emergence and organization of markets. This perspective is taken from the so-called institutional economists (Blind 2004). More comprehensive researches on the economic effects of formal standards began in year 2000 within German national standardization body (DIN) and other (ISO, 2010). ISO has worked with over 20 of its members, national standards bodies in different countries, to develop case studies to assess and quantify the benefits companies can obtain from the use of standards (ISO 2010). Many organizations from the private and public sector use standards and participate in standards development. A few of them see standardization as directly linked to their core business strategy. Some approach standardization in a highly organized way and have a clear perception of the impact of standards on their activities and performance (ISO, 2014). Others may use standards from a narrower perspective, for specific processes or activities. Most of them realize that standards bring benefits to their organization, although the level of awareness and the perception of such benefits vary considerably (ISO, 2014).

2. ISO METHODOLOGY CONCEPT

The ISO Methodology has been designed to support analysis of a company, or a specific organizational entity in order to assess the economic benefits of standards. (Gerundino, Hilb, 2010)

2.1 ISO Methodology Objectives

The methodology has the following three objectives (ISO, 2010):

- to provide a set of methods that measure the impact of standards on organizational value creation with an emphasis on business organizations;
- to provide decision-makers with clear and manageable criteria to assess the value associated with using standards; and
- to provide guidance on developing studies to assess the benefits of standards within a particular industry sector. ("Standards" in the ISO Methodology are not limited to standards developed and published by ISO, but comprise all consensus-based standards issued by any standards-developing organization. Companies often call these "external" standards to distinguish them from internal company standards. "External" standards include International Standards developed by ISO and the International Electrotechnical Commission (IEC), regional and national standards, standards developed by sector-based standards development organizations, as well as consortia standards if the consortia are open to participation by interested parties in addition to consortia members (ISO 2010).

2.2 ISO Methodology Process

Generally, the assessment of the effects of standards proceeds in accordance with the steps below:

- Understand the value chain of the industry and the company.
- Identify the impacts of standards.
- Analyze the value drivers and determine operational indicators.
- Assess and calculate results.

The first step is to determine the value chain of the industry, and to position the organization to be assessed in the context of this value chain. (Gerundino, Hilb, 2010) A value chain comprises a sequence of activities to generate a certain output, a product or a service. (ISO, 2010) Standards used by the organization are considered in relation to the organization business processes and its specific activities.

The methodology first identify in which activities standards are used and how these activities, supported by the use of standards, contribute to the creation of value for the company (ISO, 2010). The next step is to create standards impact map aims to determine the impact resulting from the implementation of standards on each of the main business functions and associated activities.
Operational indicators associated with the activities impacted by standards then need to be identified to allow quantification (EBIT accounts for the gross profit for a company (revenue minus costs) at a given point in time), Fig 1.

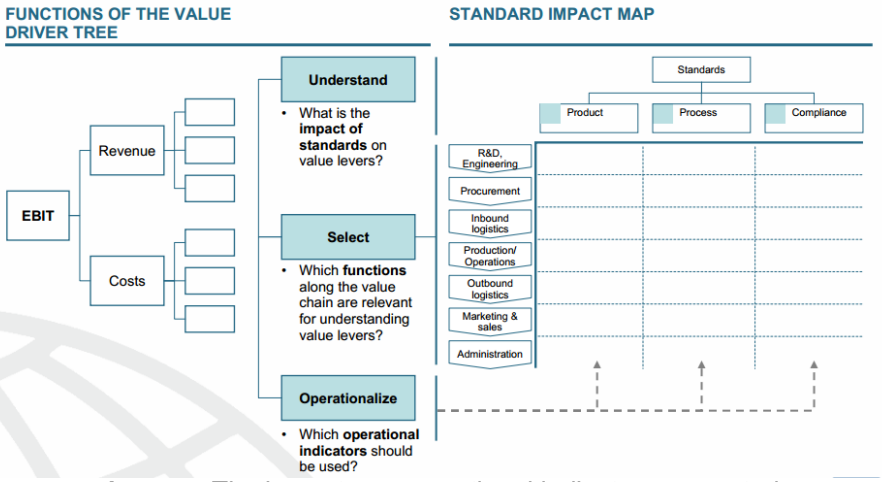

Figure 1: The impacts on operational indicators converted in EBIT impacts (ISO, 2011)

This is done by translating the impact into financial metrics. It can be directly measurable (for example, cost savings for the procurement of materials and components), or determined on the basis of existing company data (for example, the reduction of manpower needed to complete the design of products is converted into estimated cost savings on the basis of the average cost of personnel). (Gerundino, Hilb, 2010)

2.3 Some Methods for Measuring the Impacts of Standards

Basic approach to measuring the impacts of standards in this Methodology is given through some comparison:

- Before-after comparison.
- Comparing concurrent conditions – Projects.
- What-if comparison.

The second type of comparison is situation when standards may be used in some projects, and not for others. The simplest case is a "before-after" comparison when an organization may have changed from situation (1) - when it did not use standards to a situation (2) when it uses relevant standards. The final "What-if "- assumption, which is based on estimating how certain activities/processes would be performed without standards (situation 1) and comparing such a condition with the existing situation, in which standards are applied (situation 2) (ISO 2010). This methodology provides basics for:

- The assessment of economic benefits of standards for an industry sectors (given in Annex A of the Methodology).
- The extension of the methodology to assess non-economic benefits of standards (covered in Annex B).
- An overview of the individual tools (given at Annex C).
- A definition of the individual business functions (is given in Annex D Terms and definitions).

2.4 Company Case Study Findings - Application of the Methodology according to ISO

ISO Methodology has been tested in over 20 countries across the world in 30 company covering areas such as the agri-food business, the chemical industry, construction and construction materials, electrical appliances, electrical power transmission, food retail and food logistics, heating, ventilation and air conditioning, industrial automation equipment, information and telecommunication, pipes and piping systems, ship building, and water supply. Since October 2010 a case studies about the economic benefits of standards were undertaken in South East Asia (Indonesia, Singapore, Thailand and Vietnam), Southern Africa (Botswana and South Africa), South America (Brazil, Colombia and Peru), Europe (Germany and other). The set of case studies are published in couple of books edited by ISO.

Table 1: Comparative analysis of two case studies in organizations Festo Brasil and Danper

Criteria	Festo Brasil	Danper
Economic benefits generated by standards	BRL 4.5 million (USD 2.7 million) annually, which amounts to 1.9 % of sales revenues.	USD 648 158 annually which amounts to 0.73 % of sales revenue.
Key qualitative benefits	Standards are considered an essential component of good engineering and manufacturing practices, with a potential that has not yet been fully exploited	Standards helped instil a culture of continuous improvement in the company
What were the major benefits of using standards?	Using standards allowed Festo Brasil to : • Implement an efficient procurement process resulting in significant work savings • Save around 30 % in its purchase operations by buying standardized supplies • Optimize the design times of its engineers and shorten time to market • Improve communication between different technical departments in the company • Implement a company-wide continual improvement process that streamlined manufacturing and brought significant savings	Using standards (and certifications) allowed Danper to : • Continually improve its skills and implement an efficient and reliable production chain • Manage a highly efficient cold chain and delivery service for fresh produce, ensuring product quality requirements in overseas markets are met • Demonstrate to overseas customers its ability to produce and deliver safe, high-quality products and qualify as a supplier for them • Export close to 100 % of its produce and penetrate new markets by meeting the requirements and building the confidence of key international retailers

These case studies were made in close cooperation among ISO member bodies, academic institutions, companies and staff of the ISO Central Secretariat, acting as advisors to the project team. Just as illustration of comparative potential of those case studies we provide comparative analysis of two case studies of Festo Brasil and Danper. Festo Brasil is one of the group's largest companies and manufactures a wide variety of products for the Brazilian market and for export to other Festo subsidiaries and to the parent company. Danper is one of the largest agro-exporter companies in Peru.

Also, there are some interesting findings in undertaken case studies such as that the results show an incidence of the impact from standards ranging from 0.15 % to about 3 % of turn-over – depending on the company and the business function analyzed. To give a better appreciation of the scale of the standards impact, the above estimate has been projected to the total industry revenues for 2008. As a result, the total contributing impact would be between USD 38 billion and 55 billion. (Gerundino, Hilb, 2010)

Table 2: Example of Activities in the production function and standards used (Source: Juhayna, Egypt)

Business function	Activities	Standards	Description
Manufacturing	Raw material reception	ISO 22000:2005 ISO 17025:2005	• Food safety management systems • General requirements for the competence of testing and calibration laboratories
	Materials preparation : sugar syrup and other production ingredients	GMP standards ISO 22000:2005	• General requirements for the competence of testing and calibration laboratories • Good manufacturing practice • Food safety management systems
	Mixing process	GMP standards ISO 22000:2005	• General requirements for the competence of testing and calibration laboratories • Good manufacturing practice • Food safety management systems
	UHT treatment (pasteurization)	GMP standards ISO 22000:2005	• General requirements for the competence of testing and calibration laboratories • Good manufacturing practice • Food safety management systems
	Filling and packing	GMP standards ISO 22000:2005	• Good manufacturing practice • Food safety management systems
	Palletizing	GMP standards ISO 22000:2005	• Good manufacturing practice • Food safety management systems
	Storing until dispatch to distribution centre	ISO 22000:2005	• Food safety management systems

3. CRITICAL ANALYSIS OF ISO METHODOLOGY

3.1 Advantages of ISO Methodology

The first survey that DIN (2000) was conducted within different organizations and countries was using different methodologies of assessment and had different goals. But due to different methodologies and goals the results obtained were not sufficiently comparable (ISO 2010), Having this in mind, ISO Methodology provided to standard user common methodology to asses economic benefits of standards in order to give basic possibility to intercompany comparison in area of economic benefits of standards.

Because of the way through empirical attempt to quantify certain indicators this Methodology is trying to economically justify the application of standards which is very important for any organization. ISO managed to implement its complete Methodology within 30 organizations around the world for four years. With this step ISO and its Methodology succeeded in provoking many organizations to analyze and gain insight which standards they were using within their company and for which processes and activities. The fundamental point in the ISO Methodology is to consider the company perspective: its environment, objectives, business processes and activities (ISO, 2010). It is an accomplishment to conduct so many case studies and thereby including huge number of participants help to raise awareness of the importance of standards.

The ISO Methodology also offers a toolbox to support the assessment process, the capturing of information and data, and the calculation of the impact of standards (Gerundino, Hilb, 2010). Consistent with the above, case studies provide evidence that a focus on standards can be the core of an upgrading strategy through which companies aim at entering higher value-added segments of the value chain in their respective industries (ISO, 2010).

3.2 Disadvantages of ISO Methodology

It is difficult and risky to apply a specific methodology to different types of companies or various forms of organization and functioning because of their different nature, needs and goals. It is important to leave some

latitude in describing the process of the company. “The benefits associated with participating in standards development are only addressed at a qualitative level” (ISO, 2010).

As explained in section 1.3 of ISO Methodology it is important to underline that the impacts from internal company standards (even if they are not related to external standards) can also be assessed using the same approach and the same set of tools provided by the ISO Methodology (ISO, 2010). This is a delicate assumption because it is necessary to clearly distinguish what are internal standards within an organization. A frequent replacement of the thesis is that the documentation resulting from fulfilment of the requirements of external standards are so called as an internal standard of organization.

Internal company standards are excluded from the assessment except if they are related to or based on external standards. In such cases, the interplay between internal and external standards needs to be carefully analyzed, because the influence and impact of external standards can be substantial, even if the effect is achieved through internal standards. (ISO, 2010) In external standards it is always given what you need to fulfil but almost never how. Bearing this in mind, each organization can in its own way to achieve fulfilment of requirement of the standard. Therefore it is very difficult in such circumstances to make a comparative analysis of the impact of the internal or/and external standard of two or more organizations.

The approach and the tools provided by the ISO Methodology can be applied to both voluntary standards and technical regulations (ISO, 2010). We think this is overambitious due to the nature of the regulations that they are always mandatory and that they differ from one state to another. It is naive to believe that the offered method in ISO methodology can extract the effects of standardization of other effects in some organizations. This requires significant research in the context of effects separation in some organization because they are most often seen at the end of process and it is not simple to get to the cause of such an effect. And, also certainly not enough to monitor just one economic indicator, in this case, EBIT, but these complex analyzes require identification of some additional important economic indicators and their consideration.

4. CONCLUSION

The ISO methodology for assessing primarily the economic benefits of standards describes the key stages of the assessment process and provides references to some of the tools which should be applied at certain stages of the assessment. It presents the key elements and concepts of the methodology, including practical advice on the organization of projects, on steps in the assessment process, and on methods to calculate the benefits of standards. The set of case studies (published and edited by ISO) were made in close cooperation among ISO member bodies, academic institutions, companies and staff of the ISO Central Secretariat.

The ISO Methodology succeeded to provide to standard user common methodology to asses economic benefits of standards and provide basic tool for intercompany comparison in area of economic benefits of standards. ISO methodology can motivate many companies to analyze economic benefits of usage of standards and gain insight into standards usage (what standards and for which processes and activities). However, the main problem within this methodology might be related with extraction of the effects of standards usage from other influential factors on company economic performances. The methodology need to address this issue more clearly. Certainly it is not enough to monitor just one economic indicator, like EBIT, complex analyzes require identification of some additional important economic indicators and their consideration.

REFERENCES

Andre Jungmittag, Axel Mangelsdorf (2010), The economic benefits of standardization. An update of the study carried out by DIN in 2000.

Blind, Knut (2004), The economics of standards: Theory, evidence, policy. Edward Elgar, Cheltenham, Northampton

DIN German Institute for Standardization, available at : www.din.de/sixcms_upload/media/2896/DIN_GNN_2011_engl_akt_neu.pdf

Gerundino, Daniele, Hilb, Michael, (2010) The ISO Methodology, Assessing the economic benefits of standards, ISO Focus+, www.iso.org/isofocus

Gerundino, Daniele, Reinhard Weissinger (2011), Economic benefits of standards. International case studies. International Organiza-tion for Standardization, Geneva. Case studies are available at : www.iso.org/benefits_of_standards

Gerundino, Daniele, Reinhard Weissinger (2012), Economic benefits of standards. International case studies. Volume 2. International Organization for Standardization, Geneva. Case studies are available at : www.iso.org/benefits_of_standards

ISO Central Secretariat (2010) Economic benefits of consensus- based standards.The ISO Methodology, http://www.iso.org/iso/home/standards/benefitsofstandards/benefits-detail.htm?emid=6

ISO Central Secretariat (2014) Economic benefits of standards, http://www.iso.org/iso/ebs_case_studies_factsheets.pdf

Kondo Y. (2000). Innovation versus standardization, The TQM Magazine, Vol. 12 Iss: 1 pp. 6 - 10

Porter, Michael (1985), Competitive advantage. Creating and sustaining superior performance. Free Press. New York, London, Toronto, Sydney

Swann, Peter G.M. (2000), The economics of standardization. inal report for standards and technical regulations directo-rate, Department of trade and industry, London, available at : www.dti.gov.uk/files/file11312.pdf

Tassey G. (2000), Standardization in technology-based markets, Research Policy, 29 (4/5), 587-602

The Economics of Standardization (2010),: An Update, avail-able at : www.bis.gov.uk/feeds/~/media/ED32CDA672764D-7C8AC2F4E323581010.ashx

STANDARD ISO 26000 AND SOCIAL RESPONSIBILITY IN THE SERVICE OF SME-S SUSTAINABILITY

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Abstract: *This paper presents an overview of current knowledge regarding the practice of corporate social responsibility in small and medium-sized enterprises. The paper first gives an overview of the definition of social responsibility, based on the literature review. It also shows the specific features and motives for corporate social responsibility in small and medium-sized enterprises. As a standardized basis on which SMEs can build their socially responsible practices, the international standard ISO 26000 is summarized. It also shows the process of implementation of SR in SMEs. At the end of the paper, an overview of the main advantages and disadvantages of the concept of CSR in SMEs application was given through SWOT analysis, and the conclusion shows how CSR and the recommendations of ISO 26000 contribute to business sustainability of SME.*

Keywords: Social responsibility, SMEs, Sustainability, Corporate Social Responsibility, Standard ISO 26000,

1. INTRODUCTION

There is an increased number of those who advocate that companies can not be exclusively focused on obtaining the highest possible profits for the owners. It is clear that companies must take appropriate responsibility. Social responsibility is one of the pillars of operational excellence of organizations. It contributes to economic growth and development on healthy basis, both in developed and in developing countries. If properly practiced, the principles of social responsibility given in the standard ISO 26000 can be a key tool in the struggle for environmental and fair business activities, contributing to a better society.

While social responsibility has traditionally been the domain of the corporate sector, recognition of the growing importance of the small and medium-sized enterprise (SME) sector has led to an emphasis on their social and environmental impact of SMEs (Nejati & Amran, 2009). Supporting SMEs is a cornerstone of the EU"s drive for growth and jobs. Since 99% of all EU companies are small and medium-sized enterprises (SMEs), accounting for 67% of jobs, it is clear that what is good for small businesses is good for Europe"s economy (EPC, 2012). They are a major source of entrepreneurial skills and innovations, and they contribute to economic and social cohesion. In its publication "Opportunity and Responsibility - How to help more small businesses to integrate social and environmental issues into what they do", the European Commission mentioned: "*SMEs have always been very close to what we call today "CSR". Through their typically local anchoring, they are well placed to make a strong contribution to socio-economic development at a local level and act as responsible members of a community. But it is possible to help and encourage SMEs to go further down the road of CSR*."

Increased global competition means that corporations need to find innovative ways to engage stakeholders and other interested parties. One of the factors contributing to the ambiguity of CSR is the lack of consensus as to what the concept really means (Sweeney, 2007). As levels of sophistication among stakeholders and other interested parties continue to rise, businesses will come under increasing pressure to find ways of participating in sustainable development (Planken, Nickerson & Sahu, 2013). One area in which a corporation"s sustainability stance can be communicated to stakeholders and other interested parties is in the construction of a social responsibility strategy (Planken et al., 2013).

2. THE CONCEPT OF CSR

The African Policy Institute research (API, 2011) indicates that the history of social responsibility is as old as the history of the business. Taking care of business that contributes to society and has a positive impact on both the people and the environment existed in societies at a much lower level of development than today. The best sources of examples from the ancient history on this topic can be found in the books whose primary

topics are the history of law and legal rules, which give us an insight into how the ancient people resolved their legal and economic issues. Some of these examples date back to 5000 years ago, such as the laws that regulate the protection of forests. In this sense, we should not forget the ruler of ancient Mesopotamia, Hammurabi and his Code of Hammurabi, which dates from 1700 BC, as an essential example of regulation of various forms of business relationships, such as norms which prescribed the death penalty for builders, farmers or supervisors whose negligence caused an accident or death of other people (Asongu, 2007).

The concept of CSR evolved from two parallel developments (Nejati & Amran, 2009). The first comprises the efforts of policy-makers and organizations to spread the idea of socially responsible behaviour at every level, by means of numerous initiatives, formal definitions and so on (Tencati, Perrini & Pogutz, 2004). The second path consists of academic contributions, evolved from an initial, vague awareness of the relationship between companies and social-environmental contexts into an explicit identification of rules of conduct and management tools (Nejati & Amran, 2009).

To begin with, it is necessary to look at the definition of corporate social responsibility (CSR) that can be found in the academic literature. CSR concept was initially proposed in the literature of the early 1950s (Carroll, 1999). In 1980, Jones (1980) states that corporate social responsibility means that the company has a liability in respect of all stakeholders in the society, not only to their stakeholders, and that this responsibility applies not only to what is required by law or contract. In the 1990s, practitioners began using CSR as an essential part of their business language and practice (Carroll, 1999). Modern jurisprudence is presented by Marsden (2001) stating that corporate social responsibility is the basic behavior of the company and the takeover of responsibility for the overall impact on the society in which it operates. According to Holme & Watts (2000) CSR is "the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large." Authors McWilliams & Siegel (2001) define corporate social responsibility as well as activities that have a positive impact on society, which are above the interests of the company and legal requirements. Scholars have demonstrated that it is important that companies spend the resources allocated to CSR in ways that yield optimum benefits to society as well as to their stakeholders such as customers, employees, investors, supply chain associates, strategic alliances, communities, as well as governments (Poolthong & Mandhachitara, 2009). The definition that is much cited in the literature is the definition formulated by Pinney (2001), which defines corporate social responsibility as a set of management techniques that enable the company to minimize the negative and maximize the positive impact of its operations on society. Author Dahlsrud (2008) studied the definition of CSR and concluded that all the definitions include some of the following dimensions: 1) the social dimension, 2) the size of the environment, 3) the economic dimension, 4) measuring stakeholder and 5) measuring volunteerism.

"*Corporate social responsibility is the obligation of the firm to use its resources in ways to benefit society, through committed participation as a member of society, taking into account the society at large, and improving the welfare of society at large independently of direct gains for the company*" (van der Wiele, Kok, McKenna & Brown, 2001). As authors Pérez & del Bosque (2014) mentioned "*CSR refers to the company activities demonstrating the inclusion of social and environmental concerns in business operations, and in interactions with stakeholders, also according to the ambition levels of corporate sustainability*". Social responsibility, according to the authors Djuric, Vujosevic & Kovacevic (2012) could be described through the process of identifying stakeholders, identifying current and potential problems associated with them and creating appropriate strategies and processes to solve these problems. The most representative definition of corporate social responsibility given by ISO (ISO 26000, 2010) reads as follows: "*the responsibility of an organization for the effects of its decisions and activities on society and the environment, through transparent and ethical behaviour, such that it contributes to sustainable development that includes the health and welfare of the society; takes into account the expectations of its stakeholders; is in accordance with applicable law and international norms of behaviour; and which is integrated throughout the entire organization and applied in all of its relations*".

3. SPECIFIC CHARACTERISTICS OF THE CSR IN SME-S

No SME company is completely isolated from its surroundings and it usually represents an important part of its local community and the environment within which it operates. The ability of a business to succeed on a long-term basis depends on the relationships it has with its owners, investors, employees, customers, suppliers, the local community and other involved parties, who are collectively referred to as interested parties. All stakeholders should be encouraged to see the opportunities that can arise from engaging SMEs on social and environmental issues. In order to effectively implement ISO 26000 recommendations, SMEs have to understand and appreciate value of their involvement with their interested parties. This is because corporate social responsibility is not just about the advocating of the company's values and principles but also about understanding expectations of those who have an impact on the company and who are being impacted by the company. A large proportion of SMEs have always done things that could today be called "social responsibility", even if they do not know or use the term themselves. CSR in SMEs is less formal and more intuitive than in larger enterprises, but that does not make it less valuable, according to the European

Commission. SMEs are means of combating poverty in developing countries, Serbia being one of them. If the recommendations of ISO 26000 are perceived by SMEs as protectionist, inappropriate to the culture or excessively bureaucratic, the ultimate effect will be negative. On the other hand, we must not allow the SMEs to become a training ground for excessive pollution or exploitation of labour. The right understanding of the ISO 26000 recommendations points to the fact that the support in the development of SMEs is within the domain of the responsibility of large companies and that the improvements in the field of social and environmental protection go hand in hand with quality and management improvement, according to Filipovic (2008).

Governments and other public authorities in Europe are putting increasing pressure on SMEs in order to make them realize that respect for ethical codes of conduct and ISO 26000 is not only a concern of multinational corporations (Luetkenhorst, 2004). Besides, the concept of family businesses, often present in SMEs, carries elements of ethics, philanthropy, patriarchy, ethnicity and community, which provides an additional color of social responsibility. These elements are part of the essence of the social responsibility of SMEs, and therefore, aspects that need to be considered and included in all social responsibility programs aimed at SMEs, especially those in developing countries, according to Filipovic (2008). To remain competitive, companies need to be able to adapt to new demands from the market and the society in which they operate (Nejati & Amran, 2009). The flexible and personal nature of many small and medium-sized enterprises often allows them to respond quickly to these changes, because they can spot and take advantage of market opportunities more easily than many larger companies (Nejati & Amran, 2009).

Surveys and research in the field demonstrate that many SMEs tend to handle CSR activities unsystematically and on a personal ad hoc basis (Murillo & Lozano, 2006). The CSR concept is generic in nature and is applicable to organizations regardless of type and size (Nejati & Amran, 2009). The roots of CSR in SMEs seem to lie neither in purely utilitarian motives nor in ethical and altruistic decisions (Nejati & Amran, 2009). A key difference between large and small firms is that in small firms, ownership and management are not separated to the extent that they are in large multinational firms (Spence & Rutherfoord, 2001). Thus, control remains in the hands of one of the owners, potentially enabling him or her to make personal choices about the allocation of resources (Spence, 1999). Thus, in SMEs, the acceptance of CSR is largely a factor of the personal attitudes of the owner/manager (Perez-Sanchez, 2003). SMEs by their nature may experience specific barriers to CSR (Sweeney, 2007). It has been argued that SMEs are constrained by time and financial resources (Vives, 2006). A focus on the short term can mean long-term investment projects in CSR are not of immediate concern (Carlisle & Faulkner, 2004). On the other hand, it has been argued that being smaller and flatter, SMEs may be better placed than large firms to take advantage of the changing needs of society (Sarbutts, 2003; Perez-Sanchez, 2003). In one study conducted by Sweeney (2007), it was concluded that "*The volume and diversity of CSR activities was positively correlated with size. While large firms believe SMEs experience barriers such as perception and resource limitations such as financial, human and time constraints, in reality the only barrier noted by SMEs was financial constraints*". Concerning the motivations of SMEs to engage in CSR, Revell & Blackburn (2007) found that "*SMEs are only motivated to take environmental actions as a result of external pressure. Here one can think of adverse publicity, legislation and damage to the company's image leading to a reduction in a firm's competitive advantage*". Another external pressure motivating SMEs to engage in CSR is supply chain pressure from large companies (Revell & Blackburn, 2007). When companies see these external pressures as the main driver to engage in CSR their motivations fall into the integrative category of Garriga and Melé (2004), because these companies feel they depend on society for their existence, otherwise they would not see external demands as pressure. Enderle (2004) found that SMEs engage in CSR because they want to be good citizens, based on the moral obligation to contribute to the well-being of society, and not to increase profits.

According to the survey conducted by Hellenic Network for CSR, corporate social responsibility in SMEs has several components:

- **Environment** - The activities of all enterprises, independently of their size, may affect the natural environment. Implementation of comprehensive systems managing and controlling the influence each productive procedure has upon the environment may not be a simple task for a small medium enterprise.
- **Human resources** - Human resources is the most precious asset of the enterprise. Among other things, human resource is the company"s main representative to all interested parties (customers, partners, local communities etc.). A constant and socially responsible management of human resources ensures not only the company"s profile as a preferred employer but also the employees" creative involvement towards achievement of business goals.
- **Marketplace** - The most crucial factor of each enterprise"s economic effectiveness is the marketplace and the business environment into which it operates.
- **Society** - Being a "responsible citizen", the company participates definitively in local progress and development. The conscious participation of businesses in the society may also be expressed through CSR activities.

4. THE ESSENTIAL CHARACTERISTICS OF THE ISO 26000 STANDARD

Standard ISO 26000:2010 provides guidance to all types of organizations, regardless of their size or location, whether they are public or private, operating at any stage of development. The standard represents an incentive to organizations to make a difference in relation to the formal compliance with the laws, recognizing that acting in accordance with the regulations is the basic obligation and an essential part of their social responsibility.

ISO 26000:2010 integrates seven social responsibility core subjects and within each of them addresses other, broader relevant issues:

- **Organizational governance** - the system by which an organization makes and implements decisions in pursuit of its objectives. At the same time it represents the most crucial core issue that organizations should consider when applying ISO 26000;
- **Human rights** - organizations should ensure that their activities uphold the internationally recognized human rights. They should ensure that they are not complicit in human rights abuses; that staff are aware of the recommendations in the field of general culture and human rights, as well as the recommendations of the ISO 26000;
- **Labour practices** - includes all forms of policy and practice in relation to work on behalf of the organization, including wage labour. It goes beyond the scope of an organization and its relationship with employees. Include recruitment and promotion of staff, transfer of employees, training and skills development, health, safety, practices that affect working conditions, trade union activities, and the like;
- **Environment -** Organisations should ensure that their activities comply with internationally recognized principles and obligations concerning the protection of the environment. They should support a cautious approach towards environmental issues; popularize greater environmental responsibility; encourage the development and expansion of technologies that favour the environment; accept the polluter-pays principles, and so on;
- **Fair operating practices** - Organizations should ensure that their activities are in accordance with internationally recognized principles of fair dealing. For example, they should promote the application of these principals with business partners; and to consider the willingness of others to accept these principles as an important factor in deciding on partnerships;
- **Consumer issues** – They involve basic user rights: the right to fair marketing practices, protection of healthy, safe and sustainable energy, dispute resolution, the right to compensation, data protection and privacy, the right of association and the like;
- **Community involvement and development** - contribute to the strengthening of civil society based on the contention that an organization represents "a community stakeholder". A socially responsible attitude towards community organizations can contribute to its technological development, promotion and preservation of culture and the arts, developing educational programs, strengthening institutions, creating and promoting environmental protection, reducing poverty, unemployment and the like.

5. CSR IMPLEMENTATION IN SME-S - MAJOR STEPPING STONES

According to the Polášek (2010), the prescribed basic steps to be followed in the implementation of CSR in SMEs are as follows:

- **Management commitment to social responsibility** - should make efforts to ensure the management's thorough understanding of the benefits of applying the CSR principles. For larger SMEs, personal management commitment, based on an ethical approach to business, can contribute to the effectiveness of the implementation of CSR and the formation of a special team of social responsibility. It should include experts in the fields of human resource management, communication, marketing, process management, finance, manufacturing, health and safety and sales. For smaller SMEs, it is the owners, management and employees that should provide the function of such a team.
- **Identifying key stakeholders** - In today's business practices, companies are faced with the increasingly diverse range of demands and interests of its stakeholders and interested parties. They include employees, suppliers, customers, owners, narrower and wider community in which SMEs operate, a state with its institutions, groups that advocate for issues of society and the environment, future generations, etc. The identification of stakeholders and their involvement is essential for social responsibility.
- **Analysis of the current situation** - before defining the basic values and principles of corporate social responsibility, SMEs should conduct an internal and external analysis of the current situation. As part of the internal analysis, SMEs need to analyze the current situation when it comes to their involvement in the area of corporate social responsibility (legislation, current activities, tools and methods for communication, policies and documents, etc). In the external analysis, SMEs should focus attention on the identification of external factors that can affect their business (globalization, new regulations, technological advancement, etc), analysis of the activities that use competition in the area of social responsibility, the comparison of their performances, of SMEs with the best socially responsible practices (benchmarking).

- **Defining Fundamental Values and Principles** - it is essential that SMEs identify values that on which their CSR policy should be based. These values are used as the criteria for defining the proposed instruments and activities in the field of corporate social responsibility. In order to successfully direct its activities, SMEs need to identify the core values relevant for all the stakeholders.
- **Setting Key Objectives and Corporate Social Responsibility Approach** - Based on the defined values and principles, SMEs need to determine the direction in which they want to develop their CSR activities. In order to ensure effective implementation of the commitments, the SMEs must set measurable goals and identify measures for the realized performance.
- **Preparation of the Action Plan** - Considering all that has been done so far, a matrix of proposed actions related to social responsibility should be created. Most often this is done by summing up the current and by planning new activities, processes, products and impacts in terms of SMEs social responsibility, in regard to economic, social and environmental aspect. The implementation of the CSR „obligations" involves the pursuit of daily activities, processes, decision making process and so on, by which SMEs implement all their commitments deriving from the adoption of the CSR strategy.
- **Implementation Phase** - During the implementation of CSR, MSP monitors the action plan, including it in their daily activities. SMEs need to perform analysis at appropriate intervals to determine the progress in relation to their goals related to social responsibility and to identify the necessary changes to processes. When deciding which activities will be monitored, SMEs should focus on activities related to the most important and influential stakeholders.
- **Monitoring of Corporate Social Responsibility** - Performance review is used to determine the progress with the implementation of CSR principles, to identify areas in need of change and the activities that require improvement. In addition to reviewing current activities, SMEs should take into account the changes in conditions or expectations, legal and regulatory framework affecting the social responsibility and the opportunities for improvement. One of the most commonly used methods is the monitoring of the measurement with respect to the indicators.
- **Communicating and Reporting** - There are many types of communication related to social responsibility: meetings with stakeholders, the communication between management and employees in order to increase general awareness of social responsibility, communication with suppliers on the requirements for procurement, communication with the public about the emergency situations. Different methods that could be used for communication and they incorporate meetings, public events, forums, reports, newsletters, magazines, posters, advertisements, letters, voice mail, live performances, video, web sites, podcasts, instructions for use and product labels.
- **Preparation and Implementation of Improvement Measures** - Based on the periodic review of activities in the area of social responsibility and recommendations by stakeholders, SMEs should consider ways in which they can improve their performance. The review results should be used to help them achieve continuous improvement of social responsibility. These improvements can include changes to the general and specific objectives of social responsibility, expanding the scope of activities and programs in the area of social responsibility, obtaining additional resources for socially responsible activities or complete revision of the CSR strategies of SMEs.

6. ADVANTAGES AND DISADVANTAGES OF CSR IMPLEMENTATION IN SME-S

Social responsibility entails new demands that the SMEs in developing countries are expected to meet. Accepting the social and eco standards are increasingly becoming a precondition of cooperation with large companies. These are taking the form of individual codes or more widely adopted standards. Market movements can cause a situation where the social and eco- responsibility extends from SMEs that are in direct partnership with multinational companies to those which are indirectly related. This scenario occurs through local competition, strengthening of the mechanisms for the implementation of local laws, targeted investments, or through a change in user behavior. A certain number of multinational companies are very actively involved in the creation of partnerships, through enabling SMEs from developing countries access to otherwise inaccessible markets for them, funds, programs, education and training, infrastructure. Lack of access to technology, eco eligible materials, credit, information and trainings represent an insurmountable obstacle to the promotion of SMEs in terms of social responsibility and especially eco eligibility and liability, according to Filipovic (2008).

Table 1: The main characteristics of the relationship between social responsibility and SMEs (Filipovic, 2008)

DANGERS	CHANCES
'Back door' protectionism Loads as a result of needs for reconciliation and monitoring SR Paradox: Is it possible for MSPD not to benefit from the SR?	Business benefits: better compliance with user needs, cost reduction, increased productivity, innovation The positive implications of the SR to SMEs Additional benefits of SR, continuous improvement and development of local communities
OBSTACLES	**DRIVERS**
Lack of technology, expertise, training and investment necessary for improvements. A small number of initiatives aimed at SMEs. Lack of understanding of the SMEs characteristics Initiatives within the supply chain very rarely go in depth, ie. they retain on the first level Pressing of the necessity for improvement of technology, management and marketing Price competitiveness and limited pressure	Pressure by the transnational companies whose supplier chain they belong to, the requirements for certification and compliance with the Code Changing markets, the need for adjustment of production to the changing preferences of the user, the internationalization of standards Local pressures by regulation, public opinion, civil society Strategic business benefits

Improving SMEs social responsibility may prove to be a very successful business move, according to Filipovic (2008).

By applying the concept of social responsibility SMEs achieve:

- better cognition of user requirements,
- greater customer / employee / business partner loyalty
- better relate to user - supplier chain ,
- improve relations between employees and managers,
- increased ability to recruit and retain competent staff ,
- readily coping and risk management, increased capacity for learning and innovation,
- improve productivity and increase the capacity for learning, creativity and innovation ,
- increase mutual trust between companies,
- savings achieved through measures such as eco-efficiency ,
- enhance its image and reputation, improved company reputation
- opportunity to create partnerships with multinational companies ,
- increase productivity and profitability,
- greater competitiveness.

However, the aforementioned benefits will not be important for all SMEs. In the case of SMEs in the developing countries priorities are undoubtedly in the domain of mastering new production, management and marketing technologies, among which the quality management occupies an important place, according to Filipovic (2008).

7. CONCLUSIONS

ISO 26000 is intended to assist organizations in contributing to sustainable development. The intention is to encourage them to do much more than merely observing the law, given that the compliance with the law is the basic responsibility of each organization and a key part of its social responsibility. Its goal is to promote a common understanding of social responsibility, as well as to complement, but not to replace other instruments and initiatives related to social responsibility.

CSR is not a short-cut to business success, but an investment that can pay off in the longer term. It can bring advantages, for example in terms of staff retention and recruitment, staff development and motivation, customer loyalty and reduced expenditure on energy. In the knowledge economy it can increasingly be a source of innovation and it can facilitate access to and sharing of information. By managing CSR in a more strategic and conscious manner, enterprises can better reap these advantages. CSR is about continuous improvement and should be seen as part of the modern model of business excellence (according to European Commission). The personal and ethical values of SME owners, managers and employees are a strong motivation for an enterprise to pay more attention to social and environmental issues.

Small and medium-sized enterprises (hereinafter SMEs) are becoming an increasingly important part of national economies around the world. As for Europe, as early as 2001, the European Commission emphasized the need for the SMEs to fully participate in public debate on social responsibility, and to better promote their good SR practices. In the period 2004 - 2007 the number of SMEs in the total number of companies in the Republic of Serbia reached 99.7%, while the number of employees and revenues

participated with 60.6% and 67.2%, which in itself emphasizes the need for this campaign being included in the SR. Although they do not have the capacity and ability of large companies in terms of being able to make large donations, grants or engage in infrastructural projects or large projects related to the environment, SMEs are generally better integrated into local communities than large entities. Often SMEs in local communities conduct a series of socially responsible activities that are not adequately recognized as such. These activities, which are conducted periodically, in most cases point to the ethical principles of the owner rather than the idea that they could bring benefits and advantages to the owners of the business. All in all, the main obstacles to the inclusion of SMEs in CSR are the lack of awareness and lack of funds.

Keeping in mind the upcoming process of integration into the European Union, on the one hand, there is a growing opportunity for companies in Serbia to improve their approach and the presence in the single market of the European Union, but on the other hand, it is there that they are faced with the expectations of consumers, supervisors and investors regarding the implementation of CSR practices. In addition, the companies in Serbia that intend to cooperate with large foreign companies need to introduce the CSR practices because they are often in accordance their policies and a prerequisite for business cooperation (according to Strategy for development and promotion of Social Responsibility in the Republic of Serbia for the period 2010-2015).

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REFERENCES

Asongu, J.J. (2007). Journal of Business and Public Policy, The History of CSR, Retrieved from http://issuu.com/drvayanos/docs/842

Carlisle, Y. M., & Faulkner, D. O. (2004). Corporate social responsibility: a stages framework. *European Business Journal*, 16(4), 143-151.

Carroll, A. B. (1999). Corporate social responsibility evolution of a definitional construct. *Business & society*, 38(3), 268-295.

Dahlsrud, A. (2008). How Corporate Social Responsibility is Defined: An Analysis of 37 Definitions. *Corporate Social Responsibility and Environmental Management*, 15(1), 1–13.

Djuric, M., Vujosevic, M. & Kovacevic, N. (2012) The impacts of organizations" social responsibility on the supply chain management, Symorg 2012, pp.476-484.

Enderle, G. (2004). Global competition and corporate responsibilities of small and medium- sized enterprises. *Business Ethics: A European Review*, 13(1), 50-63.

European Commission - Directorate-General For Enterprise And Industry. Opportunity and Responsibility. How to help more small businesses to integrate social and environmental issues into what they do. Retrieved from http://ec.europa.eu/enterprise/policies/sustainable-business/files/csr/documents/eg_report_and_key_messages/key_messages_en.pdf

European Commission. (2014). Corporate Social Responsibility and Small & Medium Enterprises (SMEs). Retrieved from http://ec.europa.eu/enterprise/policies/sustainable-business/corporate-social-responsibility/sme/index_en.htm

European Project Center – EPC. (2012). EU funding opportunities for SMEs in Serbia. European Project Center – EPC. Belgrade. Retrieved from http://www.daad.rs/imperia/md/content/informationszentren/belgrad/eu_funding_opportunities_pages.pdf

Filipovic, J. (2008). Corporate Social Responsibility-Implications on National Quality Improvement Strategy

Garriga, E., & Melé, D. (2004). Corporate social responsibility theories: mapping the territory. *Journal of business ethics*, 53(1-2), 51-71.

Hellenic Network for CSR, Corporate social responsibility & small medium enterprises. The road to competitiveness and sustainable development. Retrieved from http://www.csrhellas.org/csr_last2/portal/images/stories/files/docs/CSR_SME_BROCHURE_eng.pdf

Holme, R. & Watts, P. (2000), Making Good Business Sense, *World Business Council for Sustainable Development*, Geneva.

ISO 26000:2010 - Guidance on social responsibility

Jones, T. M. (1980). Corporate social responsibility revisited, redefined. *California Management Review*, 22(2), 59–67.

Luetkenhorst, W. (2004). Corporate social responsibility and the development agenda. *Intereconomics*, 39(3), 157-166.

Marsden, C. (2001). The Role of Public Authorities in Corporate Social Responsibility. Retrieved from http://www.alter.be/socialresponsibility/ people/marchri/en/displayPerson

McWilliams, A., & Siegel, D. (2001). Corporate social responsibility: A theory of the firm perspective. *Academy of management review*, 26(1), 117-127.

Murillo, D., & Lozano, J. M. (2006). SMEs and CSR: An approach to CSR in their own words. *Journal of Business Ethics*, 67(3), 227-240.
Nejati, M., & Amran, A. (2009). Corporate social responsibility and SMEs: exploratory study on motivations from a Malaysian perspective. *Business strategy series*, 10(5), 259-265.
Pérez, A., & del Bosque, I. R. (2014). Customer CSR expectations in the banking industry. *International Journal of Bank Marketing*, *32*(3), 223-244.
Perez-Sanchez, D., Barton, J. R., & Bower, D. (2003). Implementing environmental management in SMEs. *Corporate Social Responsibility and Environmental Management*, 10(2), 67-77.
Pinney, C. (2001). Imagine Speaks Out. How to Manage Corporate Social Responsibility and Reputation in a Global Marketplace: the Challenge for Canadian Business. Retrieved from http://www.imagine.ca/content/media/team_canada_china_paper.asp?section = media
Planken, B., Nickerson, C., & Sahu, S. (2013). CSR across the globe: Dutch and Indian consumers' responses to CSR. *International Journal of Organizational Analysis*, 21(3), 357-372.
Polášek, D. (2010) M.B.A., Doctoral Thesis „Corporate Social Responsibility in Small and Medium-Sized Companies in the Czech Republic", Czech Management institute Praha, Faculty of Management**.**
Poolthong, Y., & Mandhachitara, R. (2009). Customer expectations of CSR, perceived service quality and brand effect in Thai retail banking. *International Journal of Bank Marketing*, 27(6), 408-427.
Revell, A., & Blackburn, R. (2007). The business case for sustainability? An examination of small firms in the UK's construction and restaurant sectors.*Business Strategy and the Environment*, 16(6), 404-420.
Sarbutts, N. (2003). Can SMEs "do" CSR? A practitioner"s view of the ways small-and medium-sized enterprises are able to manage reputation through corporate social responsibility. *Journal of Communication Management*, 7(4), 340-347.
Spence, L. J. (1999). Does size matter? The state of the art in small business ethics. *Business ethics: a European review*, 8(3), 163-174.
Spence, L. J., & Rutherfoord, R. (2001). Social responsibility, profit maximisation and the small firm owner-manager. *Journal of Small Business and Enterprise Development*, 8(2), 126-139.
Strategija razvoja I promocije drustveno odgovornog poslovanja u republici Srbiji za period od 2010. do 2015.
Sweeney, L. (2007). Corporate social responsibility in Ireland: barriers and opportunities experienced by SMEs when undertaking CSR. *Corporate governance*, 7(4), 516-523.
Tencati, A., Perrini, F., & Pogutz, S. (2004). New tools to foster corporate socially responsible behavior. *Journal of Business Ethics*, 53(1-2), 173-190.
The CSR History. (2011). *The African policy Institute*. Retrieved from http://www.africapi.org/#
van der Wiele, T., Kok, P., McKenna, R., & Brown, A. (2001). A corporate social responsibility audit within a quality management framework. *Journal of Business Ethics*, 31(4), 285-297.
Vives, A. (2006). Social and environmental responsibility in small and medium enterprises in Latin America. *Journal of Corporate Citizenship*, 2006(21), 39-50.

THE ECONOMIC SUSTAINABILITY OF STANDARDS – CAN ISO METHODOLOGY HELP?

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Abstract: *In publication by ISO, Economic benefits of standard-ISO methodology 2.0, is explained how one organization can measure the economic benefits that introduced standard brings with it. Methodology consists of four basic steps that defines what the company needs to do to make the results relevant and accurate. Using various tools and techniques that this methodology suggests, one can easily distinguish economic improvement that is caused by standard and economic improvement caused by other factors. But in practice it is more difficult than in theory. It is very hard, nearly impossible to measure economic impacts of standard. There are many issues that should be clear such as cost of assessment, determine of operational indicators and validity of results.*

Keywords: Standards, Sustainability, Economic Sustainability, Economic benefit of Standardization

1. INTRODUCTION

1.1. Importance of Standards in Business

There are many definitions of standards as term of “standards” is used in the world in almost all spheres of life. According to CEN, standard is “a document that sets out requirements for a specific item, material, component, system or service, or describes in detail a particular method or procedure. Standards facilitate international trade by ensuring compatibility and interoperability of components, products and services. They bring benefits to businesses and consumers in terms of reducing costs, enhancing performance and improving safety” (CEN-CENELEC,2014).

According to ISO “a standard is a document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose” (ISO,2014). This is one of the many definitions of IEC gives two little rougher definition of standards but also the definition of a standard observer from two aspects, in terms of formal standard bodies and industry. Standard is an agreement developed by several parties with the intent that all parties comply, and also standard is a product or service with a significant market share (IEC,2007). In terms of formal standard bodies a standard is “a document established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context” (ISO/IEC, 2004b, p.8). From the aspect of industry “A standard can be of any form or type. A standard is also one of the agents used to bring about market change” (IEC, 2007)

Standards are produced for many different products and services, and may be created for company, national, regional or global application. They may be used on a voluntary basis, or made mandatory by company policy, national or international regulation, or by law (ETSI,2014).

In Europe there are three different categories of standard (ETSI,2014):

- international standard – a standard adopted by an international standardization organization
- European standard – a standard adopted by a European standardization body
- national standard – a standard adopted by a national standardization body and made available to the public

Standards are by nature associated with the sustainability of the business system and the environment in which it operates, simply because the standards are trying to meet the criteria of sustainability arises. The environmental stewardship and social responsibility values of sustainability are reflected in the missions of

the participating organizations. In addition, many of the systems have developed environmental vision statements that articulate an organizational commitment to sustainability (Boone, Jayaraman, Ganeshan, 2012)

1.2. Relationship between standardization and sustainability

A mission is also public affirmation about how the organization defines itself. Public promotion of an organization's sustainability must be carefully managed. On the one hand, sustainability may help to bolster the organization's brand and reputation. Research has indicated that intangible assets such as reputation may provide a more enduring competitive advantage than other business assets and support long-term success. Signaling the strategic value of sustainability conveys a powerful message to communities and customers (Boone, Jayaraman, Ganeshan, 2012). Authors Darcy Hitchcock and Marsha Willard (2006) in their book "The business guide to sustainability practical strategies and tools for organizations" on sustainability told :" Unless you want to be buffered by each change you need framework for making sense what is happening in world, so that you can foresee changes and take actions before they happen. Sustainability is that kind of framework. It doesn't encompass everything you'll need to track to be successful and it's not a crystal ball. However sustainability helps you to see relationships between issues and more accurately forecast what may you occur in the future. It examines our world as a whole system revealing threats and opportunities. It forces you to see relationship between social, economic and environmental trends."

Hitchcock and Willard (2006) recognize the following Benefits of pursuing sustainability:

- Reduce energy, waste and cost
- Differentiate yourself
- Sidestep future regulations
- Create innovative product or process
- Open new markets
- Attract and retain best employees
- Improve your image with shareholders and public
- Reduce legal risk and insurance costs
- Provide a higher quality of life

After these advantages pursuing sustainability it is unavoidable mentioning definition of economic sustainability. The widely accepted definition of economic sustainability is maintenance of capital, or keeping capital intact. Thus Hicks's definition of income–the amount one can consume during a period and still be as well off at the end of the period–can define economic sustainability, as it devolves on consuming value-added (interest), rather than capital (Goodland, 2002). "Economic sustainability is the word used to pinpoint numerous strategies that make it conceivable to use accessible resources to their best advantage. The idea is to uphold the use of those resources in a way that is both skillful and responsible, and likely to deliver long-term benefits"(Ask.com, 2014). Every society can be described as comprising four dimensions, the economic, social, environmental and institutional. "Each of them is a complex, dynamic, self-organizing and evolving entity in its own right, making the coupled system one of tremendous complexity. For this system to be sustainable, each of the four subsystems has to maintain its capability to survive and evolve while the interlink ages of the subsystems must enable a permanent co-evolution. In the macro-economic debate, few other economic sustainability criteria are mentioned, like innovativeness, competitiveness or public debt, while criteria like inflation or trade imbalances are politically prominent, but hardly ever located in a sustainability context with its broader perspective and the need to balance different interests. Again, other, partly more traditional criteria like aggregate demand, consumption levels and savings rates play a minor role in the current debate. So whereas there are ideas to be found in the economics literature regarding the environmental, social and sometimes also the institutional sustainability of the economic system, there is hardly any information available on the economic sustainability of the economy (and thus not on the overall sustainability of the economy, which comprises all four components). Even less so, criteria of economic sustainability have been developed for the other dimensions. This is all the more surprising, as the economic sustainability of social security systems or environmental protection legislation is a prominent issue of the policy debate." (Spangenberg J., 2005)

Close connection between standardization and sustainability is recognized in numbered benefits of standardization. It can be seen that some benefits of pursuing sustainability and sustainable development, are also some of the benefits of standardization by ISO. International Standards bring technological, economic and societal benefits. They help to harmonize technical specifications of products and services

making industry more efficient and breaking down barriers to international trade. Conformity to International Standards helps reassure consumers that products are safe, efficient and good for the environment. ISO recognize standardization benefits for business, society and government. For business main benefits is ensuring that business operations are as efficient as possible, increase productivity and help companies access new markets. (ISO,2014)

According to ISO (2014) benefits include :

- Cost savings - International Standards help optimize operations and therefore improve the bottom line
- Enhanced customer satisfaction - International Standards help improve quality, enhance customer satisfaction and increase sales
- Access to new markets - International Standards help prevent trade barriers and open up global markets
- Increased market share - International Standards help increase productivity and competitive advantage
- Environmental benefits - International Standards help reduce negative impacts on the environment

Majority of stated benefits can be linked with the economic improvement of one organization in direct or indirect way.

2. ISO METHODOLOGY FOR MEASURING ECONOMIC BENEFITS OF STANDARDS

"ISO has developed a simple, step-by-step methodology and a robust set of tools to measure the economic benefits of standards. The methodology can be applied to all companies and industry sectors in order to identify the contribution that standards make to their performance." This is introduction line in the book published by International organization for standardization "Economic benefits of standard-ISO methodology 2.0",which can be used to measure economic impact of standards involved in organization.
In a few steps using certain methodology suggested in this publication organization can easily measure improvement expressed in money. The primary scope of the ISO Methodology is assessing the economic benefits of standards (i.e. the contribution of standards to the creation of economic value) for a company.

ISO methodology is explained in Figure 1 with all necessary steps.

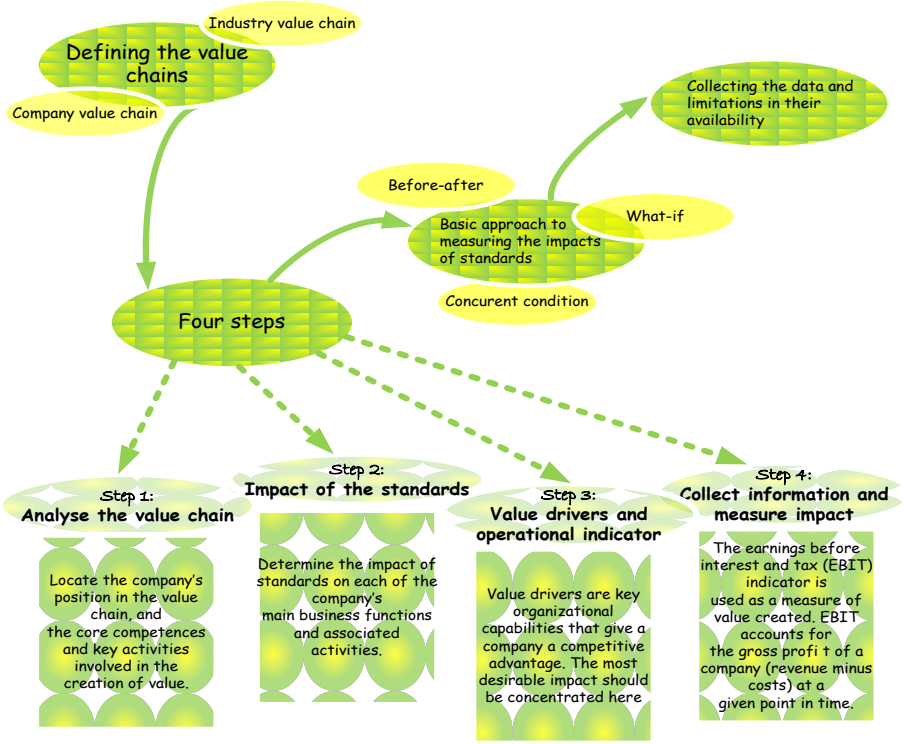

Figure 1: ISO methodology (Modified in accordance to Economic benefits of standard-ISO methodology 2.0)

There are two types of value chain explained in methodology, company value chain and industry value chain. A company value chain represents the chain of activities conducted inside a company. Those chains represent internal processes of every company and it explains their relationships.(ISO Methodology,2013)

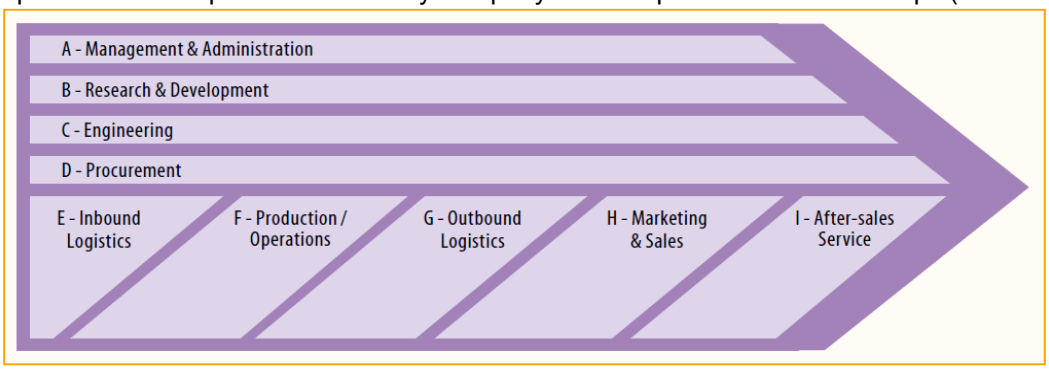

Figure 2: The value chain of manufacturing company (ISO Methodology,2013)

On the other hand value chain model can be extended to a whole industry sector, in which case the various stages of production and services and the network of suppliers and customers are included in the perspective. This is referred to as the " industry value chain " (ISO Methodology,2013)

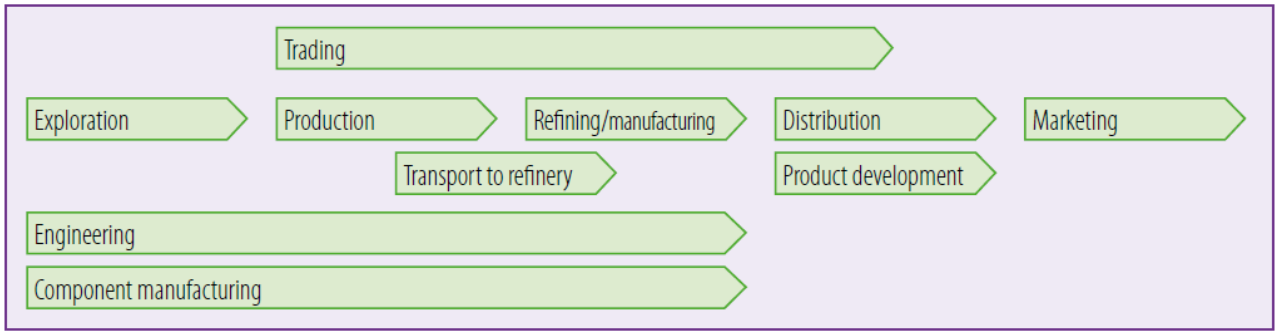

Figure 3: Oil and gas engineering industry value chain and scope (according to ISO methodology,2013)

After those steps company should have all required information needed for measuring benefits of standards. There are some techniques that organization can use for analyzing impact of standard before and after their introduction in certain company. It can be used before-after comparison, comparison of concurrent condition and what if analysis. Technique that ISO methodology recommends is before-after comparison because of information that are clearly stated after assessment. (ISO Methodology,2013)

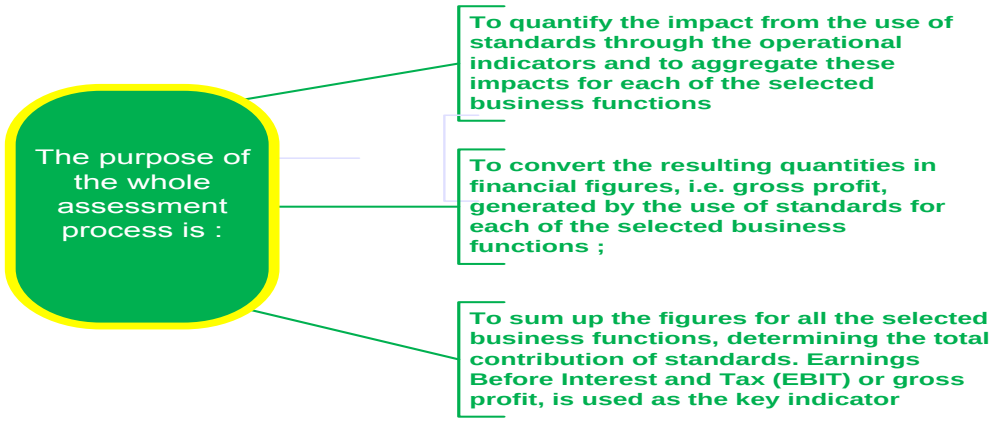

Figure 4: Purpose of assessment (Modified according to ISO Methodology,2013)

Organization after the measurement and data collection use the main indicator. The main indicator in ISO methodology is EBIT."EBIT is an indicator of a company's profitability, calculated as revenue minus expenses, excluding tax and interest. EBIT is also referred to as "operating earnings", "operating profit" and "operating income".

Income Statement for the Year Ending December 31, 2009	
Sales Revenue	$1,000,000
Salaries	(100,000)
Rent & Utilities	(100,000)
Depreciation	(50,000)
Operating Profit (EBIT)	**$ 750,000**
Interest Expense	(50,000)
Earnings Before Taxes (EBT)	**$ 700,000**
Taxes	(100,000)
Net Income	**$ 600,000**

Figure 5: Example of EBIT calculation (Investopedia, 2014)

EBIT = Operating Revenue – Operating Expenses (OPEX) + Non-operating Income

Also known as Profit Before Interest & Taxes (PBIT), EBIT equals Net Income with interest and taxes added back to it.

In other words, EBIT is all profits before taking into account interest payments and income taxes. An important factor contributing to the widespread use of EBIT is the way in which it nulls the effects of the different capital structures and tax rates used by different companies. By excluding both taxes and interest expenses, the figure hones in on the company's ability to profit and thus makes for easier cross-company comparisons." (Investopedia US, A Division of IAC,2014)

3. DOES ISO METHODOLOGY WORK?

According to ISO methodology with steps explained in this publication organization can easily measure impact of every standard introduced in system. It is also explained how organization should measure and distinguish every impact that is not caused by standard implementation and advised to be very careful in order to calculate impacts properly. (ISO Methodology,2013)

In order to implement such a methodology proposed by the ISO, the organization must meet certain requirements. One of the conditions is that the organization must be certified by a recognized standard for at least three years (ISO Methodology,2013). If organization wants to examine the impact of standards in the last three years, it needs to analyze the data at least for past three years for the sake of accuracy and relevance of the results. The question that arises is whether small and medium enterprises keep records of all operational indicators that are needed to calculate progress in accordance with ISO publication. Information system should provide information that will be easy to monitor the effect of standard. Most companies their information systems about operational indicators that has influence on economic aspect of standard, established after the introduction of relevant standards so that information from previous periods are generally useless or does not exist. Such an approach, which is present in most of the companies that have a need for an assessment of the economic effects of standards, hampers the analysis proposed by the ISO.

Determine the operational indicators is another problem that arises in ISO methodology. Operational indicators referred in this publication should not be taken for granted simply because the impact on a particular part of the organizational unit can not be measured only through the standard and its impact on the process. It also depends of all others factors that have influence on certain process. In company operational indicators point to improvement or deterioration which occur due to the influence of various factors on the process. Some operational indicators such as employee morale, which in some cases significantly affects productivity, is immeasurable. It is impossible to determine that implementation of certain standard is credited for raised staff morale .It's just another reason why you can not accurately gauge the impact of standards on entire organization. If one can not accurately determine the impact on individual organizational levels, each error is multiplied by switching to the next hierarchical level in the organization.

While introducing generic type of standard in organization it is very difficult to determine what direct impact of standard is and what is a impact of some others factor involved. Other factor includes political, economic, social and technical changes in business environment. For example, a productivity increase is achieved for certain activities after the introduction of standards. This improvement is determined by changes in the work practices that have been driven by the new standards – but also by organizational changes and the use of newly introduced technology. Also improvement of organization can be caused by various market developments that could lead to weakened competition, and thus increase organization market share.

4. CONCLUSION

According to ISO methodology with steps explained in this publication organization can easily measure impact of every standard introduced in system. It is also explained how organization should measure and distinguish every impact that is not caused by standard implementation and advised to be very careful in order to calculate impacts properly. However, in business practice it is not always easy to define performance measures, obtain data related to performance indicators and make reliable conclusion about economic effects of standards. There are many issues that should be clear:

- ISO methodology is retrospective in meaning that for adequate implementation of this methodology need at least three years of standard' implementation for first conclusion about economic effects
- Operational indicators referred in this publication should not be taken for granted simply because effects of standard can not be isolated from other influential factors as well as changes in business environment.
- Some operational indicators are immeasurable
- ISO methodology is not taking into account dynamics of performance measures and influence of others factors on particular performance measures during the measuring period (e.g. three years).

REFERENCES

Boone T., Jayaraman, V., Ganeshan R.,(2012) Sustainable Supply Chains: Models, Methods, and Public Policy Implications. Springer Science, Business Media New York

Hitchcock D., Willard M.,(2006) The Business Guide to Sustainability: Practical Strategies and Tools for organizations. Axise Performance Advisor ,Inc.

Goodland R.,(2002) Sustainability: Human, Social, Economic and Environmental. This article is a sample from the forthcoming Encyclopedia of Global Environmental Change. John Wiley & Sons, Ltd

Spangenberg J., (2005) Economic sustainability of the economy: concepts and indicators Int. J. Sustainable Development, Vol. 8, Nos. 1/2, 2005

International Organization for Standardization (2013) Economic benefits of standard-ISO methodology 2.0

"What is a European Standard" ,http://www.cencenelec.eu (retrieved 2014.04.15).

"Introduction to standards", http://www.iec.ch/about/globalreach/academia/pps/lect2007_1.pps (retrieved 2014.04.17).

"Economic sustainability definition",http://www.ask.com/question/economic-sustainability-definition (retrieved 2014.04.17)

"What are standards?", http://www.etsi.org/standards/what-are-standards (retrieved 2014.04.17).

"Benefits of International Standards", http://www.iso.org/iso/home/standards/benefitsofstandards.htm (retrieved 2014.04.15).Earnings Before Interest, Tax, Depreciation and Amortization (EBITDA), http://www.investinganswers.com/images/ebitda-def-image.gif (retrieved 2014.04.15).Earnings Before Interest & Tax - EBIT, http://www.investopedia.com/terms/e/ebit.asp (retrieved 2014.04.15).

EXPERIENCES IN THE IMPLEMENTATION OF ISO 20000

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Abstract:*This article discusses the topic of ISO 20000 standard implementation, which is very important for an organization in order to achieve continuous improvement and growth. ISO 20000 standard is a subject of numerous studies which highlight the its importance as well as its main purpose. This paper presents briefly the development and structure of ISO 20000 standard and summarizes its implementation in Serbian companies.*

Keywords*:ISO 20000 standard, IT service, ISO 20000 standard implementation*

1. INTRODUCTION

In today's business organizations are constantly trying to be better and better by improving their products and their way of work, which made a huge space for new companies to enter the market. In this manner, small changes can make a big difference. The same goes with usage of ISO/IEC 20000. There is a thesis that organizations that are using standards do a better business.This paper discusses the development and structure of ISO 20000 standard in order to stress the importance of having well defined goals and implementation of standards as a step towards stable growth. Afterwards, the successful implementation of ISO 20000 standard in Serbia has been presented by giving the description and basic information about certified companies.

Development of ISO/IEC 20000 is shown in second paragraph, explaining its roots and extensions afterwards. It also shows division of standard into 13 IT processes. The third paragraph shows the structure of the standard divided into 8 areas. The nextparagraph suggests implementation steps. First of them is to answer several questions of high importance. Besides, there is a growing trend of companies being certified, also presented in the benefits that organizations can gain by attainingthe certificate. Fifth paragraph presents current state of usage of ISO/IEC 20000 in companies in Serbia with examples of their certificates. The last paragraph is conclusion of information given and thoughts about certification and use of standard.

2. DEVELOPMENT OF ISO 20000

ISO/IEC 20000 is the first International Standard for IT Service Management processes. It was developed in 2005 by ISO JTC 1/SC 7 Technical Committee. It was based on BS15000 standard (published in 2000) which was retreated later. ISO/IEC 20000 helps organizations to effectively manage services to meet business and customer requirements.

In June 2011 comes the first update to ISO/IEC 20000, called ISO/IEC 20000-1:2011. (Part 1: Service management system requirements) It describes systems for managing services (SMS – Service Management System). It includes all requirements company should fulfil in terms of planning, establishment, application, implementation, monitoring, review, maintenance and improvement of Service Management System. This standard contains 256 requests, divided in 6 groups, which relate to design, change, delivery and service improvement. Also, it can be divided into 13 IT processes (from four key service management processes)(source: http://www.standards.org):

1. Service Delivery Processes – includes Service Level Management, Availability Management, Capacity Management
2. Relationship Processes – involves interfaces between the service provider and customers and suppliers
3. Resolution Processes – focuses on incidents being resolved or prevented
4. Control Processes – involves managing changes, assets and configurations

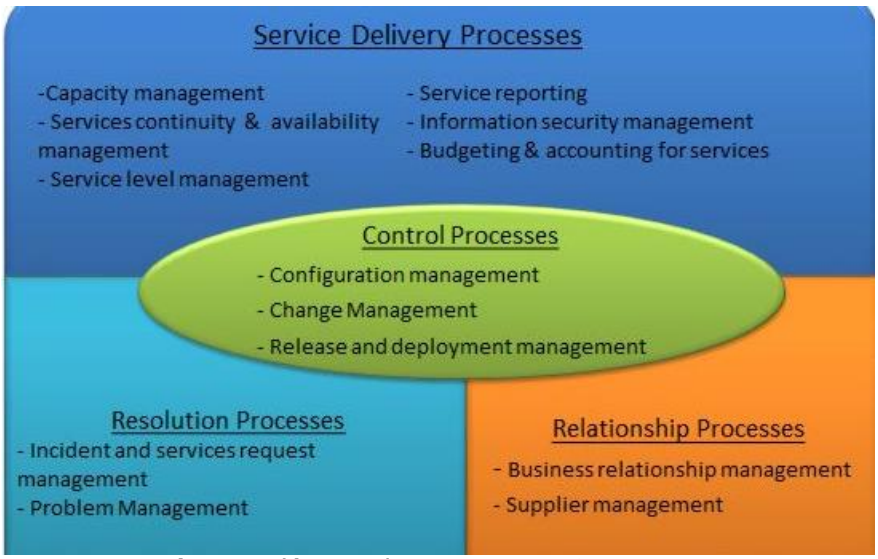

Figure 1: Key service management processes

In 2012, a new version was introduced – ISO/IEC 20000-2:2012 (Part 2: Guidance on the application of service management systems) Includes instructions for application of SMS based on the requirements in ISO/IEC 20000-1. It includes examples and suggestions for system usage. ISO/IEC 20000-2:2012 gives organizations an opportunity to interpret and apply ISO/IEC 20000-1:2011 more accurately and to use it more effectively.

ISO/IEC TR 20000-3:2009 (Part 3: Guidance on scope definition and applicability of ISO/IEC 20000-1) Provides guidance on scope definition and applicability of ISO/IEC 20000-1. It can help organizations that are considering implementing a Service Management System into their business.

ISO/IEC TR 20000-4:2010 (Part 4: Process reference model) Facilitates the development of a process assessment model according to ISO/IEC 15504 process assessment principles. Model described by this standard is a logical representation of the process' elements within the service management that can be performed at a basic level. It describes all the processes on the abstract level, including the SMS processes described in ISO/IEC 20000-1, as a primary purpose and output elements.

ISO/IEC TR 20000-5:2010 (Part 5: Exemplar implementation plan for ISO/IEC 20000-1) Is an example of implementation plan providing guidance to service providers on how to implement a SMS to fulfil requirements of ISO/20000-1 or those intending to use ISO/20000 as a business goal. ISO/IEC TR 20000-5:2010 is only for guidance. The service provider has the option of choosing their own implementation sequence to implement a service management system.

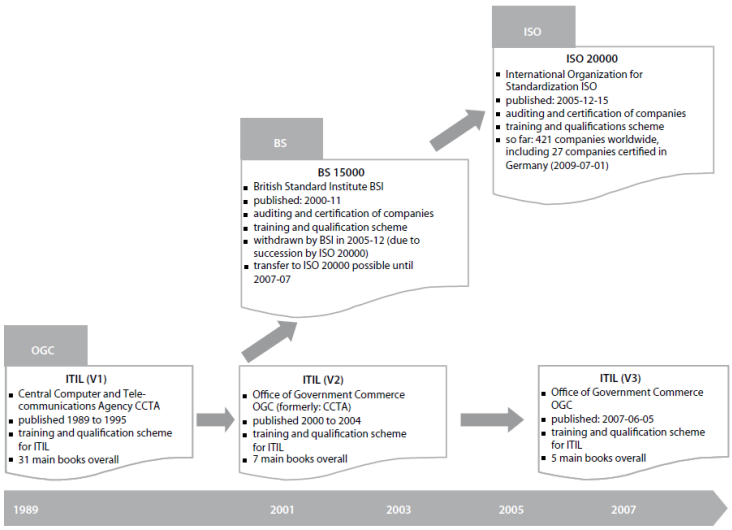

Figure 2 shows the origin and development of ISO 20000.

Figure 2: Origin and development of ISO 2000

3. THE STRUCTURE OF ISO 20000 STANDARD

ISO 20000 standardis codified into two documents:

1. ISO 20000–1 (2005)
2. ISO 20000–2 (2005).

The first document is known as “mandatory criteria” (Buchsein et al., 2007; Greb et al., 2006) because it represents the formal specification of the standard, where all the requirements that one organization needs to comply with in order to attain certificate are precisely described. In other words, this document provides an absolute set of standards that a company must meet for successfull accreditation.The second document represents an addition to the first one, in which all of the requirements are classified and the recommendations for successfull implementation are provided.for verification of conformity with the standard (MacFarlane and Dugmore, 2006). This means that here a company can consider wider optional set of best practise approaches and decide which of them to include in order to obtain better assessment.

The superordinate management processes are supposed to secure a strategic alignment of IT services, in particular an alignment to the objectives of (internal and external) customers as well as economic and quality objectives.

The structure of ISO/IEC 20000 can be divided in several areas (source: http://www.barclayrae.com):

1. Requirements for a management system –this area describes that the management of a company must deploy all suitable processes and policieson aregularly basis in order to be able to manage IT services in line with the business needs.
2. Planning and implementing service management – this area describes that the organization must plan and manage all service activity. Within ISO/IEC 20000 this implies the use of Deming’s famous PDCA (Plan, Do, Check, Act) approach.
3. Planning and implementing new or changed services – this area describes that the organization should plan any new or changed activities are carefully in terms of decreasing their impact on business and maximising the expected service quality benefits as soon as possible.
4. Service Delivery processes
    a. Service Level management – this section describes that a company must have defined, agreed level of services in order to be able to record and manage it.
    b. Service Reporting – this section describes the importance of producing agreed, timely, reliable and accurate reports in order to realise informed decision making and effective communication.
    c. Service continuity and availability management – this section describes that a company should be able to meet agreed obligations to customersin all circumstances.
    d. Budgeting and accounting for IT services – this section describes that a company should budget and account for the cost of service provision.
    e. Capacity management – this section describes that a company must have at all times, sufficient capacity to meet the current and future agreed demands of the business.
    f. Information security management – this section describes the importance of managing information security effectively within all service activities.
5. Relationship Processes
    a. Business relationship management – this section describes the importance of establishing and maintaining a good relationship between the service provider and the customer.
    b. Supplier management – this section describes the importance of managingthird party suppliers to ensure the provision of quality services.
6. Resolution Processes
    a. Incident management – this section describes that a company should have the ability to restore agreed service to the business or to respond to service requestsas soon as possible.
    b. Problem management – this section describes the importance of proactive identification and analysis of the cause of service incidents, as well as the importance of managing problems to closure in order to minimise disruption to the business.
7. Control Processes
    a. Configuration management – this section describes that a company should maintain accurate configuration information, but alsodefine and control the components of the service and infrastructure.
    b. Change management – this section describes that all changes should be assessed, approved, implemented and reviewed in a controlled manner.
8. Release Process
    a. Release management – this section describes that a company should deliver, distribute and track one or more changes in a release into the live environment.

Figure 3 shows the structure of ISO 20000 standard, described above.

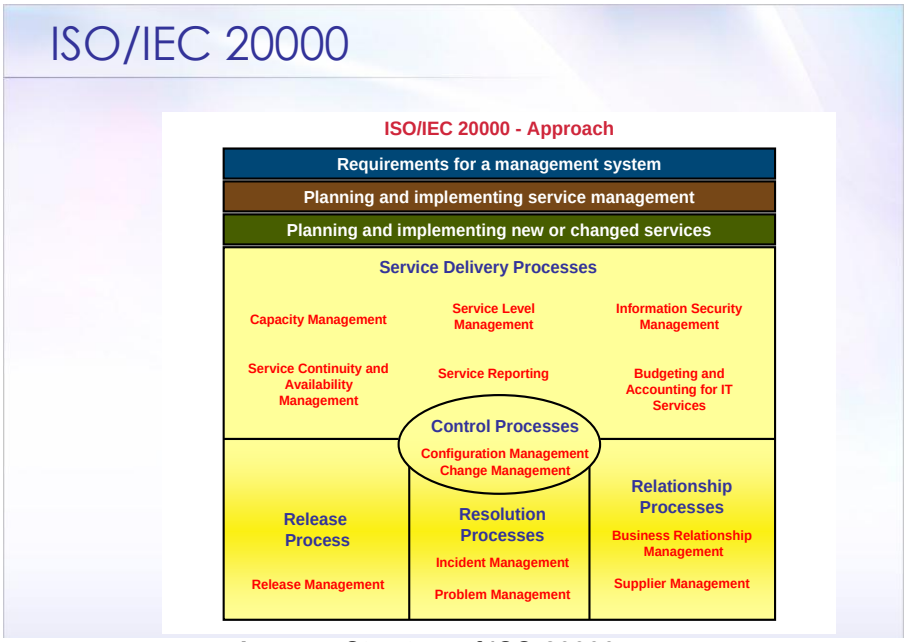

Figure 3: Structure of ISO 20000

4. IMPLEMENTATION EXPERIENCES

When considering the implementation of ISO/IEC 20000 standard, a company should seriously answer the following key questions:

- Is this right for us? – are we eligible, is this a mandatory business need, will we get clear benefits
- Where do we stand currently against the standards? – how actually are we ready for implementation and what are the current problems that need to be solved
- What benefits do we expect from ISO/IEC 20000? – what are the industry standing, cost and quality benefitsof ISO 20000 standardimplementation
- What work is involved? – how much planning, costs, time and resources are required to achieve ISO/IEC 20000 accreditation

The implementation of ISO 20000 has different internal and external effects on organization as a whole (Disterer, 2009). From an internal perspective, before organization becomes ISO 20000 certified, the anchoring of continuous improvement processes for IT services within the organization intensifies while pursuing the certificate. The employees that are involved in continuous improvement become more motivated and when the goal is reached it represents an impulse and reinforcement by highlighting the achievement of the certificate. For the senior management certification can serve as a relatively clear-cut objective of a complex transformation process. The success of implementation can be easily observed by means of the attained certificate and the position and reputation of organization on the market that improves and becomes more trustworthy and recognized by certain level of service quality. Since the certificate represents a proof of conformity with implemented standards, it is clear that it can serve the company as a marketing tool. This is closely related to an external perspective of standard implementation impacts on organization. Emphasizing that an independent body has certificated the company by using well defined procedures, customers are provided with evidence that all the conditions and requirementsof ISO 20000 standard are met. This is extremely important when customers tend to choose IT providers based on their compliance with the standard.
Figure 4 shows the number of ISO 20000 certified companies in Europe, Asia and the rest of the world (RoW) (Disterer, 2009).

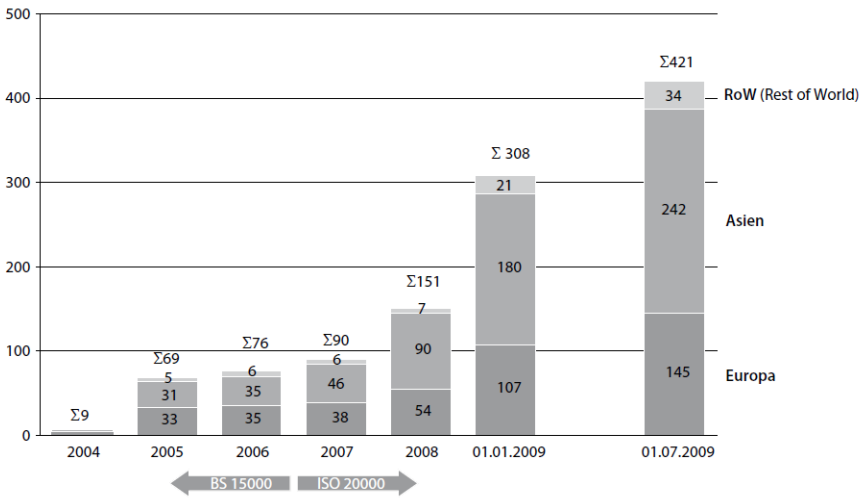

Figure4: Certified companies

Benefits

Usage of ISO/IEC 20000 benefits organization in many ways. It reduces costs, risk and time spent to introduce products/services to the market. All of this contributes to company's competitiveness. It changes way of doing services from technology driven to business driven, which makes service provides more responsive. IT becomes pro-active rather than re-active, and it brings KPI measurement criteria. Company using ISO/IEC 20000 shows service reliability and consistency, and it is more preferable to be chosen over one without this standard. "Certification audits are continual and should be treated as a mechanism for educating and raising awareness of employees. Certification can also reduce the amount of supplier audits thereby reducing costs. Finally, the use of qualified and independent auditors can be used as a benchmark" (Menken, 2009).

5.IMPLEMENTATION OF ISO 20000 IN COMPANIES IN SERBIA

ASW Engineering

Company ASW Engineering was founded in 1990 and now it operates on large IT service market in Serbia, Slovenia and Bosnia and Herzegovina (source: http://www.asw.eu). The services, that company ASW Engineering offers, include implementation, customer support and consulting. Company's most important products are shown in figure 5.

Figure 5: ASW Engineering products

Having the goal to broaden the range of solutions, company growth and expansion in region and in EU, ASW company started with serious planning and decision making regarding the regarding standardization of processes in quality management system and the quality of its products. Before making a final decision the following reason for standards implementation were identified:

- the trend of growing needs for services in IT sector
- the key income sources are services

Because of these reason it has been decided to implement first ISO 9001 (QMS) in 2005 and then ISO 20000 (SMS) in 2013. The implementation of ISO/IEC 20000 in ASW lasted over 3 months and over 50 persons participated.

Basic processes improved and implemented while attaining ISO/IEC 20000-1 include:

- Service provision processes
  - capacity management
  - managing the level of services
  - reporting about provided services
  - managing the continuity and accessibility of services
  - budgeting and accounting for services
  - managing the security of information
- Connection processes
  - managing business relationships
  - managing the suppliers
- Problem solving processes (diagnosing the source of problems and decreasing the number of incidents):
  - managing the incidents and needs for services
  - managing problems
- Control processes (controlling the change, managing new versions):
  - managing configuration
  - managing changes
  - managing versions

The changes and improvements in capacity management were made in recording the knowledge of employees, increasing the independency of individuals, creating the catalogue of products and services, company's responsiveness to short deadlines. When it comes to managing the continuity and accessibility of service handling of irregular situations in providing services become more efficient and the business continuity plan was created.Managing the level of services and reporting about provided services was improved by enriching and specifying the content of service, speeding up answering to customer needs, performing calculation on used time, creating a team for customer support, providing the customers withasw:officius–toolfor customer support and asw:portal.

The expected and achieved benefits from implementing ISO/IEC 20000-1 can be summarized with the following:

- increasing the client's satisfaction by increasing the level of IT services
- optimal resource usage
- continuous service provision
- participating in projects that require ISO/IEC 20000 standardimplementation
- better position on IT market
- integration with existing system ISO/IEC 9001, which leads to Integrated management system

Figure 6 shows ASW Engineering's ISO/IEC 20000-1certificate.

IT Service Management System

Certificate of Approval

Ovim se potvrđuje da je IT Sistem Menadžmenta Uslugom:

ASW-Inženjering doo

Takovska 45A, Beograd
Srbija

ocenjen i da ispunjava zahteve:

ISO/IEC 20000-1:2011

Sertifikat je važeći za sledeći delokrug rada:

Sistem upravljanja uslugama koji podržava pružanje IT usluga, konsultacija, korisničke podrške, razvoj i implementacija softvera u okviru tehničkih i organizacionih granica ASW-Inženjering doo

Datum izdavanja sertifikata: 06. novembar 2013.
Sertifikat važi do: 05. novembar 2016.
DAS sertifikacija od: 06. novembar 2013.
Broj sertifikata: SO1-1333-006-DC-IT

Overava:

DAS CERTIFICATION LTD

Ovaj sertifikat je u vlasništvu DAS Certification Ltd. i predmet je redovnih nadzornih provera
Re-sertifikaciona provera do 21. oktobra 2016.

DAS Certification Ltd., Company Number: 3384526, 1 Wellington, Clare, Horndean, Hampshire PO8 0UR UK

Figure 6:ASW Engineering's ISO/IEC 20000-1certificate

Other ISO 20000 certified companies in Serbia

The PREMIUM Software doo company has attained ISO/IEC 20000 certificate on 11 Nov 2013 (source:http://www.isoiec20000certification.com). The company has been certified under the APM group ISO/IEC 20000certification scheme. This certificate guarantees IT Service Management that includes the provision of enterprise and internet applications services to all external clients within the technical and organizational boundaries of PREMIUM Software doo, Serbia.

Societe Generale deSurveillance, Swiss has provided the PARALLEL d.o.o. company with ISO/IEC 20000 on 07 Oct 2013 (source: http://parallel.rs/). PARALLEL d.o.o. company is engaged in consulting and implementation of IT solutions, technical support and administration, Oracle training and licencing Oracle softwwares.

On 12 Dec 2012 the Xpro companyhas attained ISO/IEC 20000 certificate concerning the areas of sales, implementation and managed print services provision, creation and integration of document management system, application development, processing and providing services in the area of variable and transactional printing and mail packaging (source: http://www.xpro.rs). Xpro company is the Xerox corporation exclusive distributer, which means that the organization and the quality of sales and servicing are in compliance with the standards of Xerox corporation. Figure 7 shows their ISO/IEC 20000 certificate.

LL-C (Certification)

Ovim putem verifikuje se da je sistem upravljanja IT uslugama u

Xpro d.o.o.
Pavljanina Baja 53a
11000 Beograd
Srbija

ocenjen i utvrdjeno je da je u skladu sa standardom
ISO/IEC 20000-1:2011

Primenjuje se na:

Sistem upravljanja uslužnim delatnostima u oblasti savetovanja, prodaje, integracije i implementacije poslovnih rešenja u oblastima: Upravljanje procesima štampe (MPS), Upravljanje poslovnom dokumentacijom (DMS) I Upravljanje razvojem aplikacija, procesiranjem i pružanjem usluga varijabilne štampe i pakovanja pošiljki.

Sertifikat je izdat pod brojem **3810053** za period registracije od 12 Decembar 2012 do 12 Decembar 2015 godine

E7F99FE1-7F4 Koristite ovaj kod za da proverite ispravnost sertifikata na www.ll-c.info

LL-C (Certification)

LL-C (Certification) Czech Republic s.r.o. Vinohradská 184 Praha 3 - Vinohrady 130 52

Figure 7: Xpro's ISO/IEC 20000 certificate.

6. CONCLUSION

There is a growing trend in using standards, especially ISO/IEC 20000. Today, we are all witnesses to market globalization. That is why companies from Europe and other continents started introducing standard to their business. Every organization, considering whether to implement ISO/IEC 20000 standard or not, should review all the benefits that can be gained from attaining the certificate as well as the costs of implementation and assessment. In Serbia, not many companies have attained ISO/IEC 20000 certificate, but those who have, prove its good practice. The question regarding the lack of ISO 20000 standard implementation in Serbian companies remains opened. Reasons for such behaviour may lie in the low awareness of the importance of obtaining standard certificate and therefore standardizing all key processes of one company and taking a stable place on the market by providing customers with products of high guaranteed quality. Exploring these reasons will be our focus in future work.

REFERENCES

ASW Engineering. Case studies. Retrieved fromhttp://www.asw.eu

Buchsein R., Victor F., Günther H., Machmeier V. (2007). IT-Management mit ITIL V3. Friedr. Vieweg & Sohn Verlag, Wiesbaden

Disterer G. (2009). ISO 20000 for IT.Business & Information Systems Engineering – The International Journal of WIRTSCHAFTSINFORMATIK, doi: 10.1007/s12599-009-0076-x

Greb T., Kneuper R., Stender J. (2006). Nutzung der CMMI-Assessmentmethode für ITIL-Prozesse. IT Service Management, 1(3), 10–15

ISO20000. IT Service Management System. Retrieved fromhttp://www.standards.org

ITSM Goodness. General ITSMGoodness. ISO 20000 overview. Retrieved from http://www.barclayrae.com

MacFarlane I, Dugmore J (2006) IT service management – Self-assessment workbook (BIP 0015), 3rd edn. British Standards Institution, London

Menken I. (2009). ISO/IEC 20000 Certification and Implementation Guide - Standard Introduction, Tips for Successful ISO/IEC 20000 Certification, FAQs, Mapping Responsibilities, Terms, Definitions and ISO 20000 Acronyms - Second Edition. The Art of Service, Brisbane

ParallelOracle expert team. About us – Certificates. Retrieved fromhttp://parallel.rs

PREMIUM Software doo. Retrieved fromhttp://www.isoiec20000certification.com

XPRO. About us.Retrieved fromhttp://www.xpro.rs

STRATEGIC MANAGEMENT

STRATEGIC SHIFTS IN STRATEGIC RESEARCH – SHORT REVIEW OF ORGANIZATIONAL AND PROGRAM CHANGES

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Abstract: *This paper presents program orientations and reorientations of the Strategic Research Institute. We envelop a number of representative research projects for each of few main phases of development and transformation of the mentioned organization. At the moment, Strategic Research Institute tends to be a member of academic comunity of organizations accredited according to the actual standards for scientific research in Serbia. It is good time to look in past, think about that and realize what could be possible ways for future program orientation, projects selection, organizational development and organizational allocation inside an bigger organization as it is Ministry of Defence.*

Keywords*: Defence, Military, Strategic Research, Projects, Accreditation, Science*

1. INTRODUCTION

Strategic Research Institute (SRI) is an organization in the Defence Policy Sector of the Ministry of Defence (MoD) of Republic of Serbia. Its mission is to make research in different scientific areas such as next: national security, defence strategy, various military issues related to the organization, management, doctrine, resources, different aspects of human resources management, military history, etc. SRI is an integral part of the Ministry of Defence and functioning according to the rules of the Ministry, serving and supporting the MoD needs and preferences with particular sense for specific needs of the Serbian Army. At the same time, the Institute tends to operate according to the high standards of scientific work declared and defined at the level of state law of Republic of Serbia. Also, SRI always has strong and dynamic cooperation with the Military academy in Belgrade, as well as with a number of civilian faculties and institutes.

At the moment, SRI has about two dozens of researchers, organized in three sections: security analyses and integration section, defence studies section, and military history section. Span of past few years was a period of intensive actions to obtain researcher's formal competencies. The goal has been to achieve at least needed formal condition of minimal number of qualified researchers, that is: 7 research fellows and 5 junior research fellows. At this moment, SRI reached the goal obtaining 8 research fellows, two professors and 5 junior research fellows for few different sub-disciplines of social sciences and humanities, which imply that the Institute is ready to apply for accreditation at Ministry of education and science.

Life-cycle and development of Strategic Research Institute could be presented through few phases:

- First phase was from 1977 to 1984. A strategic research organization at that time has the name: "Center for Strategic Studies", and was organizationally allocated in General Staff of Yugoslav People's Army. At that time, Center has been much more dedicated to operational need of GS, than to pure academic work. A little of those works have been available, particularly for public usage, nor it has been strongly in line with pure academic standards. However, even existence of the Center is a proof of intention and will to establish a research organization for strategic studies near to the top of military hierarchy.
- Second phase was from 1984 to 1990. On the basis of one ministerial order from June, 1984, current Center for Strategic Studies changed its name to: "Institute for Strategic Research". Organizational allocation of the center was also changed, and it became a part of a structure of the military education system (Center of Higher Military Schools). Internal organization consisted of next entities: Section for researching the National Defence and Societal Self-Protection (that was a kind of national security strategy in that time); Section for researching armed combat; and Section for researching military policies and strategies.
- Third phase roughly starts around 1990 and ended in 2006. During this phase, the Center for strategic research renamed its title and became the "Institute for Military Art" (September 1992, on the basis of an order of the Chief of General Staff). In this period the Institute consists of next subdivisions: Section for military strategy; Section for operations art; Section for tactics; Section for combat information systems. This phase is complex and it consists of two sub-periods: 1990-2000, and 2000-2006.
- Fourth phase started in 2006 and continue up to now (2014). This is actual phase, and the name of the strategic research organization is: "Strategic Research Institute". The SRI became part of Defence Policy Sector of MoD. Also, it changed its program orientation as well as a structure. Part of human and

material resources of disbanded Military History Institute, has entered the Strategic Research Institute and became its integral part.

2. RESEARCH TOPICS IN PERIOD 1984-1990.

In the period 1984-1990, the organization exit General Staff and became part of wider military education establishment (Center of Higher Military Schools), and got the new name: “Institute for Strategic Research”. Program orientation was towards research of main concept of national defence in that time; investigating armed combat operations, and studying defence policies and strategies including those of foreign countries.

Research projects are in the line with national defence strategy and military doctrines in that time (the Concept of overall national defence and social self-protection). It was a time of cold war and sharp divide at the international level on two military-political blocks (NATO and Warsaw pact). At the level of military doctrine, it is a time when armed conflict’s research was under dominant perception of large scale conflict.
Also, it is a time of strong influence of ideology, and promotionally oriented research that should confirmed actual state of the art rather than to expose actual concept to the research critics and objective evaluation.

Research topics were next:
- Concept of National Defence and Societal Self-Protection (Concept of NDSSP, 1983-1990.)
- Strategy of National Defence and Societal Self-Protection (Strategy of NDSSP, 1984-1987.)
- Improvement of Counter Airborne Combat System in the system of NDSSP (1984-1986.)
- Counter Electronic Combat in the System of NDSSP (1983-1986.)
- Initial Period of War (1986-1988.)
- Combat Operations Modeling at Operational and Tactical Level (1986-1987.)
- Possible Attritions of Personnel and Equipment in General National Defencive Warfare (GNDW, 1986-1987.)
- Methods of Staff works on Estimation of Personnel Attritions and Filling Losses in Combat (1987.)
- Tito’s Military Works (1986-1991.)
- Education System in Armed Forces of Socialistic Federal Republic of Yugoslavia (SFRY, 1987-1990.)
- Use of Armed Forces in Emergency Situation (1989-1990.)
- Scientific Basement of Control and Evaluation of Combat Readiness of Armed Forces of SFRY (1989-1991.)

Research projects in this phase were complex with big project teams and were well funded. And, as a result there had been produced 142 research studies and monographs. However, much of those project’s results were not approved for public use, and were dedicated for internal usage. At the end of story, a destiny of many classified project’s results finished as other classified papers. It is fair to say that academic environment and standards in that time were very different from today. There wasn’t Internet, no Bologna process, nor transparency in dealing with defence and military issues as it is today, not only for a particular state. It was a time of the Cold war, large armies, a dominance of quantitative aspects of military forces in research, etc.

3. RESEARCH TOPICS IN SUB-PERIOD 1990-2000

Main events which define this period are dissolution of a former state (Socialistic Federal Republic of Yugoslavia, 1991), and boiling after war period and social change around 2000 year. Program orientation was dedicated to: investigating of strategic problems of armed conflict, doctrinal and strategic documents, security and defence strategies of foreign countries, realizing different studies for top managers in national defence, and realizing scientific projects in the field of military arts.

In the period up to 2000 year, there were realized next projects:
- Scientific Development of Military Arts (1990-1996.)
- History of Military Arts (1995-1998.)
- International and Internal Factors of Dissolution of Yugoslavia and its Armed Forces (1992.)
- System of Military Education in the Yugoslav Army (1996-1997.)
- Strategic Consequences of the NATO Engagement in the Balkans (1996.)
- Prevlaka (1998.)
- Military Strategy and Scientific-Technical Factor (1998.)
- Contemporary Aspects of Crises in Kosovo and Metohija (1998.)
- Fighting Commando-Terrorist Forces, Experiences and Forecasts (1999.)

- Combat Actions of Yugoslav Army in opposing NATO Aggression on Federal Republic of Yugoslavia - Lessons Learned (1999-2000.)
- Low Intensity Conflict – Unarmed Aggression on Yugoslavia and the Means of Opposing it - Expert's Talks (2000.)
- Basic Characteristics of a Future War in This Region (1999.)
- Serbian Military Memorial (1999-2000.)

There were more than 20 publications in this period, and that shows one of big change in approach to the research and treatment of the research results. Comparing the publication opus of two successive phases it is evidently that things were radically changed. Looking at the titles of research projects it is viewable research directions change, abandoning some traditional fields and perceiving new security challenges.

4. RESEARCH TOPICS IN SUB-PERIOD 2000-2006

In 2000 year, the Institute of Military Art had got formal document from his founder (the Government) for its establishing as a research organization in the MoD. The mission of Institute of Military Art was defined according to next: to make research in next disciplines: warfare art and military science in the field of strategy, operational art and tactics. Additional task were to investigate: armed combat; military doctrines; military management, command and control; as well as to make military-strategically estimations, to develop research resources, to cooperate with other institutions, etc.

In practice, the mission of the Institute of Military Arts in this sub-phase was realized dominantly through research in next disciplines: security analyses, issues on security integrations at international level, gender issues, investigating military public opinion on different topics, and making insight into new security challenges. In the period from 2000 up to 2006 year, there were realized next projects:

- The Role of Special Forces in Combat Operations (2000-2001.)
- The Partnership for Peace and Federal Republic of Yugoslavia – Expert's Talks (2000-2001.)
- Constituents of Military Strategy of Federal Republic of Yugoslavia – Symposia on a Military Science (2000-2001.)
- Civilian Control of Armed Forces – Expert's Talks (2001.)
- International Association and Organizations as Centers of Power in International Relations and Their Influence on Security of Federal Republic of Yugoslavia (2001.)
- Professionalization of Yugoslav Army – Expert's Talks (2001.)
- Security Challenges in South-East Europe – Ways Out of Crises – Expert's Talks (2002.)
- Serbia and Montenegro – Security Challenges, Risks and Threats, State-of-the-Arts and Trends – Expert's Talks (2003.)
- Military Experts Analyses of Armed Conflicts in SFRY and FRY in period 1991-1999 (2002.)
- Conflict Genesis in Kosovo and Metohija (2004.)
- Theoretical Basis for Determining the Effectiveness of Military Organizational Systems (2002-2005.)
- Scope and Models of Engaging Women in Modern Armed Forces (2003-2005.)

5. RESEARCH TOPICS AFTER THE LAST SHIFT (2006 UP TO 2014)

Main event that distinguishes this period was organizational, personnel and program transformation of the Institute of Military Arts, into the Strategic Research Institute (SRI), which is defined as a research institution of the MoD working in the fields of security, defense, and military history. The Strategic Research Institute was founded on October 1, 2006, merging resources of the Military Arts Institute and the Military-history Institut. The Institute consists of next entities: Section for strategic assessments and security integration, section for defense studies, section for military history and group for general administration.

Organizationally, SRI is allocated inside structure of the Defence Policy Sector of MoD. Basic tasks of the Strategic Research Institute are: analyzing international relations processes and factors that affect serbia's security and international status; researching the experience of regional and world conflicts important for serbian security; providing analysis, assessments and recommendations to help serbia react when its security is threatened; researching how serbia could be included and engaged in international security organizations; researching the field of defense system management; researching civil-military relations in democratic and transitional countries, with an emphasis on conversion and the reform of civil-military relations in serbia; researching psychological aspects in the military; researching public opinion within the MoD, and Serbian Armed Forces (SAF) on relevant issues; researching military history; preparing and conducting scientific and expert meetings in the fields of security, defense and military history; participating in

the Military Academy's educational process and the SAF training process; and publishing books, magazines and other scientifically useful documentation.

In the period from 2006 to 2014 year, there were next projects:

- Attitudes of High School Youth About Schooling at Military Academy (2006-2008.)
- Defence System of Republic of Serbia in Opposing Contemporary Terrorism (2007.)
- Model of Evaluating of Moral of Serbian Army in Contemporary Conditions (2007.)
- Value System of Serbian Army – Recommendation or Barrier for Security Integrations (2008-2009.)
- Opinion of Serbian Military Public on Military Reform and Security Integrations (2008-2009.)
- Military Profession in Serbia – State-of-the-Art and Perspectives (2009.)
- Democratization of Security Sector in Serbia (2009.)
- Defence from Threats in Cyber Space (2009-2011.)
- Opinion of Population in Ministry of Defence on Current State of Affairs of the Military Organization (2011-2012.)
- Security and Defence Aspects of Association of Republic of Serbia to the European Union (2011-2013.)
- History of Serbian and Yugoslav army in 19. And 20. Century (2006-2014.)

The last project, entitled "History of Serbian and Yugoslav army in XIX and XX century", is a complex multiyear project of special kind: it deals with military history through the lens and with the methods and standards of history as specific scientific discipline (humanities).

Some of publications in the current phase of strategic research are next:

- Woman in Defence: From Past to Present
- Women in the Armed Forces
- Education of Female Cadets at Military Academy
- Women in the Security Sector: A Regional Perspective
- In Step with Time – Ministry of Defence and Serbian Armed Forces on the Path of Gender Equality Objectification
- Defence from Cyberspace Threats
- Information Handbook on Defence System of the Republic of Serbia
- Proceedings: Security and Defence Aspects of the Republic of Serbia's Accession to the European Union
- Proceedings:Serbia in Contemporary Geostrategic Surroundings
- Military Profession in Serbia: Review and Perspectives
- Proceedings: Civil Emergencies
- Emergencies: How to Manage Them?
- High School Graduates' Opinion on Military Profession
- The Role of Humanitarian Organizations in Providing for Civilians during Emergencies
- The Automobile in the Serbian Armed Forces 1908-1918
- War after the War: The Kingdom of Serbs, Croats and Slovenians Armed Forces in Kosovo and Metohija and Macedonia 1918-1920
- Balkan Pact 1953-54
- Europeanization of Serbian Armed Forces from 1878 to 1903
- Serbian Military Luminaries

6. CONCLUSION

Current Strategic Research Institute and all its predecessors have dynamic life-cycle due to internal organizational changes inside Ministry of Defence, but also due to changes of a wide set of different conditions coming from military, security, political, international and technological field. Thematic orientation of scientific research depends heavily on the MoD stakeholder preferences, but also on the initiative of the management of the Institute.

Besides organizational and program transformations, subject of change were also a size of organization (number of employees), education and professional background of the staff, and least but not last a gender (sex). The general trends about staff characteristics are towards preferring younger rather than more experienced staff; civilian rather than military educational background; sexual distribution share has also dynamic character in favour of women.

Growing openness in overall work is one of strong characteristics of current phase. This stands for threefold aspect: first, openness for all kinds of international cooperation; second, openness towards all domestic organizations and institutions; and third, adjustment towards academic standards valid for science institutes and scientific work in the state. The last aspect is seen as one of the main challenges for the future, that will obtain arise of quality level of research rather then expanding quantity.

REFERENCES

Cohen, R.. (2005). Informing Decision: Strategic research in the Serbia and Montenegro Ministry of Defence. Jefferson Institute. Belgrade. Retrieved from http//www.jeffersoninst.org.

Ministry of science RS. (2010). Strategija naučnog i tehnološkog razvoja Republike Srbije 2010-2015. Retrieved from http//www.mpn.gov.rs

Skupština Republike Srbije. (2005). Zakon o naučnoj delatnosti. Službeni glasnik RS, 110/05.

Pravilnik o naučnim, umetničkim, odnosno stručnim oblastima u okviru obrazovno-naučnih, odnosno obrazovno-umetničkih polja. (2007). Službeni glasnik RS, br. 30/2007, 112/2008, 72/2008

Pravilnik o postupku i načinu vrednovanja, i kvantitativnom iskazivanju naučnoistraživačkih rezultata istraživača. (2008). Službeni glasnik RS, br. 38/08.

Projekti ISI. (2006). Pregled naučnoistraživačke delatnosti Instituta ratne veštine u periodu od 1977.do 2006.godine. Institut za strategijska istraživanja. Beograd. Retrieved from http/www.isi.mod.gov.rs

Tomanović R. i drugi. (2005). Monografija Instituta ratne veštine. Institut ratne veštine, Uprava za školstvo Sektora za ljudske resurse Ministarstva odbrane. Beograd.

ORGANIZATION AND FUNCTIONING OF THE SECURITY MANAGEMENT IN CRISIS SITUATIONS

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Abstract: *This paper suggests that in the development phase and during pacification of the crisis, security management is experiencing significant functional and institutional changes. There are several organizational and functional properties of the security management in case of crisis situations which will illustratively be presented by perceiving experiences in achieving the organization's objectives of security management in crisis situations, the content and features of functioning of the security management in crisis situations.*

Key words: *security management, crisis situations, characteristics of functioning of the security management in crisis situations.*

1. INTRODUCTION

To understand the security management, an important aspect present the doctrinal documents dealing with the areas important to engage the Army in specific situations . These specific situations, conditionally come under crisis situations and are defined by a specific mission of the Army of Serbia . In order to present these issues it is necessary to consider the importance of entities and parts of the security management , security environment of the Republic of Serbia and the specific conditions of crisis situations in which crisis management can be an essential element of resolving the situation in the Republic of Serbia.

2. IMPORTANCE OF ENTITIES AND PARTS OF THE SECURITY MANAGEMENT

Subjects of crisis management are the carriers whose activities generate the totality of relationships in resolving certain crisis . They are also the actors of this crisis and subjective factors on the scale at which the crisis is concerned. Their key feature is the effect of the crisis within a certain scale. However, it should be emphasized that the subjects of security management within the framework of resolving certain crisis are part of a broader environment which influence resolution of the specific crisis. It is important to emphasize that they present specific carriers of subjectivity in resolving certain crisis and are carriers of specific activities or events characteristic to a particular crisis and which has impact on particular organization.

From the standpoint of complete understanding of this issue, one fact should be noticed which is based on the essence of complete factors' analysis that led to the problem or crisis, which means it is needed to carry out an analysis of all the aspects of the organization. These are the elements which are essential and which have an impact on the entire management that resolves the problems directly associated with the crisis.

In order to examine the role and importance of the subjects and parts of the security management, it is essential to evaluate the adequate perspective of a particular organization in the future. This means that each specific organization needs to look far enough into the future to have enough time to prepare itself. This is especially true for military organization, which is primarily conditioned by an generally unstable environment. For these reasons, it is necessary to think and plan for the long-term effects of what would happen. The essence of this stems from the need to adapt to the changes in the environment and, therefore, impose the need for an adequate adaptation to such changes.

Context of the importance of entities and parts of the security management and the difficulties encountered in resolving the crisis may be qualitatively similar to other elements with which the organizational system meets in its work. It is primarily the similarity with resolution or conduct of specific projects, so that the holders of the security management have several common characteristics primarily expressed through:
- Unusual activities that are rarely repeated,
- Demand for skills and experiences of people of different functions,
- Limited duration and
- After the crisis, the immediate actors return to their regular duties.

These elements suggest that the holders of the security management or crisis teams should be organized and access the problems in the manner the work project teams do. This means that they need to gather experience, areas and skills needed to master the situation. However , there are some differences , primarily expressed in the lack of time to plan their activities. The teams gathered for the sake of specific hazards (e.g., fires, floods, etc.) have plans for emergency situations. Still, they also lack some knowledge of what to do, since the crisis often occurs unpredictably.

Bearing in mind that project management has four stages: defining and organizing , planning, implementation management and closure of the project, in this sense the holders of the security management can successfully adapt these steps to their needs.

2.1. Defining and organizing

At this stage are clearly defined the project objectives and organized the right people and resources. Thus, the following questions are asked:" What exactly is the problem?"," What we need to do to resolve it?"," Who should be included to help us?" and" What resources will we need to resolve an issue and bring the situation back to normal?".
The first assumption of successful action of the security management subjects is defining the crisis, gathering the right people and resources, which is also the basis for the start of action.

2.2. Planning

The main task of the manager is to ensure the successful carrying out of activities for which it is responsible. This requires a lot of thinking about future events and undertaking steps in advance to provide a normal operation. All these activities are called by one word: *planning*.
Planning begins by setting clear targets and takes place in the past in four consecutive steps: (*Luecke, R. 2005*).
- Determination of specific tasks that need to be implemented,
- Determination of the fittest individuals or groups for the execution of each task,
- Estimation of the time required to execute a specific task and
- Concretization of holders for each task.

If you approach the realization of the tasks in this manner, inevitably follows the dismantling of these tasks into sub-tasks. What is more typical in terms of the role of the management security holders is determining the holders responsible for a specific task, as it provides high-quality execution of the task.

2.3. Management implementation

The phase management implementation includes all the usual tasks of effective management as well as careful monitoring and control. These two together provide compliance to the plan, standards and budgets. In particular should be borne in mind the coordination of activities of the engaged stakeholders or teams in the implementation process.

2.4. Closing the project

A common feature of the project and the crisis is their end. The project is finished the moment its objectives are met. Security management has the final stage, and one of the main tasks of this phase is to review the development and the experience and to draw conclusions: What was good? What was done wrong? Whether and how to change the approach if and when a similar situation hits the organizational system? Drawing conclusions is an area that is assessed in detail and which is implemented in the contingency plans.

The most important thing is to declare the end of the crisis, to indicate the most important events and ensure that the immediate holders of resolving the crisis participate in subsequent analysis in order to implement these experiences in contingency plans.

2.5. Response to crisis and dangers

The crisis and sudden event can often involve a natural human reaction, surprises, denials, angers and fear. How one organization controls emotions will determine how the organization will deal with crisis or sudden event. Fight or flight risk syndrome can be overcome by internal faith. Without inner faith, the procedure is sentenced to panic and collapse. When the crisis reaches a climax, the emphasis should be on understanding, explaining and reorientation of events.

In this regard, the quality of good managers should have the following properties: perception, intuition, knowledge in one or more areas, the ability to take on additional responsibilities, the ability to think clearly, determination and composure under pressure. Of course, the question is raised whether all managers have such capabilities and whether they can carry out activities required in the process of resolving the crisis? All managers must be familiar with the work they do - aspect " work knowledge "; should have the skill and ability.

3. RESOLVING CRISIS SITUATIONS

From the aspect of understanding resolving crisis situations in the domain of defense system, it is important to emphasis that within the context of the aforementioned issue, there are acquired and generally accepted principles in the most developed countries in the world and they are mainly definad into war doctrine. In order to successfully overcome crisis situations and its actions in each stage, the elements of crisis situations are shown in Fig. 1.

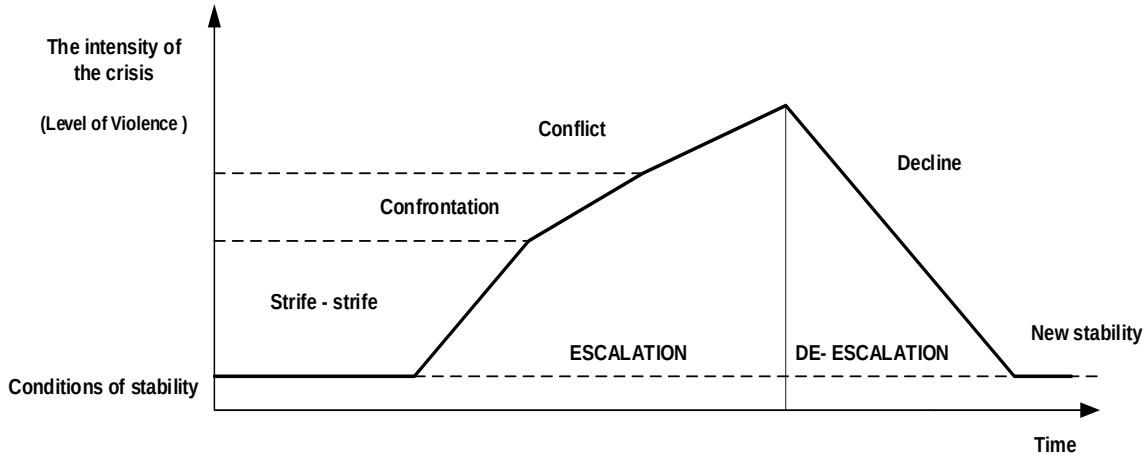

Figure 1: The general form of a crisis situation
(Karović, S. 2014.)

It can be observed in the figure that at certain stages of the crisis there are indicated elements which in the pre-crisis stage stem and are connected in a continuum; which then leads to its culmination and the highest point, regardless of whether it is a crisis in the system or a crisis caused by the act of nature. However , it is important to distinguish the effects of the particular situation where there is not an elaborate system that would fully meet all the necessary criteria. Yet, there is a general attitude that leads to that, depending on the type of crisis, quite certain resources would be engaged. To define the specific model of action is not possible, because in this case are activated the already prepared plans for a specific situation. This means that the plan is the basis fn the action model in a specific situation. (*Karović, S. 2014*).

According to the standpoints of the modern armies, primarily NATO, the approach or model for resolving crisis situations has elements shown in Figure 1. It is characterized by existence of two phases which are divided by the culmination point, i.e., the phase of escalation and de-escalation of the crisis.

In the escalation phase, there are two phases of crisis' development processas – the escalation phase, followed in certain points by the de-escalation phase. This transition occurs in any form of defining the crisis process. What characterizes the escalation phase and is apparent in the diagram as the "stability condition", is presented in the form of a crisis where there is no violence or threats to priority objectives. There is a lack of potential tensions between the conflicting parties.

The diagram unit can be moved upwards to the "disagreement - strife" showing that a threat to priority objectives is identified. It is characterized by the growth of warning of the impending crisis.

The curve can progress to a "confrontation" point, indicating that the actions of violence growth are retrieved from one or the other side of the crisis, showing that there is a crisis and, of course, the curve can present crisis growing up to the point where it escalates into conflict.

De-escalation phase is characterized by such kind of the crisis effect intensity which will eventually decrease showing its flow on the diagram. The curve shows decline passing through a phase of decline of the conflicting parties. It may include a recognition that the threat to priority objectives is in decline. This does not mean that

the crisis is over,nor that it is brought into the state *favorably*, but it only shows that the worst is over as a form of crisis. The curve decreases to a relatively low intensity showing "new stability" on the diagram which may be a crisis of intensity higher or lower than the original, shows the new "status quo" acceptable to all parties involved in the crisis. (Karović, S. 2014).

In such conditions of resolving the crisis, the position of the crisis management is oriented towards enforcement of activities substantially shown in Table 3.

Table 1: Main activities of the security management (Karović, S. 2014).

SECURITY MANAGEMENT ACTIVITIES' CONTENT	***CRISIS FORMS***					
	ESCALATION				***DE-ESCALATION***	
	Stability	***Rift***	***Confrontation***	***Conflict***	***Decline***	***Stability***
Situation monitoring	*X*	*X*	*X*	*X*	*X*	*X*
Crisis detecting support	*X*	*X*				
Crisis content		*X*	*X*	*X*	*X*	
Permitted engagement				*X*	*X*	*X*
Building stability					*X*	*X*

Situation monitoring as an activity that is conducted in resolving the crisis is characterized by properties expressed in the assessment of the operating environment, principally on collection and information analysis. It is important for one simple reason, which has its stronghold in the process of engagement the forces and the risk assessment which is born by operation performance. Information and their analysis will provide the operational planning process for the engagement of forces to be done completely and a decision to be brought which should ensure the success of the implementation of such operation. This segment is distinctive because it is done at the all crisis stages and is directly related to intelligence assessments of the battlefield, which reflects the operational planning process,

Crisis detecting support is directly related to the segment when the crisis is identified. The information in the function of supplementing previous solutions or supplementing decision with new information that will enable successful implementation of the operation.

In the crisis escalation stage are manifested certain action forms and manifestations of such a condition. Most often they are expressed in the form of discord, confrontation and conflict. In such situations the crisis management activities are focused on the development and implementation of concrete actions which lead to prevention of the crisis escalation. Actions may be substantially different and are primarily determined by the type of operation being conducted.

As particularly important should be noted that in the escalation phase when there is a conflict, it is possible to engage the power of the army. Simply, there is no reason for postponement of the force application or operation implementation that leads to dismissal of such a situation. The use of force remains at the stage of de-escalation as well, especially in the decline segment which should lead to stability condition.
The last significant activity on the dismissal of the crisis relates to building stability and is applied in the stage of de-escalation as a natural consequence of continuously conducted prior contents. Particularly are significant the development and implementation of new forms of post-crisis stability.

In order to understand the essence of crisis management, it should be emphasized that the effects of crisis management usually occur where the potential crisis is detected and where the treatment is done before the crisis emerged. In this case, the lines of communication are clean and the plan prepared in advance will prove to be effective. The management and organizations without the crisis management system will in this case inevitably have to deal with an unexpected crisis, i.e., will expect the unexpected as a specificity from such condition. *(Karović, S. 2014.).*

According to the doctrine of the Army of Serbia, the Army of Serbia plans, prepares and performs operations in peacetime, in emergency and state of war. In relation to the forces that are engaged, these operations may be: Army operations; air force and airborne defense operations; operations of the territorial forces, special forces' operations and operations of joint forces; according to the form of combat operations – they can be attack and defense. The basic division of the military operations according to the manner of their applications is: combat and non-combat operations. Special type of operations are the multinational operations, in which can participate parts of the Army of Serbia, in accordance to the law.

As part of the campaign, according to importance, one operation is planned, prepared and executed as the main operation of the campaign, while the others are ancillary operations. *(Доктрина Војске Србије, 2010.).*

It is important to emphasize from the perspective of the security management that the Army can perform non-combat operations independently or as part of combat operations performed in peace, in a state of emergency and a state of war. Non-combat operations are: an information operation; operation of civil- military cooperation and support operation to civil authorities in combating unarmed security threats.

For the needs and understanding of functioning of the security management in the defense system, support operations to civil authorities in combating unarmed security threats are carried out in the event of natural disasters, industrial accidents and epidemics. The goal of executing operations is to support civil authorities and citizens to protect and rescue people's lives, material assets and the environment. For a success in the execution of operations are needed: direct cooperation and coordination with state authorities that govern all the forces in the affected area and a use of a fully trained and equipped units of the Army of Serbia. (Доктрина Војске Србије, 2010.).

3.1. Principles of resolving crisis situations

If it is understood that settling crisis situations involves planning and undertaking appropriate measures that can be subsumed under principles, then they are generally reflected through: prevention (taking measures to prevent the outbreak of crises), retention of crisis situations in existing borders and preventing their spread and settling of crisis situations.

The aim of resolving the crisis situations is providing adequate and balanced response to the occurrence of any hot spots. The jurisdiction of the Assembly of Serbia is involvement of the Army in dismissal of crisis situations. In the context of commanding with the Army, the responsibilities are defined and in case of crisis remain unchanged.

Hierarchical line for resolving crisis situations remains unchanged and goes in the direction of: Assembly - Department of Defence - Army General Headquarters - Command of the forms - Unit commanders, or compositions. These principles of command apply to all situations when the Army is used in the process of resolving the crisis situation, especially in the context of the defined mission. Based on the decision of the Assembly and on the basis of government policy, the Ministry of Defence is responsible for the realization of all varieties of military engagement in the process of resolving a crisis situation.

3.2. Command and control in crisis situations

System of successful command and control, from the highest to the lowest level, should provide a unique deployment of all forces toward a common goal and their most efficient use. Commanders must ensure the maximum possible freedom of action, within the given political and military guidelines for the execution of the tasks.
The command and control system should be simple and maximally unique, and the decisions brought must be precise and unambiguous. Each commander must be given the command responsibilities in accordance to the level of its responsibilities. This system will have its own particular specificity for different types of operations , but is primarily based on the adopted procedures. (Karović, S. 2014.).

Means of mass media should be engaged so to ensure continuous reporting on the progress of operations and the engagement of the Army. Their work has to take place within the official (government) information campaign according to specific crisis situation. The statements and briefings from top political and military figures have special significance in informing the public about the development of the overall political and military situation in the crisis area and during the course of the military operations.

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During the operation a coordinated and continuous monitoring should be ensured of its results for timely identifying potential failures and shortcomings and prompt undertaking measures for their elimination.

After the operation, it is a must to make an overall analysis of its success (or failure) to use the experience gained to possible change of certain doctrinal solutions, the size and structure of the Army and its operational capabilities in order to provide better and more effective response to future challenges in mediating crisis situations.

4. CONCLUSION

Understanding the security management in the process of resolving the crisis can be understood through certain stages that characterize the process. The process, basically, is the dynamic that involves certain stages and they make the unity of continuous action towards resolving the crisis.

It follows from the properties of the crisis manifested in the fact that the crisis is largely left to the subject of time and the possibility to act, it requires action in order to survive. In this sense, the crisis is any entity that perceives a part of its state, which is reflected in the decline of its mechanisms of regulation, as a threat to its own existence.

In order to restore these mechanisms of regulation, security management just tends to find objects that will act to restore the function of an entity that was in a given moment found under "suffering" because there is no object which acts on it. Therefore it is essential to the functioning of the security management, for the mass media to receive special significance which makes the security management specific in the process of resolving a crisis situation.

REFERENCES

Ministarstvo odbrane. (2010). Doktrina Vojske Srbije. Beograd.

Karović, S. (2014). Krizni menadžment. Medija centar Vojska. Beograd.

Luecke, R. (2005). Upravljanje kriznim situacijama. Zgombić i partneri. Zagreb.

Talijan, M., Talijan, M., M. (2011). Opšti i bezbednosni menadžment. Visoka škola unutrašnjih poslova. Banja Luka.

Mihalski, K. (1987). O krizi. Književna zajednica Novog Sada. Novi Sad.

DEFENCE STRATEGIC MANAGEMENT- APPLICATION OF SIMULATION IN THE PERSONNEL COSTS OPTIMIZATION

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Abstract: *This article presents the simulation in iThink software in personnel costs optimization. The model is based on the correction of number of personnel in defence based on desired defence cost structure, as well as the estimated defence budget. This method considerate consequences at the height of personnel costs and cost structure of the defence, before correction of number of employees are implemented in practice. iThink, as a simulation software can be used to simulate all processes in the defence organization in order to the determine the optimal development strategy. On the other hand, the use of the program iThink requires expert knowledge of organizational processes and iThink software, ability to represent organization model using different mathematical and logical functions, and creativity, in order to obtain the required results.*

Keywords: *Strategic management, Defence, Human resources management, Simulations, iThink software*

1. INTRODUCTION

Some of Defence strategic management aim is to determine defence development goals and objectives according to environment assessment; determine strategies to achieve the goals and objectives; assessments of resources needed for the strategies implementation, as well as deploy and direct resources thru defence organization. For properly deployed and directed defence's resources in order to provide development, all the costs that defence generates need to be considered.

The total cost of the defence organization is usually classified according to usage purpose in personnel costs, operational costs and investment. Practice shows trend of continuous increase in personnel costs at the expense of operational cost and investment, so that personnel costs are the largest share of the total cost structure. There is the need to control personnel costs in the defence, and to ensure a smooth development and implementation of Long-term goals.

The value of personnel costs are influenced by many parameters. Parameters that affect the amount of personnel costs varied, and most often these are the remuneration of employees, the amount of benefits and the number of employees in the defence. Control of the height of personnel costs can be achieved by impact on some of these parameters, and thus the overall defence cost structure.

One of the parameters that are most commonly affects the control of personnel costs is the number of the employees. The question is, what is the impact of the budget and the desired cost structure to the number of employees in the defence. One way to examine this impact is by using simulation. Simulations, as a form of modal experiments, allow observation of the interconnections of the experimental factors, in this case the defence budget and desired cost structure and the experimental object, or number of employees in the defence organization. In this way, simulations can examine a variety of strategies to reduce personnel costs by influencing the number of the employees, as well as the effects of the strategy implementation before the implementation. Simulations provides to strategic management timely risk assessment for strategies implementation and provide accurate data on the number of employees that need to be corrected in order to achieve the desired cost structure.

One of the tools for the defence models development and experimentation with strategy implementation is software iThink. With this software the processes within the defence organization can be simulated, as well as the movement of resources within it, making it suitable for simulation and experimentation of the defence organization costs. In this way, required number of the employees in the defence may be a timely projected, in order to achieve the desired cost structure.

2. PERSONNEL COSTS IN DEFENCE

System of wages is a part of the remuneration of employees includes all the material rewards that an employer gives to employees in exchange for the work. Management see wages as the biggest expense (cost of personnel in companies ranging up to 50% of total costs), as well as the main instrument to influence the behavior of employees and improving organizational results (Bogicevic, 2006).

The wages system includes two types of wage earnings: direct and indirect. Direct forms of wage earnings include elements that employees receive in cash. The direct forms of earnings are: basic salary, salary increases in order to maintain purchasing power and wages depend on the performance. The base salary is the most important element of earnings that an employee receives based on the work they perform, regardless of what is his effect on the workplace. Salary increases in order to maintain the purchasing power of wages is an element that ensures the maintenance of the purchasing power of the basic pay in the long run, through a permanent salary increase based on the index of retail price increase, in most case it is CPI index or other indicator for which particular organization decides. Salaries based on the performance are the element of wage that takes into account the contribution of the individual in achieving organizational results, the result of the organizational unit or team in which the employee works and include various forms of short-term and long-term incentives.

Indirect forms of wages include conveniences and benefits. Conveniences are an element of profit that aims to provide safety to employees and their families. Conveniences include two types of applications, including: program to protect employees through health insurance, pension, social security, disability insurance, life insurance etc; and paid absence program that includes military service, vacation, sick absence, etc. Benefits are indirect earnings that is related to status and status symbols and includes a variety of forms such as free meals or meals at lower prices, use of a company car, free entertainment, the use of mobile phones and more.

In the any organizations disparity in the high of employee's wages has been present. Wages of some employee depends on which personnel category it belongs in the established personnel structure frame. For example, in some organizations personnel structure frame is divided into categories: Clerk, lower executive, middle manager, senior managers and the like. etc. Personnel costs of specific personnel category *k* depend on the number of employees who fall into that personnel structure frame (N_k), the average height of the direct forms of wage (Dw_k) and the average height of the indirect wage (Iw_k), and it is calculated according to the formulae 1,

$$P_k = N_k \times (Dw_k + Iw_k), k = \{1,2, \dots, n\} \quad (1)$$

In present formula, *n* is total number of personnel category in established personnel structure frame in some organization.

Height of personnel costs in the defence is even more pronounced, ranging from 50% to 80% of the total budget of defence. That is because of the specific involvement of human resources, which affects the level of benefits, free food of some categories of personnel, the cost of training staff, as well as clothing prices and footwear (uniforms, protective clothing and footwear, and civil suits for people who follows procurement of civil suits). Typical Europe country in the biggest share of personnel costs in total defence costs are: Romania with 80%, Portugal 78.5%, Albania 77.1%, Belgium 75.4%, Italy 74.8% and Slovenia 74.6%. By the smallest share of personnel costs in total costs of the defence in Europe country are Estonia with 32.3%, UK 35.7%, Norway 43.4% and Luxembourg 44.3%,. The average share of personnel costs in total costs of defence for European countries is around 60% (Military balance, 2012).

In defence, personnel structure frame is usually divided into the following categories: officers, non-commissioned officer, civilian personnel, professional soldiers and cadets (Military Compensation Congressional budget office, November 2012). Due to the involvement of different tasks and level of education, the average cost of certain categories of personnel in the defence depend on the average cost of training staff (*T*), average clothing and footwear purchase price (*C*), average food price (*F*), average participation in multinational operation price (*M*), average extras and fees price (*G*) and average cost of business travel in the country and abroad (*S*) (Steven, 2005). In this case, the formulae 1 is expanded with the above mentioned costs and will have a shape as shown in formulae 2,

$$P_k = N_k \times (Dw_k + Iw_k + T_k + C_k + F_k + M_k + G_k + S_k), k = \{1,2, \dots, n\} \quad (2)$$

Total personnel costs (*P*) is the sum of personnel costs of all personnel categories in the defence organization, on the basis of formulae 3,

$$P = \sum_{k=1}^{n} P_k, k = \{1,2, \dots, n\} \quad (3)$$

To manage personnel costs, we can affect on one or more of the elements that make up this cost (Bogicevic, 2006). Because personnel costs in defence are in dominant height compared to the other costs, for strategic

management control of this cost are of great importance. According to formulae 2, manage personal cost can be done on two ways:

- Control of the number of employees;
- Control of average wages value.

Control of the number of employees is a common method of controlling personnel cost, while maintaining the same average level of wages (Carl, 2007). By keeping the average wages maintaining the status of employees is achieved, which greatly affects the prevention of personnel leaving and positively influence employee behavior and organizational results. Disadvantages of the number of employees control is reflected in the legal regulations in many countries, in the impact of the reduction of capability of the company for the execution of mission and tasks, increasing the degree of combustion of staff, as well as the amount of the required financial resources for the payment of retirement benefits to employees who terminate employment. All of the above deficiencies can result in the reduction of profits to a profitable organization, or loss of role, due to the impossibility of conducting tasks for non-profitable organization, so in control of the number of employees should be approached carefully.

3. APPLICATION OF ITHINK SOFTWARE IN OPTIMIZATION OF PERSONNEL COSTS

Personnel costs in defence have a tendency of continuous growth and influence the changes in cost structure so the operational costs and investments are getting lower. On achieving defence long-term goals most affect have investment and operational costs, so optimization of the cost structure is one of activity that provides defence development. One of the possible ways to optimize the cost structure is the use of simulation, in order to comprehend the long-term effects of using certain strategies.

The basic preconditions for the application of simulation are: the existence of the model (the experimental situation), the ability to set the experimental factors, the ability to repeat the experiment, the possibility of permanent control of results, providing personnel for data collection and development of appropriate tools for data logging. With development of personnel computers usage of simulation are gaining in importance in the social sciences. The processes can be simulated in real time, fast or slow, depending on the intentions of researchers, research subjects and capabilities of simulators and computer. Also, simulations can be carried out reconstruction of certain events from the past, to simulate the phenomenon of present or may have prognostic character. The difference is primarily in the number, nature and organization of data, which may relate to past, present or future (Sakan, 2006).

According to iThink official web page, iThink is software for modeling and simulation of business processes. As such, it is useful to create models that simulate the original business processes and procedures, shows the consequences of new procedures and policies, and in particular to show the unwanted outputs from the process and the development of options for the control of undesirable outputs. The importance of iThink for Strategic planning is reflected in the way that it indicates the output from the system that can be critical, and therefore cause material loss or decrease of reputation of the organization. iThink provides a wide view on a particular issue, operation and the entire organization by enabling dynamic modeling and simulation, which can examine or modify the parameters of all the key points and processes in the system. In this way, iThink prevents decisions that can have harmful consequences. In this connection, iThink, besides tools for modeling and simulation, also support tool for decision makers (Systems Thinking for Business, 2014).

One possible application of iThink software is for the personnel costs optimization, taking into consideration the achieving of the desired cost structure of the defence organization and defence budget constraints. As an example, model of the cost structure and the personnel number of defence organization are created.

In created model experimental factors are:
- The defence budget -*B*;
- Cost structure-*Cs* (in defence organization it is usually divided into personnel costs - *P*, operational cost- *O* and investment- *I*);
- Personnel cost escalation- *E* (increase the salaries of employees in order to maintain purchasing power, and increase the the cost of of other forms of indirect wages, such as food and clothing);
- The average individual wages per personnel structure frame - *W*.

The experimental object is a total number of personnel in the defence organization - *N*.

With experimental situations processes related to personnel costs are isolated from the impact of other costs of defence, such as the operational costs and investments.

A simplified model of optimization of personnel costs using the software iThink is shown in Figure 1.

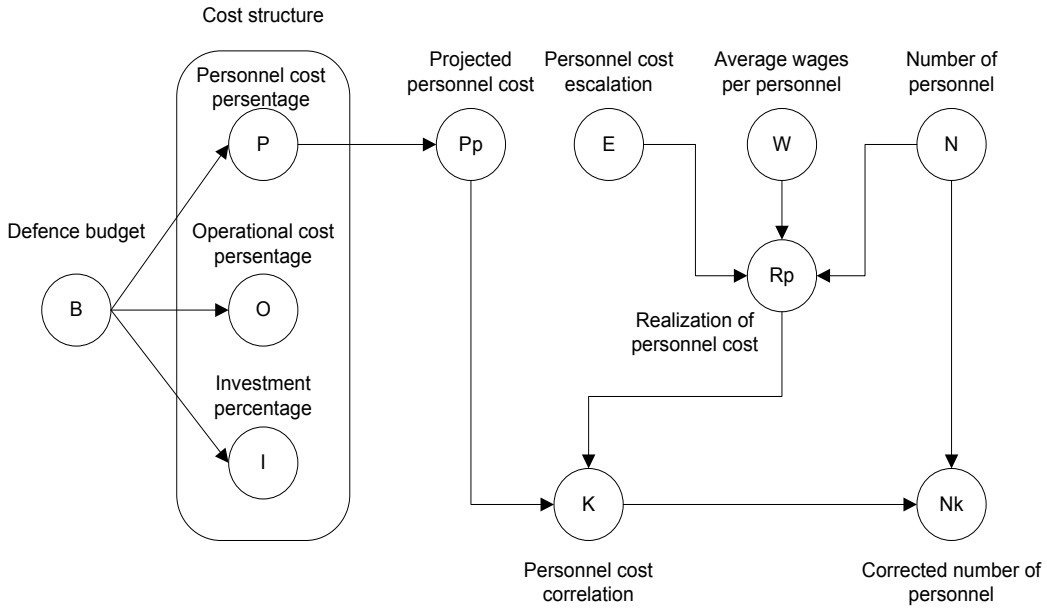


Figure 1: Simplified model of optimization of personnel costs using the software iThink

Part of the operational model in iThink is shown in Figure 2. Using the available tools for graphical data input in interface layer, the defence budget are entered the model. Entering the budget is done for each subsequent year of the simulation period starting from the initial year. Thereafter, an entry of the desired cost structure is made.

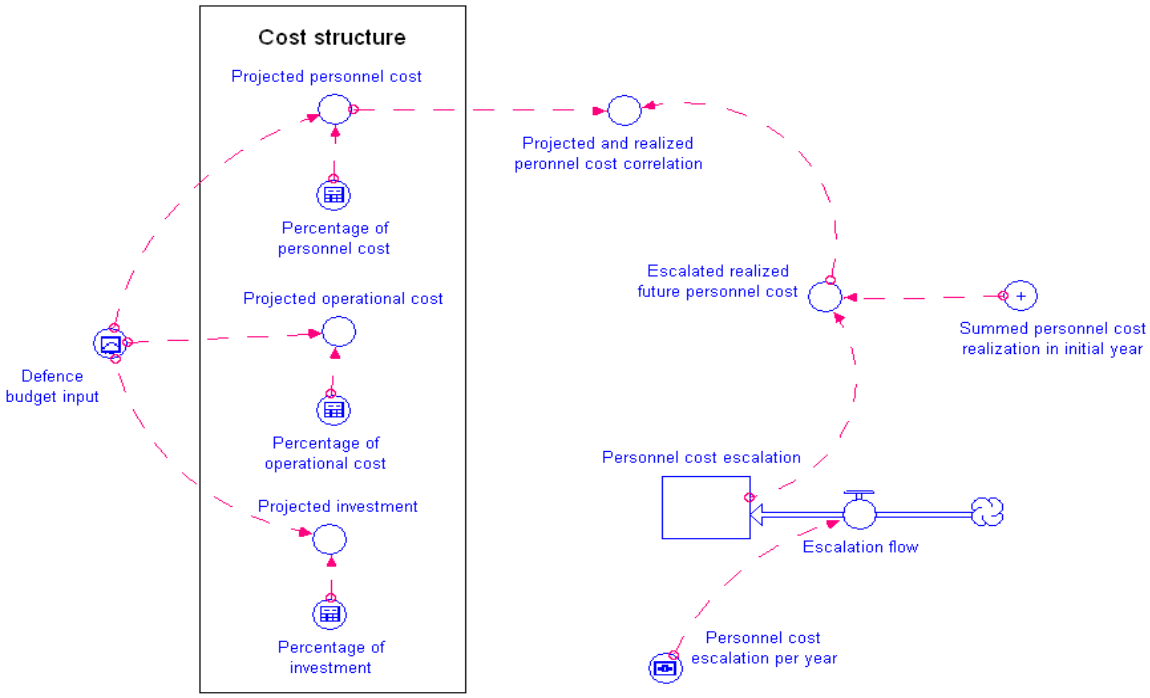


Figure 2: Part of the operational model of personnel cost optimization using iThink software

Personal costs are isolated with experimental environment, so the amount of personnel costs to be achieved, or projected personnel costs (*Pp*) are calculated according to formulae 4,

$$Pp = \frac{B \times P}{100} \qquad (4)$$

On the other hand, the number of personnel of defence organization and the average earnings per personnel structure frame, affects the level of personnel costs realization. In addition, the height of personnel costs realization in the future are also affected with escalation of personnel costs in order to maintain purchasing power, which is annually. Personnel cost realization (*Rp*) are calculated according to formulae 5,

$$Pr = N \times W + \frac{N \times W \times E}{100} \quad (5)$$

Often the personnel costs realization differ from the projected amount of personnel costs. One of the tasks of defence strategic management is to harmonize personnel costs realization and the projected amount of personnel costs in order to provide sufficient funds for operating costs and investments. Also, strategic management must reconciled cost realization with allocated budget in the long term period. The goal is to achieve a statement from the formulae 6,

$$\frac{B \times P}{100} = Ne \times W + \frac{Nk \times W \times E}{100} \quad (6)$$

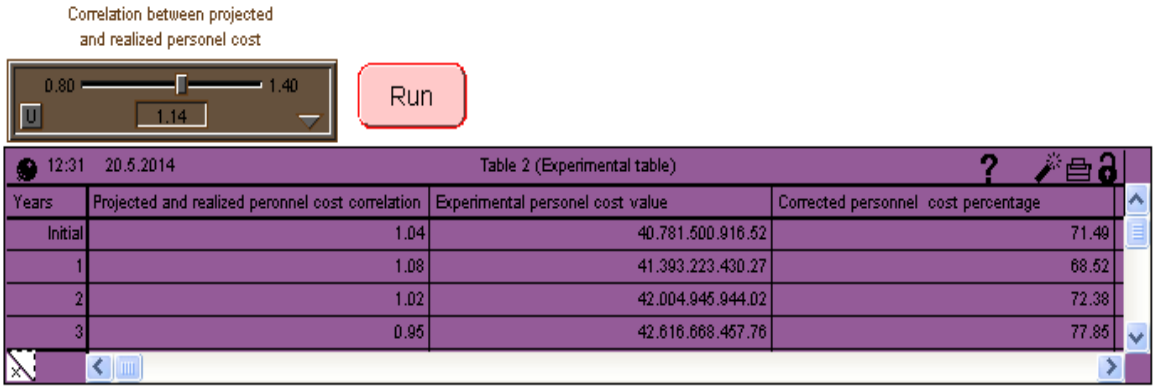
In presented formulae *Ne* is corrected number of personnel, so that projected and realized personnel costs are equal. Based on the above, the corrected number of personnel in defence organization is calculated according to the formulae 7,

$$Ne = \frac{B \times P}{W \times (100 + E)} \quad (7)$$

Ratio between realized and projected personnel costs (*K*) is equal to formulae 8,

$$\frac{Pp}{Pr} = \frac{1}{N} \times \frac{B \times P}{W \times (100 + E)} = K \quad (8)$$

By changing the ratio (*K*) between projected and realized personnel cost in the simulation, as a result new and corrected value of personnel costs and cost structure was obtained, as shown in Figure 3. In this way, synchronization of designed and realized personnel costs are achieved.



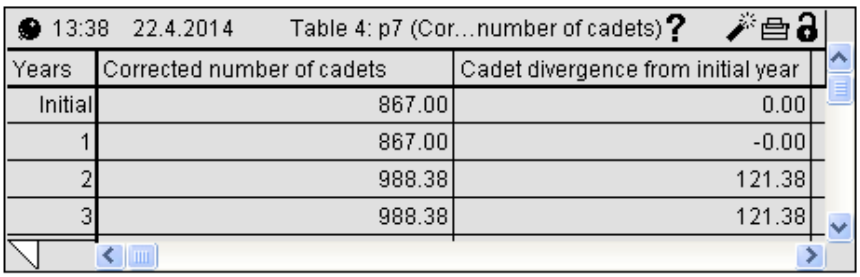
Years	Projected and realized peronnel cost correlation	Experimental personel cost value	Corrected personnel cost percentage
Initial	1.04	40.781.500.916,52	71.49
1	1.08	41.393.223.430,27	68.52
2	1.02	42.004.945.944,02	72.38
3	0.95	42.616.668.457,76	77.85

Figure 3: Correction of the amount of personnel costs and cost structure by changing ratio between designed and realized of personnel costs

Based on the above, the corrected number of personnel (*Ne*), which is adapted to the projected cost structure, is calculated based on the formulae 9,

$$Ne = K \times N \quad (9)$$

Practically correction of number of the personnel in the defence are executed by changing the value of K in the model, which represents the ratio between designed and realized of personnel costs. The results of simulation can be observed in Table in interface layer, as shown in Figure 4.



Years	Corrected number of cadets	Cadet divergence from initial year
Initial	867.00	0.00
1	867.00	-0.00
2	988.38	121.38
3	988.38	121.38

Figure 4: Table in interface layer that show corrected number of personnel

In this way we get a new number of personnel in defence in the categories of personnel and years, as well as the difference between corrected number of personnel and number of personnel in initial year.

4. CONCLUSION

The simulations can be successfully used in defence strategic management to investigate various options of managing the defence organization, before a particular strategy is implemented. In this way it allows the selection of optimal management options and preventing of uncertainty in strategies implementation. The development of computers and various software allows usage of simulations in strategic management and it is becoming more common.

One of the tools for creating process models and defence organizational elements, as well as execution of experiment is the iThink software. This software allows creation of a model in a very simple way by using the available tools, and then changing the value of the experimental factors and environment, which allows objectiv analysis of all the consequences of the specific strategies implementation.

One of the areas of defence strategic management is to manage cost structure of the defence, taking into consideration that the share of personnel costs in total costs are dominant, relative to other costs. Therefore is particular significance for defence strategic management to establish control on personnel costs. Because the height of the personal the cost depends on the number of employees in the defence and the average value of individual wages, controls of total the amount of personnel costs can be establish by impact on one of those parameters.

By using iThink software the model of the cost structure of the defence organization are created. The model allows the correction of the personal costs in defence, by influencing the number of the personnel in the organization. Number of personnel, as an experimental object, directly depends on value of experimental factors, in this case, the difence's budget, the projected cost structure, the average wage per person and escalation of personnel costs. In this way, model enables optimization of personnel costs in order to conform defence budget and the desired cost structure.

This model, with the extension, can be used to optimize operating costs and investments, which includes the entire cost structure of an defence organization. In this way it allows the selection of optimal defence development options and presentation of these options and the consequences of their implementation to the decision makers.

REFERENCE

Bogicevic B. M. (2006). Menadzment ljudskih resursa. Centar za izdavacku delatnost ekonomskog fakulteta. Belgrade. Serbia. pp. 267-292

Carl J. D. (2007). The Cost of a Military Person-Year. A Method for Computing Savings from Force Reductions. RAND National Defense Research Institute. Retrieved from http://www.rand.org/content/dam/rand/pubs/monographs/2007/RAND_MG598.pdf, [Publication]

Congress of the United States. Congressional budget office. (November 2012). Costs of Military Pay and Benefits in the Defense Budget. Retrieved from http://www.dtic.mil/dtic/tr/fulltext/u2/682719.pdf

iThink Systems Thinking for Business. Retrieved from http://www.iseesystems.com/Softwares/Business/ithinkSoftware.aspx

Milosavljevic S., Radosavljevic I. (2008). Osnovi metodologije politickih nauka. Sluzbeni glasnik. Belgrade. Serbia. pp. 543

Sakan M. (2006). Metodologija vojnih nauka. Vojnoizdavacki zavod. Belgrade. Serbia. pp. 304-312

Steven M. K. (2005). Military Compensation: Requirements, Trends and Options. Center for Strategic and Budgetary Assessments. Retrieved from http://www.csbaonline.org/wp-content/uploads/2011/03/2005.02.18-Military-Compensation.pdf.

The Military Balance. (2012). Routledge. Mortimer House. London. United Kingdom. [Publication]

EVALUATION OF CAPACITY DEVELOPMENT IN STRATEGIC PLANNING – A CASE OF CENTRAL GOVERNMENT INSTITUTIONS IN SERBIA

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Abstract: *The paper presents evaluation results on capacity development in strategic planning in Central Institutions of Government of Republic of Serbia. A wide range of actions has been undertaken over the period 2005-2012 in order to build and develop sufficient capacity in Central Government to strengthen planning, monitoring and policy coordination process for effective support needed for addressing complex policy challenges. As a result, the policy-making and co-ordination system in Serbia now posses some elements required for an effective public management and public administration system. Evaluation showed that* capacities for strategic planning on individual and enabling environment level are fairly developed, but it still have to be developed on organizational level. In depth evaluation has been conducted using survey *and structured interviews with state authorities' representatives. The research showed that the highest level of capacity development was achieved in the process of strategic plan development, but the problem are planning function institutalization and capacity development support.*

Keywords*: strategic management, strategic planning, capacity development, strategy implementation, public administration system development*

1. INTRODUCTION

The Government of Republic of Serbia faces many complex policy challenges as the country pursues European integration and in the same time struggling with economic crisis. The Government needs a public management and public administration with sufficient capacity to provide effective support and strengthening central institutions and government processes (Obradović, Mihić and Mitrović 2011).

A wide range of actions has been undertaken over the period 2005-2012 in order to build and develop sufficient capacity in Central Government to strengthen planning, monitoring and policy coordination process for effective support needed for addressing complex policy challenges. The process started in 2005 when the Government of Serbia decided to launch an important project to improve the efficiency and the effectiveness of the central public administration in the field of planning, budgeting, monitoring and reporting. In the first phase 2005-2006 it was a pilot project entitled: *Joint Project - Towards the More Effective Implementation of Reforms: Improving Planning, Budgeting, Monitoring and Reporting*, that was extended to the majority of line ministries and other central key agencies for the period 2007-2008. Starting with June 2007 the project was redesigned and renamed: *GOP –Towards the more effective planning and implementation of reforms.* During 2009-2010 the project: *Support to strengthening of policy coordination in the Government of Serbia* endured already started work on reform of various elements of policy system. This was continued with the project *Reforming Policy of Coordination of the Government of Serbia* planned for period 2011 - June 2012. During this period mentioned projects were designed to support the Government of Serbia to implement the reforms more effectively by developing capacity and tools that (Obradović, Mihić and Mitrović 2011):

- Strengthen planning capacity within Ministries through the development of a comprehensive action plan per Ministry, bringing together all reforms and strategies within the sector into one framework to be used as a basis for implementation and monitoring of progress;
- Improve the efficiency of the overall reform process by consolidating and bringing together activities and networks across the Government / sector ministries that are initiated and managed by Serbian European Integration Office (SEIO), Poverty Reduction Strategy Implementation Focal Point (PRS IFP), Ministry of Finance (MFIN), DACU, the General Secretariat (GS) of the Government and during the last year the Office of the National Investment Plan; and
- Provide conditions and develop tools and systems for future strengthening of the central coordination role of the Government.

As a result, the policy-making and co-ordination system in Serbia now has some of the elements required for an effective public management and public administration system. These include (Obradović, Mihić and Mitrović 2011):

- The legal framework was revised in (2005/6), including a revised Law on Government, Rules of Procedure, Regulation on the General Secretariat of the Government, and Regulation on the Cabinet of the Prime Minister.
- There are legally established committees of ministers to discuss items prior to their reaching the government session, which is supported by the General Secretariat of the Government.
- The Rules of Procedure establish the concept of the government"s collective responsibility, requiring that in all public communications members of the government should support its decisions regardless of their own views or of how they voted in the government sessions.
- The Rules of Procedures establish basic requirements for policy preparation in ministries, including appropriate procedures for inter-ministerial consultations, public debate, certification of harmonisation with the *acqui*, assessment of alternative approaches, assessment of financial consequences, and a full regulatory impact assessment (RIA).
- There are provisions for the preparation of an Annual Work Plan for the Government, for the regular monitoring of the implementation of the Annual Work Plan and for an Annual Report to Parliament on the implementation of this Plan.
- A Budget System Law is finalized to institutionalize a more policy-driven budget process and the middle term planning methodology as a key element of policy and budget planning. All ministries are now involved in this process.
- New department is established in General Secretariat for planning, monitoring and coordination of policies, with skilled staff to perform this process. IT system that supported new processes.
- Improved Annual Government Work Plan process linked to strategic planning model.

To evaluate the results it is necessary to consider methodological recommendations of relevant bodies. UNDP (2009) defines capacity development as the process through which individuals, organizations and societies obtain, strengthen and maintain the capabilities to set and achieve their own development objectives over time. OECD defines it as the process by which individuals, groups and organizations, institutions and countries develop, enhance and organize their systems, resources and knowledge; all reflected in their abilities, individually and collectively, to perform functions, solve problems and achieves objectives (UNDP 2009). World Bank on the other hand gives own definition: “Capacity development is a locally driven process of learning by leaders, coalitions and other agents of change that brings about changes in sociopolitical, policy-related, and organizational factors to enhance local ownership for and the effectiveness and efficiency of efforts to achieve a development goal” (Otoo, Agapitova and Behrens 2009).

In contest of capacity development in Serbian Central Government it was long-term process that lasted for seven years, through which individuals, organizations and society (the process included all line ministries and related organizations, Secretary General, other funding organizations all leaders and almost all staff of this organizations), strengthen and organize their systems, resources and knowledge, in area of strategic planning should enabled better planning, coordination and control of policies and politics, which should enabled effective and efficient implementations of reforms that on the end will contribute to sustainable development.

Literature suggests capacity development on following three levels individual, organizational and enabling environment (OECD 2006) (Bloger 2000) (UNDP 2008):

- **The enabling environment** is the term used to describe the broader system within which individuals and organizations function and one that facilitates or hampers their existence and performance. This level of capacity is not easy to grasp tangibly, but it is central to the understanding of capacity issues. They determine the „rules of the game“ for interaction between and among organizations. Capacities at the level of the enabling environment include policies, legislation, power relations and social norms, all of which govern the mandates, priorities, modes of operation and civic engagement across different parts of society (UNDP 2008). In the case of Serbian Government there was vast of policies, legislations and strategies that support reforms of Central Government. The first is commitment of Serbian Government to strategic priorities that are mainly defined by two pillars the European Integration process (EIp) and of the Poverty Reduction Strategy (PRS). The Government"s strategy for public administration reform (PAR) was adopted in November 2004 and with this strategy is implemented five key lows - Law on Government, Law on Public Administration, Law on Civil Servants, Law on Administrative Procedures and Law on Pay with the Decree on Grading. Beside mentioned lows there is the Budget System Law and revised legal framework included Rules of Procedure, Regulation on the General Secretariat of the Government, and Regulation on the Cabinet of the Prime Minister. Power of determination to pursue policy of European Integration and all strategies, laws and procedures that are adopted because of it, brought to society the new social

norms. So the capacity development in Central Government has enabling environment. (Obradović, Mihić and Mitrović 2011)

- **The organizational level** of capacity comprises the internal policies, arrangements, procedures and frameworks that allow an organization to operate and deliver on its mandate, and that enable the coming together of individual capacities to work together and achieve goals. If these exist, well resourced and well-aligned, the capability of an organization to perform will be greater than that of the sum of its parts (UNDP 2008). The organizational level is maybe the poorest point of capacity development and building in this case, except the part that concerns General Secretariat that have developed internal procedures and frameworks that facilitate capacity development and building on organization level. This level of capacity development is slowest on ministry and related organizational level because it demands commitment of ministries and their deputies, which are political appointed. They are still not under pressure of performance measurement so they are not forced to be managers beside their political role. This need for managerial behavior is one of basic doctrines of New Public Management. This trend in the Serbia is very slowly progressing. Since 2011 with support and dedication of Central Institutions and laws the most of line ministries and related organization had working groups with deputy ministries headed or deputy directors of related organizations. Even if there is in the most cases bottom up approach to developing middle term plans the monitoring and requested accountability for planned results would made ministry and his deputies to be more seriously included and as matter of fact to mange planning process. (Obradović, Mihić and Mitrović 2011)
- **The individual level** capacity refers to the skills, experience and knowledge that are invested in people. Each person is endowed with a mix of capacities that allows them to perform, whether at home, at work or in society at large. Some of these are acquired through formal training and education, others through learning by doing and experience (UNDP 2008). At this level the Human Resource Department within Secretariat General doing great work. There are regularly trainings for all interested parties. So all the members of working groups in ministries and related organizations could pass the trainings and beside that every working group have a mentor that help to enquire needed education through learning by doing. (Obradović, Mihić and Mitrović 2011)

Considering that the poorest results of capacity development are achieved on the organizational level we decided to further investigate the issues. The following chapters present methodology, results and discussion of the research.

2. METHODOLOGY

Data collection consisted of survey and structured interviews with state authorities‟ representatives. Questionnaire was specifically structured to enable the assessment of the strategic planning process step-by-step by evaluation of processes, methodologies and methods and techniques used for strategic / medium-term planning processes and evaluation of the results of the process. The first segment consisted of questions were spread over 4 sections:

1. Institutionalization of the planning function
2. Establishing the strategic foundations, conducting strategic diagnosis and developing strategic plan
3. Management of strategic plan implementation
4. Capacity development support

The second segment consisted of three questions with 10 statements that need to be ranked by importance from 1 (the most important) to 10 (the least important), namely:

1. Goals of strategic planning process capacity development
2. Results of strategic planning process
3. Challenges of strategic planning process

Sample consisted of 32 respondents; most of them (26 (81.25%) out of 32) were from organisations with more than 100 employees. Further, 12 (37.5%) respondents were working as Advisors, 15.63% (5) as Senior Adviser, 12.5% (4) as independent advisers, 9.38% (3) as civil servant, one respondent as junior counsellor and the rest of the respondents 21.88% (7) were working as project team members. The average work experience of the respondents was 14.2 years. It was interesting to note that respondents employed in the ministries have much longer experience of respondents employed in related organizations, or organizations that have fewer than 20 employees.

All respondents, except one who has recently become a member of the working group, have already participated in processes of medium-term planning. Further, 11 (34.38%) out of 32 respondents was the contact person in front of working group who correspondent with General Secretariat. Average length of membership in the working group was 2.7 years. Respondents have following positions in working groups:

- Manger/Deputy (6.25%)
- Secretary (6.25%)
- Member/Deputy (87.5%)

The research results and discussion are presented in following section.

3. RESEARCH RESULTS

An analysis of the data collected from survey and interviews for first segment of questions showed that in most cases their organizations have developed up to some level capacities for strategic planning process, but that there is still work that have to be done in order to develop sufficient capacities. The questionnaire employed a rating scale, with „5" for highest level of development. The researcher set a level of 4 and below. Any score below 4 signals the need for improvement.

Table 1 – Level of capacity development

	Segments	Ratings
1	Institutionalization of the planning function	3.87
2	Establishing the strategic foundations, conducting strategic diagnosis and developing strategic plan	4.26
3	Management of strategic plan implementation	3.60
4	Capacity development support	4.18

Results showed that fairly developed segments of strategic planning capacities are establishing the strategic foundations, conducting strategic diagnosis and developing strategic plan and capacity development support. Then follows level of institutionalization of planning function and the lowest rated is managing strategic plan implementation, both segments should be under of serious consideration.

Analysis of every segment independently showed where improvement is most needed. As institutionalization of planning function matters, the poorest results are achieved because top executives failed to take formal responsibility for the organization"s strategic planning and they insufficiently actively participate in planning process. Also one of the problems that could be alarming is that responsibilities for medium-term planning activities are not in certian number of organisations formaly included in job descriptions. More detailed results are shown in Table 2.

Table 2 – The level of institutionalization of the planning function

	The level of institutionalization of the planning function	Ratings
1	Top executives take formal responsibility for the organization"s strategic planning.	3.89
2	Strategic planning is a top priority activity that is performed on a regular basis.	3.75
3	Ministry/Department provide resources (managers' time, staff support, etc.) for strategic planning implementation.	3.53
4	Ministry/Department consistently follow a defined set of procedures in its strategic planning process.	4.44
5	Ministry/Department consistently follow a budget calendar.	4.57
6	Managers actively participate in planning process.	3.44
7	Responsibilities for medium-term planning activities are included in job descriptions	3.45

Evaluation of segment *establishing the strategic foundations, conducting strategic diagnosis and developing strategic plan* as we already mentioned is fairly developed. Every element of this section is highly rated with average rat above 4, except that there is still in some of organizations lack of methodological support for project/program prioritization. The best results are achieved in a field of participatory approach in definition of goals. More detailed results are illustrated in Table 3.

Further, the results of evaluation of section management of strategic plan implementation are shown in Table 4. Notice that the only developed element is that strategic decisions are based upon the strategic plan. Every other element here needs special effort in order to be improved. The most underdeveloped segment is that individuals responsible for strategic planning and implementation are not rewarded for successful performance. This could be related to the fact that activities on strategic planning in certain number of organizations are not yet included in job descriptions.

Table 3 – The level of development of activities of establishing the strategic foundations, conducting strategic diagnosis and developing strategic plan

	Establishing the strategic foundations, conducting strategic diagnosis and developing strategic plan	Ratings
1	Vision/mission statement been distributed to all the Ministry/Department's staff.	4.11
2	All the Ministry/Department staff, particularly management and higher-level staff understand this vision/mission statement.	4.36
3	Goals are defined in participatory manner and all the Ministry/Department staff understands them.	4.47
4	Situation analysis (which includes one or more of the following analysis: analysis of the strategic framework, SWOT, PESTLE, stakeholder analysis, problem analysis) is a regular activity in the strategic planning process.	4.38
5	The results of the situational analysis are used for plan development (objectives, programs, projects, budgets), re-examination and revision of goals or initiating new initiatives.	4.37
6	There is a methodology for prioritization and selection of programs / projects.	3.91
7	The planning of programs/projects always includes consideration of cross-sector cooperation.	4.26
8	Projected costs of programs/projects are included in the budget of organization.	4.21

Table 4 – The level of development of capacities for management of strategic plan implementation

	Management of strategic plan implementation	Ratingss
1	Strategic decisions (implementation action plans) are based upon the strategic plan.	4.14
2	Lead responsibility for action plan implementation is clearly assign to one person.	3.56
3	Sufficient resources are allocated for implementation of projects/programs.	3.11
4	Ministry/Department review monitoring data regularly, and revise strategic decisions as appropriate.	3.88
5	Ministry/Department has at its disposal all the information necessary for quantitative and qualitative monitoring of the implementation of the plan.	4.00
6	Individuals responsible for strategic planning and implementation are rewarded for successful performance.	2.71
7	Stakeholders are regularly informed on results of medium-term planning process.	3.87
8	Top management uses a medium-term plan, and requires regular monitoring and reporting on the implementation of the same.	3.45
9	Ministry/Department has a tracking system that allows measurement of the actual results achieved against planned targets.	3.69

The last section of this segment is related to evaluation of support of General secretariat to capacity development of strategic management process. The results are shown in Table 5. Respondents rated the mentor support as highest and Human Resources Management Service (HRMS) with poorest rates, sending a message that need to have more proactive approach in the process of capacity development.

Table 5 – Evaluation of capacity development support

	Capacity development support	Ratings
1	The training system for strategic/medium-term planning is well designed and meets the requirements.	4.22
2	There is a need for additional training for strategic/medium term planning at all levels of management.	4.20
3	Human Resources Management Service (HRMS) is adequately involved in the development of capacity.	3.79
4	Mentor support is adequate for the working group in the process of implementing strategic/medium term plan.	4.42
5	Support of the General Secretariat is adequate and meets the needs of the working group in the process of implementing strategic/medium term plan.	4.25

Respondents‟ highest ranked answers on question what are the most important goals of introducing strategic/medium-term management were:

- Meeting the requirements of the EU accession process
- A results-oriented public sector
- Increase transparency of state administration

Respondents‟ highest ranked answers on question what are the most important results of the introduction of strategic/medium-term planning were:

- Formed working groups
- Developed capacities for strategic planning
- Introduction of the Budget Law, Fiscal Strategy and other relevant documents

Respondents‟ highest ranked answers on question what were the biggest challenges in the process of the introduction of strategic/medium-term planning were:

- Lack of commitment of managers
- Unclear roles of people involved in the planning process
- Opposite instructions and the requirements of the Ministry of Finance and the General Secretariat

The answers showed that respondents have developed understanding of why the capacity development process for strategic planning is important. Also the segment showed what is considered to be the biggest challenges in this process suggesting where further actions are needed.

4. CONCLUSIONS

The first part of the paper is consisted of background review of capacity development process for strategic planning in Central Institutions of Government of Republic of Serbia. A wide range of actions has been undertaken over the period 2005-2012 in order to build and develop sufficient capacity in Central Government to strengthen planning, monitoring and policy coordination process for effective support needed for addressing complex policy challenges. As a result, the policy-making and co-ordination system in Serbia now posses some elements required for an effective public management and public administration system.

Capacity development in Serbian Central Government was long-term process that lasted for seven years, through which individuals, organizations and society (the process included all line ministries and related organizations, Secretary General, other funding organizations all leaders and almost all staff of this organizations), strengthen and organize their systems, resources and knowledge, in area of strategic planning should enabled better planning, coordination and control of policies and politics, which should enabled effective and efficient implementations of reforms that on the end will contribute to sustainable development. Evaluation showed that capacities for strategic planning on individual and enabling environment level are fairly developed, but it still have to be developed on organizational level.

In depth evaluation has been conducted using survey and structured interviews with state authorities‟ representatives. Evaluation was consisted of assessment of institutionalization of the planning function, development of strategic plan, management of strategic plan implementation and capacity development support; and evaluation of goals, results and challenges of strategic planning process capacity development. The research showed that the highest level of capacity development was achieved in the process of strategic plan development, but the problem are segments of planning function institutalization and capacity development support. For further development of capacities the following actions have to be made:

- Top executives have to take more active role and formal responsibility.
- Responsibilities for medium-term planning activities have to be formaly included in job descriptions.
- Methodology for project/program prioritization has to be developed.
- Human Resources Management Service (HRMS) need to take more proactive approach in the process of capacity development.

Finally, results that this paper provides are significant in the way that they could contribute to further development of capacity development on organisational level.

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REFERENCES

Obradović, V., Mihić, M., & Mitrović, Z. (2011). Experiences and challenges of the central government capacity building: the case of Serbia. *9th International scientific conference – "Serbia facing the challenges of the globalization and sustainable development"* (pp. 165-170). Belgrade: Megatrend University.

UNDP. (2008). *Capacity Development: Practice Note.* New York: UNDP.

UNDP. (2009). *Frequently Asked Questions: The UNDP Approach to Supporting Capacity Development,.* UNDP: UNDP, Bureau for Development Policy, Capacity Development Group.

Bloger, J. (2000). *Capacity Development: Why, What, and How.* Quebec: CIDA Policy Branch.

OECD. (2006). *he Challenge of Capacity Development: Working Towards Good Practice.* Paris: Organization for Economic Cooperation and Development (OECD).

Otoo, S., Agapitova, N., & Behrens, J. (2009). *The Capacity Development Results Framework.* Washington: World Bank Institute .

SUSTAINABLE DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT

DELTA UNIVERSE AND NATURE PROTECTION IN THE DANUBE DELTA

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Abstract: *Danube, the second longest river in Europe through a tortuous path in the Black Forest to the Black Sea. River arises through union sources: Breg, Brigach, Donau Quelle and joins the sea by three branches: Chilia, Sulina and St. George forming the Danube Delta. As space crosses so large and diverse to establish the International Commission for the Protection of the Danube River which aims to ensure the sustainable use and equitable access to water resources along the river basin, the Commission's work jumpers Danube River Protection Convention which is an important instrument for cooperation and transboundary water management in the Danube basin. Romania was in 2007 president of the International Commission for the Protection of the Danube River. Romania is interested to protect the water of the river, given the length that it crosses the country and the fact that the arms of the Danube flows into the Black Sea forms one of the most rare and beautiful wetlands, named Danube Delta. It is appreciated that the Danube Delta Biosphere Reserve has become as compared to other deltas of Europe and the Earth has retained a high biodiversity, that a multitude of species from a variety of systematic units. In the European continent, Delta retained natural habitat. This area has special significance both ornithological aspect and morphological and climatic factors have described it as a very important reserve. Nature reserves in the area of 41500 ha were delineated in three different biotypes of the delta and was placed in the international studies program "Man and Biosphere" attached to UNESCO to recognize the importance of Romanian scientific nature reserves and the richness and variety of flora and fauna elements.*

Keywords*: biosphere, convention, delta, flora, river.*

1. INTRODUCTION

Nature recommences same things again, every year, day, hour, so it creates a kind of infinity and eternity – Blaise Pascal Danube from its source at the river mouths- Danube Delta.

The Danube River is the second largest in Europe after Volga and it is formed by the confluence of the rivers Briegach and Brege that arise from the Black Forest. The Danube has a length of 2 840 km; an area of its basin is about 817 000 km2; the incoming flow into the Delta is of 6350m3/s and is divided in the three branches: Chilia 58%, Sulina 19%, Sf. Gheorghe 23%. The Danube Delta is shared by Romania and Ukraine and has a total area of 4178 km2, of which 82% (3446 km2) in Romania and 18% (732 km2) in Ukraine.

Because of its route, the Danube can be called the river of ten countries (Germany, Austria, Slovakia, Hungary, Croatia, Serbia, Romania, Bulgaria, Republic of Moldova, and Ukraine) and also the river of four capitals (Vienna, Bratislava, Budapest, Belgrade).

2. MATERIALS AND METHODS

2.1. The International Legal Regime of Danube

Water is an indispensable element of the existence of life on the planet, a renewable, vulnerable and limited natural resource, a raw material for productive activities, an energy source and a transport pathway, a key factor in maintaining the ecological balance for the existence of life and the realization of all human activities (Dutu, 2010). “This scarce resource essential for life should be considered a natural treasure that is part of the common heritage of the mankind”.

2.2. The international regulations on the protection of the Danube

The international regulations on the protection of the Danube appeared relatively late in comparison with those for other continental waters. For a long time the international legal regime of the Danube referred exclusively to the freedom of navigation, to the economic and technical use of waters and to the fishing (Marinescu, 2003).

Since it crosses a vast space it was set up the International Commission for the Protection of the Danube River. The Commission aims to ensure sustainable use and equitable access to water resources along the river basin. The Commission's activity has the Convention of the Danube River Protection as a starting point, which is an important instrument for cooperation and trans-boundary water management in the Danube basin.

An important moment in the history of Danube´s protection efforts is the signing of the Declaration of Cooperation between the Countries of the Danube in the Management and Protection of the Waters of the River against Pollution on 13 December 1985 in the Conference of Bucharest (Dutu, 2010).

After 1990, the riparian concern regarding cooperation in order to protect the river from pollution, both bilaterally and multilaterally grew. The situation materialized with the signing of several conventions and agreements, among which the Convention on Cooperation for the Protection and Sustainable Use of the Danube River - signed in Sofia, at June 29, 1994.

2.3. Current International Legal Framework

The international legal framework for protection against pollution of the Danube border currently has three categories of international norms: rules and principles on trans-boundary pollution, specific regulations targeting watercourses and international lakes, and regulation governed by coastal states within bilateral and regional cooperation.

2.3.1. Principles on trans-boundary pollution

Most of these principles are rooted in customary international law. The Stockholm Declaration on the Human Environment in 1972 established the fundamental rule which provides that the states must proceed in such a way that activities within their jurisdiction do not damage the environment of other states. This rule was taken up and proclaimed subsequently in the texts adopted at the 1992 Rio de Janeiro Convention on Environment and Development (Cobzaru, 2013).

Other principles and rules were set out in the Espoo Convention -1991- on environmental impact assessment in a trans-boundary context. The same category of principles on trans-boundary pollution includes rules concerning the responsibility of polluters, the duty to inform immediately the states likely to be affected by any event which may cause adverse effects on their environment, the rule of equal application of the national law, regardless of the place producing the environmental damage.

2.3.2. Specific regulations regarding watercourses and international lakes

The development of this category of regulations occurred through two framework agreements: the Helsinki Convention -1992- on the protection and use of trans-boundary watercourses and international lakes and the Convention on the right of use of waterways for purposes other than navigation -New York, 1997.

The concept of trans-boundary waters and of trans-boundary impacts was explained and regulated according to the terms of The Helsinki Convention which is the international regulatory framework on the subject. The injurious effect of the trans-boundary impact can "take many forms: attacks on human health, flora, fauna, soil, air, landscape and historical monuments, buildings; the interaction among these factors may also means a breach of cultural heritage and of socio-economic conditions resulting from alterations of those factors."

The Helsinki Convention has created a general legal framework that was an incentive for the elaboration of agreements between riparian of international watercourses to prevent and reduce trans-boundary pollution.
The New York Convention aims "to enable to use, highlight, devote, manage and protect international watercourses and promote optimal and sustainable use for the benefit of current and future generations".
The general principles of the previously mentioned conventions are equitable and reasonable use, the obligation to not cause significant damage, paying special attention to meet the essential needs in conflict resolution etc.

The Sofia Convention -1994- on the sustainable protection and conservation of the River was signed by the ten Danube countries and the European Community, and it has a sub-regional integrative character.
The fundamental objectives of cooperation between the Danube countries, the basic principles of the river protection, and so on were thus established. (Dutu, 2010)

A series of bilateral documents aimed preventing and combating the pollution of the river was agreed between riparian states. Such documents are: in 1991 the Convention between Romania and Republic of Moldova, in 1991- the Convention between Romania and Bulgaria in 1993 the Agreement between Germany and Romania, in 1993 the Convention between Romania and Slovakia, in 1998 the Convention between Romania and Yugoslavia on operation and maintenance of hydropower and navigation systems "Iron Gates I" and "Iron Gates II".

Community environmental law is constantly growing. The member states of the European Community have already assimilated the Community rules into law while the candidate states are in the process of harmonizing and assimilating those; the adoption of EU legal regulations (represented by about 20 directives on water) is an important milestone, especially for determining the water quality objectives and the regulation of water discharges.

The International Day of the Danube is celebrated every year on the 29th of June, as initially proposed by the Danube countries and under the auspices of the International Commission for the Protection of the Danube River (ICPDR in Vienna). This day marks the signing of the Convention on Cooperation for the Protection and Sustainable Use of the Danube River, an event that took place in Sofia (Bulgaria), on June 29, 1994.
Danube Day celebrations take place in all Danube states to mark their mutual desire to join forces in support of protecting this unique river in Europe.

The International Commission for the Protection of the Danube River launched "Danube Box", an educational project in the domain of the water protection. This project is designed as a tool (kit) to be use by teachers and students in the education process at the level of elementary school.

"The Book of the Blue Danube" has a special role to inform and educate children on values and traditions belonging to the Danube area and increase their awareness regarding the need to protect and preserve the aquatic ecosystem of the river basin.

The Danube creates a delta with three great branches at its mouth to the Black Sea. The first branch is Chilia. With a length of 120 km it is the most vigorous as it accounts for 58% of the Danube's flow. Chilia, with its many biffs and islets, has the greatest depth of the three channels, 39m.

Sulina, the second branch, is mainly used for navigation because there was done extensive work to deepen and to correct the meanders. The channel length decreased from 93 km to 64 km because of these works which took place between 1862 and 1902.

The third branch, Sfântul Gheorghe, is the oldest and it carries 24% of the volume of water and river deposits (alluvia). The branch has undergone significant transformations, namely the cutting of six meanders, which brought its length down to 70km.

Remarkably, the Danube Delta has become a biosphere reservation. It has retained a high biodiversity (a multitude of species from a variety of systematic units) in comparison with other deltas in Europe and even on Earth. The Danube Delta has become a Biosphere Reservation due to the fact that compared to other deltas on Europe or on the Earth; it has retained a rich biodiversity, ie a multitude of species from a variety of systematic units. Given the importance of this unique space, since 1991 the Romanian government started a comprehensive program to inventory the flora and fauna of the Danube Delta Biosphere Reservation. The purpose of this ample effort is to gain a better understanding of an important component of the natural heritage in a biosphere reservation and identifying species that require protective measures and / or conservation.

As a result, this huge puzzle represented by the Danube and its delta is a habitat for a wide variety of plant and animal communities estimated at 30 types of ecosystems and 7405 animal and vegetal species.

Given the unique nature of the Danube Delta, the concerns about environmental protection, rational use of resources and preservation of its ecological balance have increased.

Regarding the delta, technical and scientific research revealed two relationships that are fundamental from an ecological point of view. These relationships affect an area far beyond their geographical boundaries, namely:
a.- the key position for the ecology of fish fauna in Danube Floodplain and the Black Sea coastal zone;
b.- the key position in the life of migratory avifauna in Europe, taking into account that delta is situated at the crossing of the main bird migration routes.

3. CONCLUSION

The Danube Basin contains various riparian countries and a total population of about 250 million inhabitants, which generates pressure on the river environment. Generally, Coastal States have not sufficiently developed economies and they do not give due consideration to environmental issues; from the point of view of the industry, agriculture and technology, the most developed is the upper basin, followed by the middle basin and the lower basin.

The Cooperation of the Danubian states is influenced by reporting to the process of European integration in the context that a part of riparian countries are members of the European Union (Germany, Austria, Czech Republic, Hungary, Romania, Bulgaria).

The Conservation of the natural conditions and historical and cultural monuments aligns with the basic concerns of our state: "It is necessary to take rigorous measures to control the industrial hazards, to prevent water and air pollution, to protect the forests, rivers, mountains and lakes considered monuments of nature. Within the European committee, the Danube Delta maintains its natural biotope and thus it has an exceptional significance taking into account the ornithological rapport and the morphological and climatic factors that have made from it an important reserve with many rare vegetal and animal species. These features have made the delta to be considered absolutely unique compared to any first rank touristic area in our country.

The Danube Delta integrates:
- Resources of reed (cane) for cellulose and paper manufacturing industries;
- Areas for hunting and fishing;
- Recreation places for tourists;
- Areas of scientific interest.

In 2000, due to the favorable conservation status of the ecological systems and species in the Danube Delta, the Council of Europe awarded the European Diploma for this reserve, diploma renewed in 2005. Home to a wide variety of plant and animal species as well as associations and communities particularly interesting and valuable, the Danube Delta remains one of the best preserved deltas in Europe, being declared Natura 2000 site both as Special Area of Conservation and Avifaunistic Special Protection Area.

The objectives that we have set through the establishment of the Danube Delta Biosphere Reservation are based on the principle of sustainable development whose primary goal is re-naturalization of the delta by removing the disastrous effects of the past. Parallel efforts were made to preserve the entire Delta ecosystem's potential fauna and flora, to be able to offer to people loving the nature not only eco-tourism, but also the opportunity to enjoy - now and in the future - the benefits of nature.

The fragility and the active dynamic of the deltaic system aroused for a long time the interest of scientists. At the same time, all actions that must carry ARBDD require a scientific foundation for a rational, environmental management, ensuring both biodiversity conservation and sustainable development. The Danube Delta is the chosen place by nature and people, where all actors involved are trying to understand and learn how to use natural resources and, at the same time, preserve them for the future.

The Romanian wetlands were defined as stretches of swamps, marshes, natural or artificial, permanent or temporary waters, where the water is stagnant or flowing, fresh or salted, including the marine water bodies whose depth at low tide does not exceed six meters. The above mentioned areas are areas where the saturation with water is the main determinant of the soil nature, and of the types of plant and animal communities living in the soil or on the soil surface.

The Convention on Wetlands signed in Ramsar, Iran, in 1971, established February 2nd as World Wetlands Day; the document was ratified by Romania through Law 5/1991. This year, the World Wetlands Day is celebrated under the slogan “Without wetlands there is no water" and is the occasion to draw attention to the

fact that the sustainable use and conservation of the wetlands must be part of any solution to reduce the global drinking water crisis.

REFERENCES

Angelica Cobzaru 2013– Principiile dreptului european al mediului, Editura CH.Beck, Bucharest

Mircea Duțu 2010– Dreptul mediului, Environmental Law Tratat, Editura CH.Beck, Bucharest

Mircea Duţu 2003 - Dreptul mediului, Environmental Law Tratat, Editura economică, VOL.II, Bucharest

Daniela Marinescu 2003, Tratat de Dreptul Mediului, Environmental Law Treaty, Editura ALL BECK, Bucharest

Convenţia privind cooperarea pentru protecţia şi utilizarea durabilă a fluviului Dunărea/ Semnată la Sofia. la 29 iunie 1994- Convention on Cooperation for the Protection and Sustainable Use of the Danube River / Signed at Sofia at June 29, 1994

Convenţia de la Rio de Janeiro asupra mediului şi dezvoltării-1992 - Rio de Janeiro Convention on Environment and Development-1992

Convenţiei de la Espoo -1991 Espoo Convention

Convenţia de la Helsinki -1992 Helsinki Convention

Convenţia asupra dreptului referitor la utilizarea cursurilor de apă şi în alte scopuri decât navigaţia – New York-1997 - Convention on the law on the use of the waterways for purposes other than navigation - New York 1997

Convenţia de la Sofia privind protecţia şi conservarea durabilă a fluviului Dunărea-1994 - Sofia Convention on the protection and conservation of the Danube River-1994

Convenţia dintre România şi Republica Moldova-1991 Convention between Romania and Moldova-1991

Convenţia dintre România şi Bulgaria-1991 Convention between Romania and Bulgaria-1991

Convenţia dintre România şi Slovacia-1993 Convention between Romania and Slovakia-1993 Convention between Romania and Yugoslavia on the operation and maintenance of hydropower and navigation "Iron Gates I" and "Iron Gates II" .1998

Convenţia dintre România şi Iugoslavia privind exploatarea şi întreţinerea sistemelor hidroenergetice şi de navigaţie « Porţile de Fier I » şi « Porţile de Fier II ».1998- Convention between Romania and Yugoslavia to operate and maintenance hydropower and navigation to "Iron Gates I" and "Iron Gates II" .1998

Convenţia asupra zonelor umede semnată la Ramsar-1971 Convention on Wetlands signed in Ramsar-1971

Declaraţia de la Stockholm privind mediul uman-1972 Stockholm Declaration on the Human Environment, 1972

Acordul dintre Germania şi România - Agreement between Germany and Romania

Legea 454/2001, privind înfiinţarea Rezervaţiei Biosferei Delta Dunării - aw 454/2001 on the establishment of the Danube Delta Biosphere

Tratatul CE TreatyUE

MULTIPLE CRITERIA APPROACH TO SELECTING SITES FOR PORTS OF NAUTICAL TOURISM

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***Abstract**: In this scientific paper the authors explore the issue of selecting a site for a nautical tourism port using the methodology of multi-criteria analysis (MCA). Given the huge importance of tourism, in particular, nautical tourism in most maritime countries, including the Republic of Croatia and its coastal counties, any help in resolving that issue would be of immense significance. In Croatia, the existing distribution of nautical tourism ports (NTPs), their capacities and the quality of their services are not fully suited to the spatial features. Often these ports fail to blend with their environment and provide no effective protection to natural assets. The distribution of capacities does not match actual spatial potential, while the quality and level of facilities and services varies greatly and is generally inadequate. Hence, the aim of this paper is to identify criteria for the location and development of NTPs in coastal areas. The paper applies the multi-criteria approach to selecting a site for NTPs in Split-Dalmatia County (SDC). Potential micro locations (35) in that region have been studied and criteria and sub-criteria for selecting sites for NTPs, identified.*

***Keywords**: criteria, multiple criteria analysis, site analysis, nautical tourism port, Croatia.*

1. INTRODUCTION

Site selection is a strategic problem addressed in many studies and by many authors whose scientific work have provided a better understanding of the importance of using the right methodology. Different issues are often united in a methodological approach involving the use of multiple criteria analysis (MCA). The reason for this is the fact that using MCA at the scientific level helps to expand the number of NTP sites and sites for accommodating vessels on land, thus resolving the problem of lack of space and the growing demand for berths by boaters.
This paper focuses on identifying the current state of nautical tourism in Croatia, specifically in Split-Dalmatia County (SDC), comparing it with Mediterranean trends, and analysing its spatial and environmental factors. Upon analysing existing and proposed NTP sites in SDC, the advantages and carrying capacities of marine areas are evaluated and criteria for selecting sites on the mainland and on islands are established.
Through research and analyses, the authors seek to accomplish the purpose of this paper which is to define spatial possibilities and constraints, and to propose criteria to ensure the selection of a location for NTPs. With regard to the research problem, the general and special goals set call for the application of MCA in selecting the criteria critical to determining the location for NTPs.

2. THEORETICAL DETERMINANTS AND NAUTICAL TOURISM DEVELOPMENT IN CROATIA

One of the most promising forms of tourism in Croatia, nautical tourism is a complex tourism and maritime concept and its pervasive connection with the sea and navigation makes it all the more difficult to define (Luck, 2007). Namely, the maritime component does not define nautical tourism in its entirety, although superficial analysis may make this seem so (Luković, 2007). Given the fact that both *tourism* and *nautical tourism* are derived concepts representing a set of activities adherent to them but which can change and be added to over time, the authors conclude that nautical tourism is a multidisciplinary phenomenon.
The Tourism Activities Act (Official Gazette 8/96, 19/96, 76/98) defines nautical tourism as "*the navigation and sojourn of tourists/boaters in vessels and in NTPs, for the purpose of recreation and entertainment*".
In the Croatian Adriatic, nautical tourism received powerful incentives and a strong identity in the mid-1980s through the construction of the ACI Marina system, which quickly became the leading nautical organization in the Mediterranean. However, due to various reasons, this role as a leader was lost during the two decades following Croatia's independence. During that period, France, Greece, Turkey, Italy, and other Mediterranean countries invested heavily in marina construction. Today the nautical tourism capacities of Italy are five-fold greater than those of Croatia. An analysis of the current state of nautical tourism in Croatia indicates that the assets of Croatia's Adriatic coast and islands have still not been valorised to any sufficient

extent (Bošković et al, 2006). An analysis of statistical and other available data and the Development Strategy of Nautical Tourism in Croatia (2008) suggest that less than half of all vessels and yachts sailing the Croatian Adriatic in the summer season use berths in commercial marinas, while the majority of vessels and yachts are freely anchored in natural coves or moored in transient local harbours. The main reason for this is the shortage of marina capacities in the summer period, in particular, on the islands. Less than half of nautical tourism traffic (excluding small vessels that do not use marinas) in Croatia is encompassed in the organized accommodation of vessels, an activity which has an environmental protection function as well as an economic function. SDC is no exception; it accounts for a mere 13% of all available berths in Croatia. Considering that the existing offering of berths at sea and on land is lacking, many authors are of the opinion that it is necessary to plan sites for the organized accommodation of vessels.

Table 1: NTPs in Croatia and SDC, 2006 - 2012

Year	NTPs, total		Share of SDC in %	Indices	
	Croatia	SDC		Croatia	SDC
2006	95	11	11.6%	-	-
2007	94	11	11.7%	99	100
2008	97	11	11.3%	103.2	100
2009	98	13	13.3%	101	118.2
2010	98	13	13.3%	100	100
2011	98	13	13.3%	100	100
2012	98	13	13.3%	100	100

Source: the authors after CBS

Table 1 shows the number of NTPs in Croatia and SDC. The table demonstrates a continued growth in the number of NTPs in Croatia over the years, the greatest increase being in 2008. SDC also displays an upward trend, with the greatest boost being in 2009.

Table 2: Number of berths in Croatia and SDC, 2006-2012

Year	NTPs, total		Share of SDC in %	Indices	
	Croatia	SDC		Croatia	SDC
2006	15 973	1 591	9.9%	-	-
2007	15 834	1 581	9.9%	99.1	98.4
2008	16 403	1 576	9.6%	103.6	103.6
2009	16 848	1 789	10.6%	102.7	101.1
2010	16 913	1 792	10.6%	100.4	101.1
2011	17 059	1 913	11.2%	100.9	106.8
2012	17 454	2 238	12.8%	102.3	117

Source: the authors after CBS

Table 2 shows the number of berths in NTPs in Croatia and in SDC per year. Both Croatia and SDC display an obvious upward trend, with SDC accounting for about one-tenth of all berths in Croatia.
An analysis of the current state of NTPs in Croatia compared with the Mediterranean countries (Kovačić et al, 2012), together with an analysis of the existing state of infrastructure for accommodation of vessels in SDC, reveals there are:

- Sites which are established in existing plans
- Sites already being used for the purpose of nautical tourism although there is no organized accommodation of vessels at such sites and
- Sites which need to be included in new spatial plans.

Previous practice indicates that without the approval of the local community, the business policies of investors and the location of new NTPs come up against resistance as early as the initial phase of site preparation.
SDC spatial plans have identified sites for the construction of new NTPs, spurred by the growing demand for berths, the distinctiveness of the destination and the vicinity of outbound tourism regions. NTP capacities foreseen in plans are in accordance with the county's spatial potential and the interest of boaters. A large

number of NTPs in SDC are used only during the summer season. The existing ports and harbour that do not have NTP status are exploited extensively and their marine areas are mostly occupied by small vessels, with no economic effect for the local community.
A survey conducted in SDC local government units points to poor communication (interaction) between towns/municipalities and NTPs, primarily as a result of imposed coexistence in a constrained area of two separate entities whose interests and goals apparently seem to differ:

- A port of nautical tourism – a marina, in particular – is a business entity focused on business efficiency, productivity, market competitiveness and development.
- A town/place/municipality, as a community of residents, is focused on promoting the well-being and quality of life of its citizens, and accordingly aspires to the environmental and visual assets and the expectations of people (residents).

From these diverging visions, conflicts may emerge bringing the physical and functional use of space into question (Kovačić et al, 2013). Hence, it is essential to involve the local government in the preparation phase of spatial planning, not only to gather opinions but also to communicate the socio-economic effects that the organized accommodation of vessels could bring (Favro et al, 2005).
The Development Strategy of Nautical Tourism (2008) is a fundamental document of the future development of nautical tourism in Croatia. It foresees the construction of NTPs as follows:

- Marinas in the vicinity of airports
- Marinas and moorings within urban centres
- The organization of transit berths at tourist moorings in traditional island ports
- The organization of a system of anchorages
- The construction of marinas for mega yachts.

3. BASIC FEATURES AND METHODOLOGY OF MCA

If conducted correctly (Nikolić and Borović, 2006), MCA requires the cooperation of all interested parties and the practical involvement in the decision process of all stakeholders to whom a problem applies, which, on the other hand, facilitates the realization of obtained priorities and eliminates any doubts concerning subjective decision making (Favro and Kovačić, 2010). The importance of building NTPs and using natural resources in contemporary conditions is particularly emphasized, as well as the number of parties interested in reaching a suitable solution (Jugović et al, 2011). The transparency of available data used in making analyses is highly important because it makes it possible to check whether parameters have been correctly evaluated. From a methodological perspective, MCA represents a systems approach, and in terms of methodology, it is the most effective and functional approach to problem resolution (Kovačić, 2010).
A systems approach to the problem of selecting sites for NTPs in SDC points to an unstructured problem which at strategic and tactical levels of decision making required a complex analysis of the goals set in this research. Problem structuredness or refinedness is the most important characteristic with regard to the decision-support methods and procedures available for a concrete problem (Brans and Vincke, 1985).
Before MCA methodology can be applied, it is necessary to establish whether the problem is characterized by alternative solutions. This was established for the problem of selecting sites for NTPs in SDC. It is also essential to ascertain whether all relevant criteria have been taken into consideration and have been properly evaluated, in particular parameters which are the product of expert judgements. Previous experience in evaluating the use value of space has justified the convenience of using MCA because it makes it possible to understand and then evaluate all aspects of a problem across a variety of criteria.
A number of methods can be applied in resolving a problem, such as linear programming (Barković, 2002), AHP (Saaty, 1990), ELECTREE (Čupić et al, 1991), PROMETHEE (Brans et al, 1986, 2005), GAIA (Mareschal, 1988) and other methods. The experiences of authors in this field differ (Brans et al, 1984, 1986, Martić, 1992, Nikolić et al, 1996). In accordance with this paper's research problem, the PROMETHEE and GAIA methods have been applied.
PROMETHEE is an MCA method that makes it possible to express differences in the soundness of a particular site or part of the coastal zone. A mathematical procedure helps to objectivize the suitability of the selection of an NTP site.
The use of the GAIA software provides numerical results and charts that help decision-makers to understand the problem more clearly and gain better insight into the relations between criteria and activities.

4. METHODOLOGY FOR ASSESSING THE IMPORTANCE OF CRITERIA

Based on the research conducted and the results obtained from analysing the facts, the authors have identified the crucial criteria and ranked them in accordance to their importance. The weighting coefficient has been calculated for each criterion, and its preference level.

Any multiple criteria problem contains a number of different and, usually, conflicting criteria that can be of differing importance to decision makers. Most methods of multiple criteria decision-making (MCDM), require information on the relative importance of each criterion (Roubens, 1990). A number of methods can be applied in assessing the level of importance of criteria, each of which relies completely upon human judgement. The techniques in this category may pertain to individuals or to groups of people. Measuring opinions consists of a series of methods used to obtain information from an individual or to gather information from a certain number of people, mostly experts in a field relating to the given problem. The advantage of group opinion over individual opinion is that it provides a broader spectrum of information and brings expertise and experience to the analysis. However, there are certain problems related to the use of expert groups. An important aspect of assessing criteria importance is the fact that the involvement of a number of people will generally result in a varied ranking based on an individual judgement. So, methods are required that serve to synthesize these differing assessments. Relative criteria importance can be expressed in terms of priority or weight. Priority relates to cases in which criteria are listed in order of importance. In this, until a higher level (more important) criterion is taken under consideration, the next (less important) criterion may not be considered. On the other hand, weighting is used to numerically express (usually in percentages) the importance of a criterion or to distinguish between the relative importances of several criteria within the same priority. For the purpose of this research, group weighting methods have been used. These are: (Nikolić et al., 1996).

• **Ranking** – It is assumed that n criteria Aj (j = 1, 2, ..., n) need to be assessed and that l experts Ek (k = 1, 2, ..., l) are involved in this task. Each referee (expert) is required to rank all criteria according to their importance, by assigning the number $n-1$ to the most important criterion, the number $n-2$ to the second most important criterion and so on, down to the least important criterion that is assigned the number 0. This is a fairly simple method and requires little time to obtain the judgements of experts. Because only a set of whole numbers is obtained from each referee, there is no need for weighting the assessments of each individual referee. Instead, only the rankings of all experts are weighted.

• **Rating** – Each referee is presented with the criteria and asked to give a numerical rating to each criterion. Ratings are usually made on a given scale of, for example, 0 – 10 or 0 – 100. Each criterion is weighted separately as the sum of elements in a given line in the table. If these weights need to be normalised, this is done by dividing each criteria with the sum of all weights, which is equal to the number of referees.

5. APPLYING MCA IN SELECTING NTP SITES IN SDC

This chapter analyses SDC spatial and environmental factors and presents criteria and sub-criteria for selecting NTP sites.

5.1. ANALYSIS OF SDC SPATIAL AND ENVIRONMENTAL FACTORS

According to data of the Croatian Bureau of Statistics (2013), SDC is the largest Croatian county in terms of space. SDC has a total area of 14,045 km^2 of which, land accounts for 4,572 km^2 and 67.5% is sea (9,473 km²), (RiĐanović, 2002). The county is located in the central part of southern Croatia in the historical district of Dalmatia. It stretches from Vrlika in the north to the islands Vis and Palagruţa in the south, and from Marina in the west to Vrgorac and Gradac in the east. Its population numbers 455,242 people, of which 67% live in the coastal area; 7%, on the islands; and 26%, in the hinterland. SDC comprises 368 settlements organized in 16 towns and 39 municipalities.

Being the most populated and developed part of Dalmatia, the coastal zone of SDC has always played an important role in terms of traffic in this part of the Adriatic. This is where the traffic corridors running parallel to the coastline intersect with traffic corridors running vertical to the coast from the hinterland (neighbouring Bosnia and Herzegovina), and continue in the direction of the islands and across the Adriatic.

The island area comprises 74 islands and 57 rocks and reefs. The islands are poorly populated. Although economically more developed than the hinterland, the islands have experienced steady emigration due to a variety of circumstances. Four islands stand out in terms of size and population density: Šolta, Brač, Hvar and Vis. Six more islands are also populated: Veli Drvenik, Mali Drvenik, Sv. Klement, Šćedro, Biševo and Sv. Andrija. The islands have a pronounced Mediterranean climate and gentle relief.

Table 3: Spatial features of large SDC islands

Island	Area km^2	Length of coast (km)	Indentedness coefficient
Šolta	58.98	73.1	2.69
Brač	394.57	175.1	2.49
Hvar	299.66	254.2	4.14
Vis	90.26	76.6	2.88

Source: by the authors according to CBS data for 2012

SDC is within the zone of the Adriatic type of Mediterranean climate, the primary features of which are dry, hot summers and mild, humid winters (Filipčić, 1996). Mean annual temperatures drop from the islands towards the coastal zone and hinterland, while the amount of annual precipitation increases. The island area has a warm climate with abundant sunshine, temperatures that rarely drop below zero and little precipitation, unlike the climate of the hinterland where temperatures during the autumn and winter often fall below zero and there is much more precipitation.

5.2. ANALYSIS OF MCA INPUT PARAMETERS – CRITERIA AND SUB - CRITERIA

In resolving the problem of selecting NTP sites in SDC, factors relevant to site selection were previously analysed. The analysed factors were grouped according to their importance and parameters were identified that can be recognized as criteria for site selection. The importance of each criterion based on rating is defined by its weight or priority. Priority represents the importance of an individual criterion in a group of factors. These criteria, together with others identified during analysis, make up the information basis that enables decision makers to choose one solution from a number of proposed solutions. This is important with regard to management structure and the management level of the decision-makers.
Considering that an array of factors impacts the quality and suitability of a coastal area for NTP development, target analysis was used to separate those factors (criteria and sub-criteria) that have the greatest influence on the quality of specific sites and parts of the coastal zone. Elimination criteria were also needed to exclude those areas whose natural features would be substantially threatened by NTP construction.

Table 4: Criteria and sub-criteria for selecting an NTP site in SDC (with assigned weights and established min/max)

Criterion/sub-criteria		***weight***	***min/max***
Institutional and political	**A**	**10**	
Spatial plans of micro locations	**A1**	**8**	**max**
Regional tax and surtax system	**A2**	**2**	**max**
Natural and accommodation	**B**	**25**	
Geo-morphological features (relief of the coastal area, etc.)	**B1**	**5**	**max**
Hydrographic features of the site	**B2**	**7**	**max**
Oceanographic features of the micro location	**B3**	**6**	**max**
Micro climate features	**B4**	**7**	**max**
Environmental	**C**	**25**	
Ecological value and vulnerability of micro location to human activity	**C1**	**8**	**min**
Environmental impact assessment	**C2**	**8**	**min**
Amount of investment in environmental protection (5%-30%)	**C3**	**9**	**max**
Technical and technological	**D**	**15**	
Carrying capacity of micro location – size of vessels (yachts); assumed installed fleet	**D1**	**4**	**max**

Level of development of transport and other infrastructure, distance from airport, distance from Port of Split	**D2**	**3**	**max**
Distance from town cores	**D3**	**3**	**min**
Safety and sailing conditions at the micro location	**D4**	**5**	**max**
Economic	**E**	**15**	
Nautical services offering in the region (potential scope of market activity)	**E1**	**2**	**min**
Offering of providers in surrounding area	**E2**	**3**	**max**
Concession fee	**E3**	**3**	**min**
Investment amount	**E4**	**5**	**max**
Available personnel (professional ability)	**E5**	**2**	**max**
Socio-cultural	**F**	**10**	
Direct and indirect benefits	**F1**	**4**	**max**
Level of urban development and distinctiveness of micro location	**F2**	**3**	**max**
Improvement in quality of life of local community	**F3**	**3**	**max**

Source: the authors

For some (or all) criteria, corresponding qualitative ratings may be given which are translated into quantitative values using a linear scale of 0 – 10 and the ratings *poor*, *average* and *good*. Criteria have two characteristics:

- They can be of the maximization or minimization type.
- Most often they do not have the same importance and it is customary to assign weight coefficients. The sum of sub-criteria weights equals the global (total) weight of a criterion.

In the rating procedure, criteria weights were normalized by the total possible sum (100), which greatly facilitated further analysis.

The greatest weights were given to the Natural and Accommodation criterion and sub-criteria, and the Environmental criterion and sub-criteria. The importance of the Institutional and Political criterion and Socio-cultural criterion is relatively small. The Technical and Technological criterion and Economic criterion are of slightly less importance, which is understandable considering that the economic criterion is not necessarily crucial in selecting suitable sites and is dependent upon technological solutions. Distance from the town core, road and other infrastructure is not a crucial factor considering that research is focused on sites on islands which already have to deal with the problem of distance and accessibility. When sub-criteria are analysed, it is evident that some sub-criteria have greater weights than others. For example, all three sub-criteria of the Environmental criterion have distinctly greater weights. Interestingly, sub-criteria A1- Spatial plan of micro location – has greater importance than most of the sub-criteria of the Technical and Technological criterion and the Economic criterion. This is because sub-criterion A1 could be a constraining factor in cases where a spatial plan has not been adopted or does not foresee a possible NTP site in a given micro location. Such cases require preliminary research to be carried out and the presentation at the local level of all benefits and advantages that an NTP built at a specific micro location could bring. Special attention should be called to the importance of safety and sailing conditions in selecting a site, as experts have rated this sub-criterion as important in ensuring the safety of boaters and their vessels. Considering the widespread trend in the Mediterranean and worldwide towards vessels exceeding ten metres in length, sea depth plays an important role in selecting sites for NTPs.

6. RESULTS ANALYSIS AND PROPOSED MEASURES FOR FURTHER RESEARCH

The ratings are the results of research based on available data and cartographic presentation of the Croatian Hydrographic Institute of Split for each individual location. Taking into consideration the collected data and the importance of factors for selecting sites for NTPs, the ratings for each group of criteria can be explained.

The Natural and Accommodation criterion is especially important and its sub-criteria were analysed for each individual location, where, for example, the depth of the marina area was established and assigned a certain value. All three sub-criteria were maximized. Criterion C – environmental factors – was rated on a 1-10 scale using five sub-criteria. While the importance and influence of some of these sub-criteria was maximized, in

others (C1 and C2) it was minimized. Criterion D – technical and technological factors – consists of four basic sub-criteria rated on a 1-10 scale. Because of their importance, the value of these sub-criteria was mostly maximized. Sub-criteria D2 and D3 referring to the distance of an NTP to the Port of Split and the airport, and to the distance from the town core, respectively, were expressed in separate ratings based on the geographical position of each site. The distances from each site were calculated and a value in points assigned. Criterion E – economic factors – was broken down into five sub-criteria rated on a 1-10 scale, with the exception of sub-criterion E4 which was expressed in actual monetary value. It should be noted that an estimation of the costs of building NTPs in the selected sites is not possible without a comprehensive cost analysis of individual sites. Such an analysis involves the meteorological and hydrographic features of areas. The need to build a breakwater or set up a floating pontoon or sea-wall is determined based on the specific features of each site, considerably impacting construction cost. The availability of infrastructure and the condition of the shore (stone waterfront or a rocky shore full of shoal) also have a great impact on the NTP construction costs. The estimation involved the cost of building NTPs (with 50, 100, 150 or 200 berths). A preliminary cost estimation, which assumes the basic preconditions to building NTPs, was done for the sites included in MCA. This estimation represents the minimal investment required for constructing an NTP and while it may give a site a certain advantage in this phase of research, it is still not the deciding criterion or sub-criterion. The value of the overall investment increases depending on the facilities and services planned and the technological capacity of the nautical port. Criterion F – socio-cultural factors – consists of three sub-criteria, the importance of which has been maximized. The distinctiveness of a micro location contributes towards its selection and may bring direct and indirect benefits to residents. The rated criteria and sub-criteria and their maximization or minimization enable the presentation of the MCA procedure carried out.
The objective of research was to identify the criteria and sub-criteria required for selecting sites for NTPs in the SDC region. Research results point to six groups of criteria and 21 sub-criteria. Obtained by using the MCA method, these results may be used in the decision process to select sites for NTPs in SCD, which will be the subject of further research by the authors.

7. CONCLUSION

Great progress has been made in the Croatian Adriatic in the past 15 years through the development and construction of accommodation facilities for vessels, justifying the market orientation towards nautical tourism. The nautical tourism market is experiencing an upward trend in the Mediterranean and worldwide.
The paper examines the opportunities of developing NTPs in SDC from the viewpoint of proper spatial use and protection. The research conducted has accomplished the goals set out. Stress is placed on the correct selection of methodologies using the group weighting method and MCA, which can be applied in the decision process of selecting the optimum location and facilities for NTPs. The research results point groups of criteria and sub-criteria. In accordance with research problem, authors recomended the PROMETHEE and GAIA MCA methods and Visual PROMETHEE as very usefull software. Based on these insights, further progress can be made in research pertaining to the valuation and management of the marine domain and NTPs.
The criteria have been correctly chosen and are appropriate for the selection of NTP sites in SDC. Research results provide decision-makers with a scientific foundation on which to base further NTP development and site planning.

REFERENCES

Barković, D. (2002). Operacijska istraţivanja, Sveučilište J. Jurja Srossmayera u Osijeku, Ekonomski fakultet Osijek.

Bošković, D., Favro S., Kovačić, M. (2006). Evaluating the Significance of Nautical Tourism for Tourism and Economy, 25th International Conference on Organizational Science Development, Portoroţ, ISBN 961-232-185-X, 957-967.

Brans, J.P., Mareschal, B. and Vincke, P. (1984). Promethee – A New Family of Outranking Methods in Multicriterial Analysis, Operational Research, North Hollan, Amsterdam.

Brans, J.P., and Vincke, P. (1985). A Preference Ranking Organisation Method: The Promethee method for Method for Multiple Criteria Decision - making MCDM, Management Science, 31, 6., p. 647-656.

Brans, J.P., Mareschal, B. and Vincke, P. (1986). How to Select and How to Rank Projects: The Promethee Method, European Journal of operational Research, vol. 24, p. 228-238.

Čupić, M.E., Tummala Rao, V.M. (1991). Savremeno odlučivanje, Naučna knjiga, Beograd, 1991.

Favro, S., Kovačić, M. (2005.). Physical Plans in Managing Sea and Coastal Area, 25th International Conference on Organizational science development: „Change management“, Portoroţ, p. 1049-1058.
Filipčić, A. (1996.): Klimatologija za geografe, Školska knjiga, Zagreb.
HHI and Ministry of Sea, Traffic and Infrastructure, Ministry of Tourism. (2008). Development strategy of nautical tourism in the Republic of Croatia 2009-2019.
Jugović, A., Kovačić, M., Hadţi ć, A. (2011). Sustainable Development Model for Nautical Tourism Ports, Tourism and Hospitality Management – An International Journal of Multidisciplinary Research, Vol. 17, No. 2, Opatija, Wien, Thessaloniki, str. 175-186.
Kovačić, M. (2010). Selecting the Location of a Nautical Tourism Port by Applying Promethee and Gaia Methods, Case Study – Croatian Northen Adriatic, Promet, Traffic&Transportation, Pardubice, Portoroţ, Sarajevo, Trieste, Zagreb, Ţilina; Vol. 22, No. 5. p. 341-351.
Kovačić, M., Favro, S., Saftić, D. (2012). Comparative Analysis of Croatian and Mediterranean Nautical Tourism Ports, 2nd Advances in Hospitality and Tourism Marketing&Management Conference Proceedings, 31 May - 3 June, Corfu, Greece.
Kovačić, M., Violić, A., Schiozzi, D. (2013). Organized Anchorage and their Impact on Business of Marinas, 32nd International Conference on Organizational Science Development. „Smart Organization. High Potential. Lean Organization. Internet of Things.“ Portoroţ, p. 442-452.
Luck M., (2007). Nautical Tourism: Concepts and Issues, Cognizant Communication Corporation, New York, USA.
Luković, T., (2007): Nautical Tourism- Definition and Classification, Acta Turistica Nova, Vol. 1, No. 2.
Mareschal, B. (1988). Geometrical Representations for MCDA, The GAIA procedure, EJOR, 34, pp. 69-77.
Martić, LJ. (1992). Matematičke metode za ekonomske analize I, IX izdanje, Narodne novine, Zagreb.
Nikolić, I., Borović, S. (1996.). Višekriterijumska optimizacija: metode, primena u logistici, softver, Centar vojnih škola VJ., Beograd.
Roubens, M. (1990). Preference relations on actions and criteria in multi-criteria decision making, European Journal of Operational Research, 10, 1982. p. 51-55.
Saaty, T.L.(1990.). How to make a decision: The Analytic Hierarchy Process, European Journal of Operational Research 48, pp. 9-26, North-Holland.
RiĐanović, J. (2002.). Geografija mora, hrvatski zemljopis. dr. Feletar, Zagreb.
Zakon o turističkoj djelatnosti Republike Hrvatske, NN broj 8/96, 19/96 i 76/98

ALTERNATIVE – RSE ENERGETIC RESOURCES IN SLOVENIA AND SERBIA AND ITS POSSIBILITIES OF EXPLOATATION IN PRACTICE

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Abstract: *Energy represent important source on the whole parameters of life. For human and other living organisms-give us an imortant souce for growth, progress, industry for resources, and production, nature for its survive. In this time and place, so many states, reduce its own consumption and with energy dependence and on the other hand with searching alternative sources, which will replace gas, oil, coal. Because of market demands, reducing fosil fuels, economic circumstances and in connection with political dependence and not at the end growth of environment senses. Countries have different nature possibilities depends of geografical, geological and generally economical situation. Many resources are have been disregarded, because of different reasons and energetic lobies. Today in time of many crisis with those alternative resources, countries can improve better and reliable use of energents. In this paper we will represent comparative possibilities two states Slovenia and Serbia, as future members of EU and compare with European. We will try to represent greath potention of exploatation sources in the case of development and economical potential two countries*.

Keywords*: energetic dependence, fosil fuels, alternative sources, European union, ecological minds*

1. ENERGY AND RENEWABLE SOURCES OF ENERGY (RSE)

The word energy derives from Greek words *ergon* which means work, power and vitality, and from the word *energeia* which means activity. Because of this the concept of energy is connected with the ability of a body to perform a work (Rant, 2008).

Renewable sources of energy (RSE) are sources which can restore and replace utilized resources as are wood-biomass, wind, hydro energy, sun energy.

Various states use different strategies to fulfil everyday needs of energy. These strategies depend on energy needs, trends in future, own resources etc. Slovenia for a certain period of time balances between criteria and demands resulted from the membership in European Unity, its own resources and dependence from foreign resources which presents about 50% of total energy need. Because of facts which have been already mentioned it is urgent to chose the adequate energetic scenario as soon as possible.

- **Fossil-nuclear scenario** with supposes energy increase for 30-40%. These scenario incorporates considerable increase of capacity of thermal power plants (TPP) using coal or gas; extension of operation of Nuclear power plant in KRŠKO (NEK – Nuklearna Elektrarna Krško) and construction of the second block Nuclear power plant Krško, construction of gas terminal in Koper, or construction of wind power plants and hydroelectric power plants.

- **Bad sustainable scenario** which assumes stabilization of electric energy use, continuation of operation for existing thermal power plants with the change of fuel (transition from coal to gas), eventual extension of operation for nuclear power plant in Krško, construction of hydroelectric plants along the entire Slovenian section of the Sava river, and smaller wind power plants and considerable number of photovoltaic power plants.

- **Significantly decentralized sustainable scenario** which assumes continual decrease in the use of electric energy and increased number of thermal plants for district heating– power plants (co-generation of thermal and electric energy) which will use gas and biomass as a fuel, closing of nuclear power plant in Krško until 2030, more hydroelectric power plants along the entire Sava river, increased number of small hydroelectric plants as well as use of geothermal energy and photovoltaics (Plut, 2010).

According to the available information and the facts that a new block in Thermal power plant Šoštanj (TEŠ 6) is in construction and there can be also observed strong tendencies to build additional block in nuclear power plant Krško it seems that the centralized and intensive fossil-nuclear scenario is the most probable (Plut, 2010).

In the long term energy balance for Slovenia until 2030 it is expected that 580 GWh of electric energy will be provided from dispersed renewable energy sources and 1.555 GWh from intensive centralized sources. The main contribution to the increase in the production of electric energy is expected from small hydroelectric power plants, wind power plants and from the use of biogas and wooden biomass.

1.1 Renewable Energy Sources in energetic balance of Slovenia until 2030

According to demands of EU which suppose continuous growth of production and use of energy from renewable sources in Slovenia it is expected that until 2030 the production of electric energy will increase on the following segments:

- Small hydroelectric power plants 72 MW (construction of new plants and extension of existing plants)
- Biogas power plants 41 MW (landfill gas, gas from agriculture and waste water treatment plants)
- Wind power plants 150 MW
- Photovoltaic plants 100 MW
- Wooden biomass plants 35 MW
- Big hydroelectric power plants 350 MW (finalization of plants in the lower Slovenian part of the Sava river 154 MW, construction of plants in the middle part of Sava 189 MW and reconstruction/finalization of plants in the upper part of Sava 12,5 MW).

In the period until 2030 it is expected that the total use of energy from renewable sources from existing 32,3 PJ will increase on 53,8 PJ (increase of 67%) (SURS, 2014)[1].

EU demands obligate Slovenia to increase production and use of energy from renewable sources. Nevertheless, there can be observed the influence of certain lobbies which try to limit the use of energy from renewable sources. This presents a step back in the process of green energy production. This is particularly evident in legislative regulations which limit or hinder the construction of small hydroelectric power plants, wind power plants and photovoltaic plants. The most evident regress in promotion of green energy presents the construction of the sixth block in the Thermal power plant in Šoštanj (TEŠ 6).

2. RENEWABLE SOURCES OF ENERGY AND EU

Today become more and more evident two facts: the exhaustion of stocks of fossil fuels and consequential tendencies to reduce energetic dependency as well as increased care for environmental protection and reduced degree of pollution. Therefore, many states turn from conventional energy sources as are coal, oil and gas to alternative sources of energy. They try to satisfy their energy needs with their own resources and thus increase energetic independence. Which energy alternative sources of energy are used depends on natural – geographical specialities of a particular country, by example Iceland exploits geothermal energy, Spain sun energy, countries with rich water resources exploit hydro energy etc.
States, members of EU as well as states which plan to join EU like Serbia have to reach in the period until 2020 certain goals in coordination to the Climatic-energetic package of measures accepted by EU on January 23rd 2008. Renewable sources of energy relate to three fields: electric energy, heating and traffic.

1 Original - SURS Statistični urad Republike Sovenije – english-Statistical office of the Republic of Slovenia

The concrete way on which particular states will reach these goals depend on their own natural and energetic-economic resources. Particular goals, emphasized in EU documents, are:

- At least 10% energy used in traffic should derive from bio-fuels
- Reduction of annual carbon dioxide emissions for 600-900 millions of tons for the entire EU
- Reduction of fossil fuel use for 200-300 millions of tons for the entire EU
- Reduction of dependence from fossil fuel import and thus increased stability of energy supply in EU
- Increased initiatives for the development of high technological industry offering new economic opportunities and creating new working places.

From Figure 1 it can be seen that particular countries have already reached the planned goals (20% of energy from renewable sources, by example Sweden, Finland, Denmark and Austria. On the other hand, countries classified at the frontend of ranking as are Malta and Cyprus will hardly reache the goals. Slovenia with 19,6% of renewable energy used in 2013 approached very close to the fulfilment of planned goals.

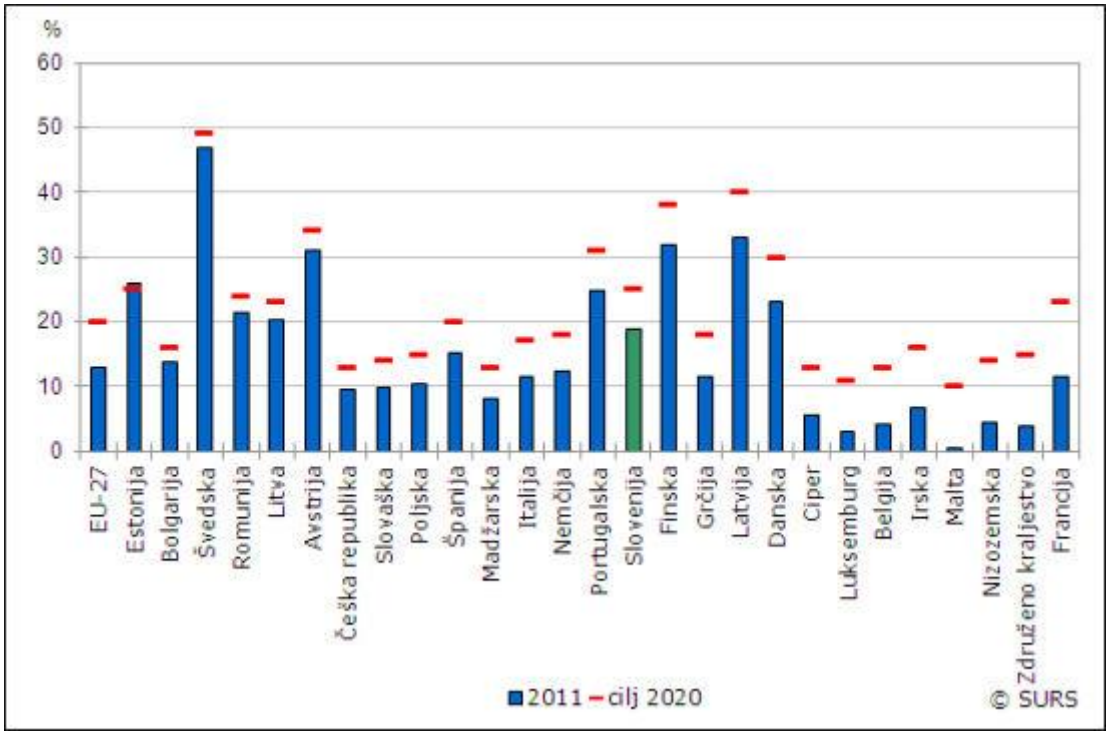

Figure 1: Share of energy from renewable sources in the total energy balance for EU countries (SURS, 2014).

3. SLOVENIA AND RENEWABLE SOURCES OF ENERGY

Slovenia as meber of EU is obligated to reach the following goals in the period until 2020:

- 25% share of crenewable sources in the final energy use
- 20% increase in energy efficiency
- 20% reduction of greenhouse gases emissions
- 10% share of biofuels use in traffic.

Biomass Slovenia has on disposal various potentials to meet the obligations and planned goals. Wooden biomass is one of the most important natural resources in Slovenia. 62,8% of the Slovenian territory is covered by forests. This ranks Slovenia in the third position in Europe, following Finland (73,9%) and Sweden (66,9%) (Bončina, 2013). The entire area of forests in Slovenia is 1.264.000 hectares. The annual increase of wooden biomass is 7.900.000 m^3 or 6,64 m^3 per hectare (Ministrstvo za kmetijstvo in okolje-

Ministry of Agriculture and the Environment and Zavod za gozdove Slovenije- Slovenian Forest Service). Biomass use is reasonable in the case of better utilization of wood and improved systems for combustion in larger as well as in smaller local heating systems.

Hydro-energy On the second place after wooden biomass in Slovenia are water resources. Potentials exist on bigger as well as in smaller rivers which derive in Slovenia, by example the degree of exploitation in Sava is only 34%, in Soča 18,5% meanwhile the greatest unexploited potential exist on Mura and Idrijca (now only 0,3% degree of exploitation). On the other hand, Drava is its Slovenian part (entrance from Austria by Dravograd and exit in Croatia by Ormoţ) already exploited at the degree of 97,8%. Hydro-energy presents the second most important source of renewable energy. The estimated energetic potential of Slovenian rivers is 19.400 GWh/year meanwhile technical potential is about one half of this (9.100 GWh). Economic viability is estimated between 7.000 and 8.500 GWh/year. In the case of construction of hydro electric power plants in the middle and lower part of Sava river the installed power will increase up to 274 MW. This would be reached in the case of construction of hydro electric power plants Blanca at Sevnica, Krško, Breţi ce and Mokrice.

Solar energy and potential of sun energy present additional potential of green energy. Periods of solar irradiation in various parts of Slovenia differ considerably due to the relief specificities. They range from 2.000-2.500 hours/year to 1.650-1.850 hours/year average in the continental part of Slovenia (Ogrin, 2002). The important differences exist among various parts of the year by example in winter valleys are often covered by fog meanwhile in mountain regions is the sunny weather. Sunny regions in the world often reach the average 2.500 kWh/m^2 meanwhile in Slovenia this is only 1. 500 kWh/m^2 (Medved and Novak, 2000, Medved and Arkar, 2009).

Geothermal energy presents very important potential which in Slovenia for certain period of time is already exploited in the North-eastern part of the state. Geothermal sources which were found in the North-eastern Slovenia exhibit considerable possibilities and can be exploited for the operation of 15 to 30 power plants with average capacities of 7-15 MW. In the near future it would be possible to produce 100-200 GWh of electric energy per year in the case of appropriate partnership between state and investors.

4. RENEWABLE SOURCES OF ENERGY IN SERBIA

Serbia as a future member of EU in the field of renewable sources of energy has to follow EU directives and goals obligatory for EU member states. However, Serbia will reach these goals (by example Slovenia has goal until 2020 to use 25% of energy from renewable sources) in a longer period of time. The most important problems in Serbia are low energetic efficiency, outdated technological systems in energetics, lack of investments and various lobbies in energetics.

In Serbia in 2006 only 6% of total energy use derived from renewable sources. The majority of renewable energy is produced in big hydroelectric power plants and a very small part derives from use of geothermal energy or biomass – only 39.272 PJ of 609.096. The most important energy source in Serbia in the year 2006 was coal (55%) followed by oik (26%) and gas (13%). The major part of renewable energy as has been already mentioned in Serbia is produced in big hydroelectric power plants with capacities more than 10 MW and annual production of 10,3 TWh – 25.200 TJ..

4.1 Potentials of Serbia for production of energy from renewable resources

Total technical potential is over 160 PJ per year. The greatest part of this – 62% (100,4 PJ) presents potential of biomass, almost 17% presents solar energy with 26,7 PJ, 10% (16,7 PJ) energy from small hydroelectric power plants, and 5% geothermal energy (8,3 PJ) as well as wind energy (7,9 PJ). According to the official projections the share of renewable energy in the total energy production will remain unchanged until 2015.

Hydroelectric power plants In Serbia exist 900 locations on small rivers with possibilities for construction of power plants. 90% of these power plants would have capacity less than 1 MW. However, there exist also considerable possibilities to reconstruct big hydroelectric power plants as are Đerdap and Bajina Bašta. Small hydroelectric power plants with capacities between 216 kW and 8 MW are planned in Sopočani, Bela

Palanka, Rečica, Rainara, Javor, Sokolovac and Bovan. The total capacity will be 0,5 millions of toe[2] or 5.815 GWh.

Wind energy is another potential form of renewable energy. However, exploitation of wind energy is reasonable only in seven areas in which average wind velocity is about 6-7 m/s. Moreover, only one location – on the Miţo r mountain – can be classified as good. Potential of wind energy is 0,2 millions of toe or 2326 GWh. Other potential locations are Eastern part of Serbia-Stara Planina, Ozren, Rtanj, Vlasina, Zlatibor, Kopaonik, Divčibare and in Panonian plain Vršac and Bela Crkva.

Biomass There exist considerable possibilities for biomass use in Serbia. However, modern advanced combustion systems should be applied. To estimated potential of 314.000 GWh or 2,7 millions of toe potential of 314.000 GWh or 2,7 millions of toe presents more than half of total renewablewable energy resources (except big hydroelectric power plants). Remnants from wooden industry and forestry present about 1 million of toe. The total area of forest in Serbia presents 27,3% of the total Serbian territory: Vojvodina 6,8%, central Serbia 32,8% and Kosovo and Metohija 39,4%. Energetic potential of livestock is about 42.000 toe, in agricultural, vineyard and fruit sector is estimated to approximately 1,7 millions of toe.

Geothermal energy: Geothermal energy in Serbia exhibits great potential which is today exploited in a very low degree. About 100 locations with thermal wells have potential of about 2.300 GWh/year. The regions with the most pronounced geothermal potentials are in Vojvodina, the highest temperature of spring water is Vranjska banja, Jošanička banja and in Sijerinska banja.

Solar energy: The estimated potential of solar energy in Serbia is 0,6 millions of toe or 6.978 GWh and thus presents presents the third most importanr potential of renewable energy. The sun radiation intensity in Serbia is about 40% higher than European average. Nevertheles, the exploitation of solar energy in Serbia is still much less intensive than in many other European countries. Average annual level of solar irradiation in Germany is 1.000 kWh/m^2 meanwhile in Serbia is 1.400 kWh/m^{2}The areas in Serbia which are particularly interesting for exploitation of solar energy are the sorroundings of Leskovac, Pirot, Vranje and Prešovo, but also in 50% of other parts of the state the exploitation of solar energy is reasonable (Despotović, 2009).

5. CONCLUSION

Slovenia and Serbia have considerable potential for production of energy from renewable sources. However, the adequate vision of future energetic policy is necessary. The support of the state and orientation to green energy production is also very important. Slovenia has great potential in wooden biomass and geothermal energy as well as in construction of small hydroelectric power plants. In Serbia there is potential in construction of big and small hydroelectric power plants. However, the realization of these possibilities for green energy production in practice depends on many factors. These factors include economic power of the state, interests, environmental awareness of the citizens etc. Today, unfortunately, to often happens that political-economic lobbies limit expansion of production and use of energy from renewable resources – as shows in Slovenia by example the case of TEŠ 6 (the sixth block of thermoelectric power plant in Šoštanj). Also in the case of exploitation of renewable sources of energy it is very important to take care for protection of environment and wildlife. When locating various objects into the environment there must be paid considerable attention to all possible effects on the nature. In Slovenia exist great possibilities for the so called dispersed regional production of renewable energy which will enable safe supply with energy on the entire territory of the state. There should be emphasized that also in the case of production of energy from renewable sources certain negative impacts on the environment can not be avoided. However, in the case of production of energy from renewable sources these negative impacts on the environment are smaller than in the case of fossil fuels or nuclear energy.

When regarding the production of energy from renewable sources Serbia is in the beginning of a journey. There exist considerable potentials for the production of energy from renewable sources in the state.

2 1 toe is 1 ton of oil equivalent, or 11,360 kWh.

Particularly should be emphasized the potential of hydroelectric power production – big power plants as well as construction of many smaller power plants. There is necessary to restore existing power plants as well as investments in new objects. Besides hydro electric power in Serbia interesting potential exhibits also geothermal energy. The fact that Serbia is still in the beginning has also some advantages as experiences of some other countries can be used and examples of good practice can be followed.

Both, Slovenia and Serbia, must take care of lowering energy consumption. The introduction of systems with more rational energy use is necessary as well as change consumer habits of citizens. The zero degree of energy consumption growth should be reached as soon as possible as well as reduction of personal environmental footprint until 2020.

Trends to exploit alternative and domestic sources of enegy become more and more actual because of recognition that stocks of fossil fuels are limited. The exploitation of domestic energy sources is interesting also because of economic effects as well as because of political independency of imported energy. Appropriate procedures exist, they should only be implemented in practice – however, this depends on economic power of the society. When regarding protection of the nature and sustainable development energy deriving from renewable sources presents undoubtedly the energy of future. energije, su svakako energenti budučnosti.

LITERATURE AND SOURCES

CEKOR. (2008) Renewable Energy resources in Serbia, Subotica

Kralj, P. (2009). Geothermal-one of the great Slavic power whirlpools. Delo FT, Ljubljana

Medved S. (2009). Using Solar energies for heating and cooling of buildings. Renewable energy resources (s) in Slovenia, Fit media, Celje, p.51-60.

Medved, S., Arkar C. (2009) Energy and Environment; renewable energies, Faculty of Health Sciences, Ljubljana.

Plut D. (2010). The potential of renewable energy sources in Slovenia. Ljubljana.

Ogrin D.,Plut D. (2009), Applied Physical Geography of Slovenia. Scientific publishing the Faculty of Phylosophy, Ljubljana.

Despotović Ţ (2012). Renewable energy sources-the state of the world s u s perspective of Serbia, Belgrade..

Ţnidarič D., Senegačnik M., Vuk D., Possibilities for production of thermal energy with the use of biomass in the Republic of Slovenia, Focus 2020 – Proceedings of the International Scientific Conference in the Development of Orgabizational Sciences, 19-21.3. 2014, Portoroţ , Slovenia .

E-sources

http://www.energetika-portal.si)- /fileadmin/dokumenti/publikacije/Energetska_bilanca/EBRS_2013.pdf – Jan 2014

http://www.stat.si/tema_okolje.asp - Jan 2014

http://gcs.gi-zrmk.si/Svetovanje/Clanki/PDFknjiznjicaAURE/V5-biomasa.pdf) - Jan 2014

SURS: http://www.stat.si/novica_prikazi). Jan 2014

http://nep.vitra.si/datoteke/clanki/Lesna_Biomasa_Maj_2013.pdf)- Jan 2014

http://www.geosonda.com/financiranje/primerjava-stroskov-ogrevanja

THE MODEL OF AN ORGANISATION OF THE EFFECTIVE PUBLIC COMMUNICATION IN HAZARDOUS WASTE MANAGEMENT

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Abstract: *The presenting paper maps the problem of communication in hazardous and industrial waste management. It discusses the model of successful waste management with the support of communication strategy. The case of remediation of acid tar dump explains the necessity to accommodate the rising democratic expectation of public participation in deliberations over the incineration waste policy. Accordingly the transparency and the communication of the process with the dissemination of results is an important element in the successful model of hazardous waste management. The technical elements of the process are discussed with the explanation of successful communication model. The waste management in the case of acid tar remediation in Slovenia stresses the need for investment at the level of public participation and public communication.*

Keywords*: communication, public communication, waste management, model of communication, public, communication tool*

1. INTRODUCTION

Environmental activities that are part of any industrial projects need the strategy of communication as part of public interest. The public communication about the waste management, particularly hazardous waste, has often been excluded from policy processes.

People's responses to different risks are determined by psychological factors and technical information would rarely have a very strong impact to people's reaction. Awareness and understanding of public concerns must be the basis of an effective risk management strategy. (Frewer, 2004)

In oil refinement process, based on the treatment with sulphuric acid, a bituminous residue, called acid tar, is formed. With such a treatment, linear paraffin molecules (desired fraction) are divided from undesired additions (aromatics, iso-paraffines, heterocyclic compounds). Acid tar is a mixture of liquid, paste-like and solid hydrocarbons, containing free and bound sulphuric acid (Nanut, 2010). The remediation of acid tar dump in Slovenia can be analyzed as hazardous waste management. This was the basis for our investigation about public communication in this sphere of action (Ţilič-Fišer, Dvoršak 2010). As a case study we analyzed the remediation of the area, called Pesniski Dvor that is situated in North East part of Slovenia, close to the border of Austria. The project was coordinated by company Gorenje Surovina which is a leading company in the field of waste management in Slovenia. The technical elements of hazardous waste management were included in the process in production but are not key elements for the aim of this paper. Our focus was to present the importance and the potential of the public communication in the field of waste management. For the aim of public communication we produced the documentary film that was discussed as important communication tool in the hazardous waste management.

In Maribor the re-refining of the used motor oils with the process of treatment with concentrated sulfuric acid was done. Refinery disposed the acid tar, which is the residue after the treatment with sulfuric acid since 1967 in landfill in Pesniski dvor. Acid tar is a thick, viscous substance with an acidic smell; it can contain 10-50% sulfuric acid and a noticeable amount of oil and resin and is highly corrosive toward metals. Acid tars are amenable to oxidation and solidification in air; therefore, their properties could substantialy vary during storage (Kolmakov, 2007).

The landfill was built in accordance to the applicable regulations and permits of the competent administrative authorities in 1966, an operating permit was issued in 1967. The refinery disposed the acid tar until the year 1983. Since then, the old abandoned landfill is a burden, which represented a significant risk for the environment and required the intervention for the remediation. Historically, acid tars have been disposed with or without prior treatment in worked out quarries, clay or gravel pits, or landfills, normally referred to as acid

tar lagoons. This dumping is not environmentally sustainable because of the potential risk posed by the components of acid tars to human and ecological receptors (Leonard, 2010). Once acid is generated, it may contaminate receiving water, lowering the pH and increasing the concentration of dissolved elements (particularly metals) of environmental concern. If unchecked, acid drainage can result in acute and chronic impacts on aquatic ecosystems, as well as community health risks. The paper maps the communication importance in the hazardous waste management and presents the business model that can be applied into area in the broader region.

2. RESEARCH OBJECTIVES

The first research objective was to analyze the results of the technology solution for the acid tar remediation in Pesniski Dvor during the whole process. The remediation of the dumping site of the acid tar at Pesniski Dvor includes the preparation works, excavation of the acid tar and contaminated soil, process of the solidification and energy recovery of the solidificate, recycling of the contaminated soil into construction materials, dismantling of the technological equipment and removal of the objects and revitalization of the dumping site.

The second research objective was to analyze the public participation and integrating environmental monitoring results in effective public communication. Public participated in the complete process of the remediation of the disposal site of acid tar in Pesniski Dvor from the obtaining of the construction and environmental permit until the end of project activities and revitalization of the disposal site. The project activities and objectives were transparent and all the monitoring results were published.

The third research objective was to examine the appropriate communication tool for presentation of acid tar remediation to broad audience and to design the model of communication that can be implemented in the hazardous waste management in Balkan area. Public concerns influence consumer behaviours, citizens' support of environment pressure groups, and political preferences of voters during elections. Therefore, the effective risk communication and successful communication to broader public should be the priority in hazardous waste management.

The model of acid tar remediation in Pesniski dvor explained the importance of dissemination of results in the way that could be easily perceived by the broader public. Moreover, the research and the explanation of the remediation with the audio-visual product resulted in the positive attitude toward the waste management.

3. METHODS TO DESIGN THE MODEL OF WASTE MANAGEMENT: CASE STUDY OF PESNISKI DVOR

3.1. Method of technological solution for the remediation of acid tar in Pesniski Dvor

The main criteria for selecting the technological solution for acid tar remediation were the sustainability of the technology. Due to these criteria different technological solutions were examined. The technology was approved by the investor and the Ministry of Environment in Slovenia. The chosen technology had the minimal environmental impact during the construction of the equipment for the solidification on site, operating and dismantling of the equipment.

The technology for solidification of the acid tar had the capacity of the 10t/h and was installed in the immediate vicinity of the dumping site. The excavated acid tar was delivered to the receiver-mixer, where waste wood, stones and bulky waste were sorted out non-reactive additives (saw dust, coal dust...) were added to the acid tar and the consistence of the mixture was adjusted. The pre-mixture went through the metal separator into the lamella mixer where reactive additives were added and neutralized the acid substances in the mixture. To achieve the best results of the neutralization it was necessary to have the suitable mixing and exact time. The type of added reactive additive depends on the analyses of the acid tar, availability, price and distance from the local sources of supply. The mass flow diagram is shown in Figure 1.

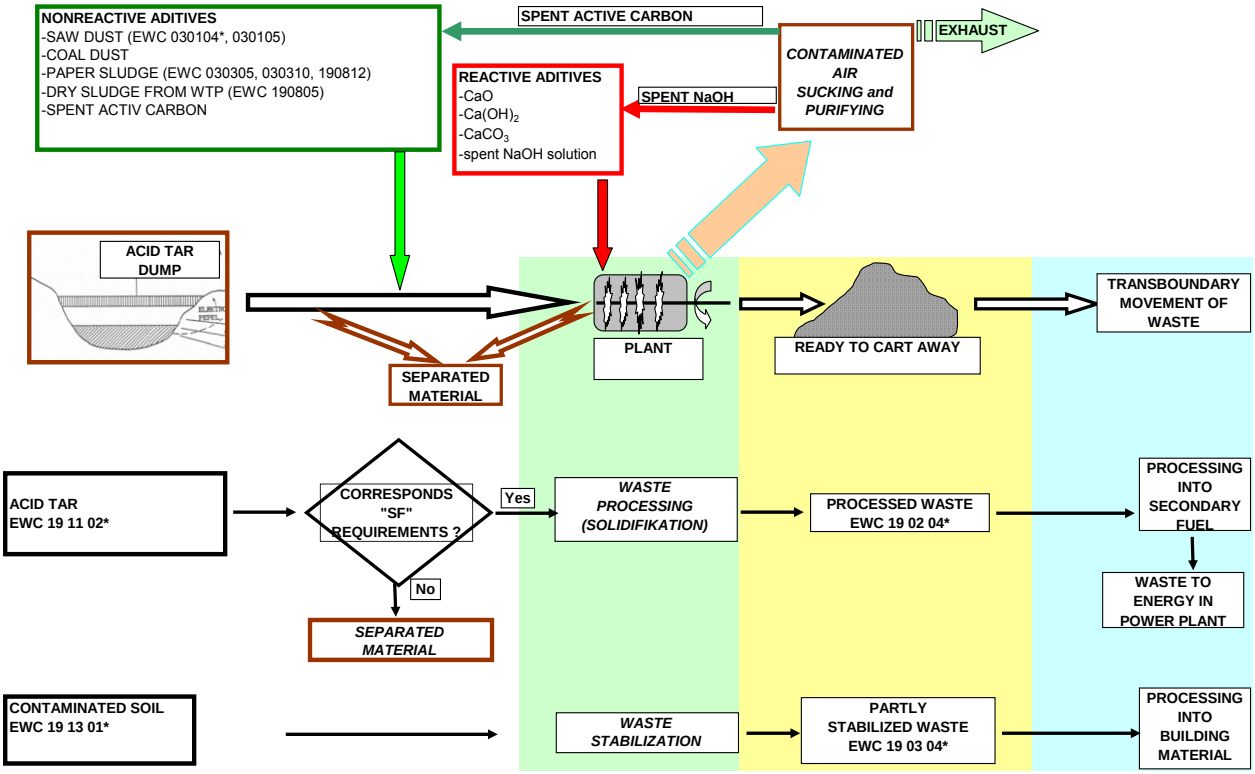

Figure 1. Mass flow diagram (Lipovšek, 2007)

A number of serious and highly publicized pollution incidents associated with incorrect waste management practices, led to public concern about lack of controls, inadequate legislation, environmental and human health impact (Giusti, 2009). Monitoring is essential to assess changes in the environment, to provide early warning of potential problems, to assess efficacy of remedies, and to assess possible future adverse effects on humans and the environment (Burger, 2008). Due this reason a detailed monitoring plan was prepared, that include all environmental parameters.

3.2. Organization of communication model for acid tar remediation

The information about technical risks alone does not form the basis for coherent management policy that is also acceptable by consumers. Researchers as Slovic (Slovic, 2000) has consistently demonstrated that factors such as whether a risk is perceived to be involuntary, potentially catastrophic, or uncontrolled are more important determinants of public response that technical risk information alone. Risk communication and waste management must also take into account of societal concerns and values. Risk perception also has a direct impact on how citizens respond to risk management activities. It is public concerns and attitudes that have direct consequences for human health, food safety and security, economic expansion and international regulation (Frewer, 2004, Petts 1992). The issue of public participation and the engagement of the broad public at different level of process is the priority in the hazardous waste management. Some authors (Gusti, 2009) stressed the need for public participation in waste management at the local and regional level.

Moreover, the level of social responsibility of waste industry is becoming the priority issue in democratic modern world. In modern democracy citizens should be educated and included in political process. The criteria for democratic political process (Dahl, 1998) are effectiveness of participation, voting equality, control over the agenda, equal opportunity and most important enlightened understanding. To realize all the steps of democratic political process, education and awareness of citizens has to be considered. The awareness about the environmental issues is high on the agenda of modern global and national political processes.

Best practices in risk communication encompass developing ways to communicate these to broader public. Institutions and organizations must consider how to develop and maintain public confidence in risk

management practices. Trust and confidence is particularly important under circumstances where people feel that they have very little personal control over their personal exposure to potential hazards. This was the case with public perception of the case of Pesniski dvor where local community opposed to any waste management industry in the area. Accordingly, the principle of N.I.M.B.Y (not in my backyard) is widely accommodated in the perception of citizens when issue of waste management is discussed. In the local communities in Slovenia the rebellion towards any waste management practice came from citizens, particularly after the early 90s when political system with new national state developed. The political democratic development of new government supported any public debate regarding the economic, political and environmental issues.

It is important to communicate the uncertainty about the risk with the explicit and understandable way that is focused on the information needs of target audiences. There is little evidence that elite groups in the scientific and policy community have underestimated the ability of non-experts to understand uncertainty (Frewer et al, 2002.)

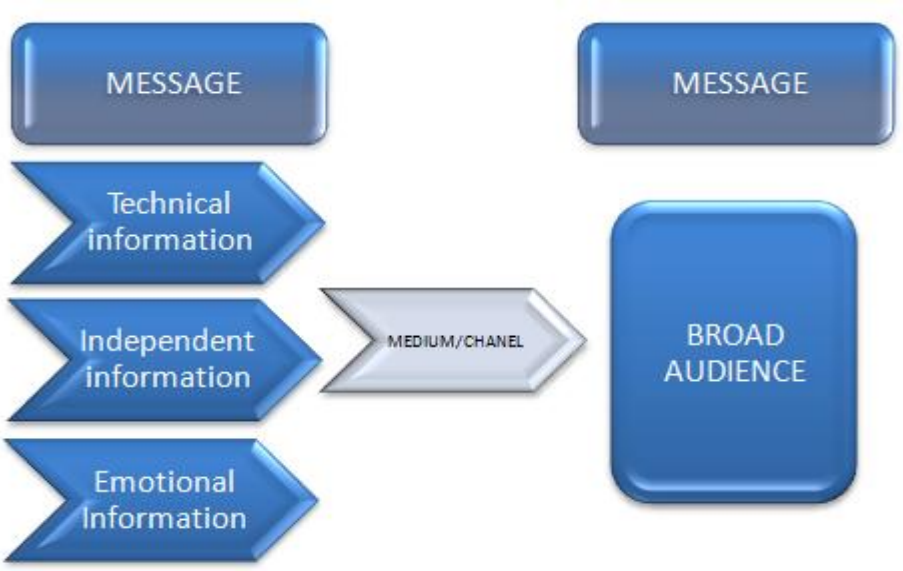

Figure 2. Model of communication in documentary case of acid tar

The non-experts need the communication in the way to establish trustworthiness and certainty about the waste management. For the successful communication of this matter the appropriate tool of communication should be chosen. For the case of Pesniski Dvor the audiovisual documentary (Zavrl, Zilic, 2008) was chosen as a tool of communication. The documentary film covered all the stages of remediation. Research behind the documentary film included interviews with experts from different companies, experts from independent and governmental institutions, local inhabitants and opinion makers from the region.

The audiovisual product, which based on the presented model of communication, could describe the best practices in the way that are successfully perceived from broader public (Figure 2).

The situation of the audiovisual viewer is paradoxical. There is a sense in which person is living in two places, and sometimes two times, at once – in the world in which he is physically situated and the world that documentary presents to him (Scannell, 1991). The media with the sound and the picture could bring the waste management closer to the individual.

The best practices in waste management described in journals are well perceived by experts; however the broader public could get closer to the issues with the (media) product that better appeals to the emotions. The medium for communication that has strong effect is television/screen where picture and sound bring the “reality” to the audience.

3.3. Results of the waste management process

The final result of the acid tar remediation in Pesniski Door was excavation and recovery of all acid tar, contaminated soil, the removal of complete facility used for the processing of acid tar and re-cultivation of the area.

The results of the environmental impact assessment before the remediation showed very high risk of the pollution of the soil and ground water near the dumping site. The acid tar remediation was successfully finished due to the effective technological solution that limited any possible negative impact on the environment.

Communication is a two way process and organizations need to learn how to internalize public views and societal values into the process of hazardous waste management. Woolgar (1996) has discussed the ways in which science and social world are often viewed as independent of each other, one result being the discounting of social factors. This separation (Frewer, 2004) produced the decline in public confidence in risk management practices that became the focus of regulatory concern in the 1980s and 1990s. In the paper we wanted to express the importance of public enlightenment regarding risk issues. Moreover, according to Hilgartner (1990) it could often resolve some problems of technology acceptance in waste management businesses.

The documentary about the hazardous waste management in the case of acid tar remediation tried to explain the process of waste management that leads to revitalization of local area. The sound, picture and interviews with independent experts and non-experts combined the successful way of persuasion in the documentary film. The successful waste management method was accompanied with the suitable communication tool as it was shown in the case of acid tar remediation in Pesniski Dvor. The goal of documentary was the development of the effective message for the broad public.

4. CONCLUSION

The conclusions and recommendations of this paper arise from an examination of the waste management, environmental impact and impact of public concerns about waste management in Slovenia. The model of waste management in Pesniski dvor explains the good practice of hazardous waste management. The model of acid tar management in Pesniški dvor brings the sustainable development of the nature. The reference communication model of waste management could be applied into the countries of Balkan region; however the special circumstances of the local area should be taken into account. The elements of the model that comprise of modern technological process, transparency with monitoring and film documentary as a main communication tool are important elements in the suggested model of waste management.

The suggested model of acid tar remediation is successful business model that company Gorenje-Surovina tries to apply into the area of Balkan region. The waste management in the case of acid tar remediation stresses the need for investment at the level of public participation and public communication. The issue of waste management should be discussed to engage participaton of broad audience.

The results of the acid tar remediation in Pesniski Dvor was complete remediation and revitalization of the old disposal site which previously presented high environmental risk for the nature and humans. During the process of remediation 18.200t of acid tar, 14.600t of contaminated soil and 600 m^3 of the waste water from the disposal site was neutralized and recovered. The quality of the nature in Pesniski Dvor increased and the old dumping site is well integrated with the surrounding forest and meadows. The model of communication with suitable communication tool for broader audience was important part of the project. Therefore it can be apply to other projects in the field of waste management where public participation and public awareness is extremely important.

REFERENCES

.

Burger, J. (2008). Environmental management: Integrating ecological evaluation, remediation, restoration, natural resource damage assessment and long-term stewardship on contaminated lands. Science of the total environment 400 (2008) 6–19.

Dahl, R. (1998). On Democracy, Yale University Press.

Frewer, L. (2004). The public and effective risk communication; Toxicology letters, Vol.149, Issues 1-3. 2004, EUROTOX, 391-397.
Frewer, L.J. et al. (2002). Public preferences for informed choice under condition of risk uncertainity: the need for effective risk communication. Public Understanding Sci. 11, 1-10.
Giusti, L. (2009). A review of waste management practices and their impact on human health. Waste Management 29. 2227–2239.
HIDROOPREMA, (2009). Remediation of the acid tar disposal site - Final report.
Hilgartner, S., 1990. The dominant view of popularisation: conceptual problems, political uses. Social Stud. Sci., 519-539.
Kolmakov, G. A. , Grishin, D. F., Zorin, A. D. & Zanozina, V. F. (2007). Environmental Aspect of Storage of Acid Tars and Their Utilization in Commercial Petroleum Products. Petroleum Chemistry, 2007, Vol. 47, No. 6, pp. 379–388.
Leonard, S., Stegemann, J. & Roy, Amitava. (2010). Characterization of acid tars. Journal of Hazardous Materials 175 (2010) 382–392.
Lipovšek, F. & Kovač, P. (2007). Renewal of Acid Tar Lagoon Site at Pesniski Dvor , International conference "Waste Management, Environmental Geotechnology and Global Sustainable Development (ICWMEGGSD'07 - GzO'07)" Ljubljana, SLOVENIA, August 28 - 30, 2007.
McQuail, D. (2006). Mass Communication Theory, 5th ed. Thousand Oaks: Sage Publications.
Nanut, E., Kovač, P. & Šimenc, B. (2010). Recovery of Acid Tar Disposal Conference Zenica.
Panagopoulos I., Karayannis A., Adam K. & Aravossis K. (2009) Application of risk management techniques for the remediation of an old mining site in Greece, Waste Management 29 (2009) 1739–1746.
Petts, J. (1992). Incineration risk perceptions and public concern: Experience in the UK improving risk communication, Waste Management Research, Vol 10, Issue 2. 169-182.
Scannel, P. (1991). The relevance of talk. In Scannel, P. (ed.), *Broadcast talk.*London: Sage.
Woolgar, S. (1996). Psychology, qualitative methods and the ideas of science in: Richardson, S.T.E. (Ed.), Handbook of Qualitative Research Methods. British Psychological Society, Leicester, pp. 11-24.
Zavrl, Ţilič-Fišer S. (2008). Documentary about acid tart management in Pesniski dvori, documentary film, University in Maribor, Faculty of Electrical Engineering and Computer Science, Institute of Communication.
Ţilič Fišer S. & Dvoršak, S. (2010). The model of an effective public communication in remediation of acid tar dump: Case of Pesniški dvor, Conference: "Hazardous and Industrial Waste Management" 5-8 October, 2010, Chania, Greece.

ENVIRONMENTAL SUSTAINABILITY SCREENING OF SMALL-SCALE URBAN WATER SUPPLY SYSTEMS

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Abstract: *Practitioners and researchers are in need to develop practical tools to quickly measure environmental sustainability of an urban infrastructure system through its life cycle. This paper proposes a framework for an environmental sustainability screening of urban infrastructure systems, which is based on interactions between infrastructure and surrounding environmental systems. One way of quantifying these interaction effects is through use of environmental sustainability indicators selected on basis of simplified life cycle assessment (LCA). A small set of selected indicators was applied in a case study of the urban water supply system of Bratunac, Bosnia and Herzegovina.*

Keywords*: life cycle assessment, environmental sustainability, indicators, water supply systems*

1. INTRODUCTION

Urban water supply systems in developing countries experience difficulties in meeting challenges of increasing population and lack of funding for intensive capital infrastructure solutions. Much of municipal water supply infrastructure which was built during the 1960s and 1970s is now outdated and deteriorated. Municipal authorities are faced with not only with the existing infrastructure reconstruction but also with the demand for its development. Also, national and international development agencies and financing institutions face problems when appraising the commercial viability and sustainability of infrastructure project proposals. Water systems which can satisfy the changing demands placed on them now and in the future without system degradation can be called “sustainable” (ASCE, 1998, p. iv).

Over the last few decades, numerous attempts have been made to describe and measure various aspects of sustainability, with emphasis often being put on the environmental aspects. One approach included environmental sustainability indicators (ESI). Several organizations used frameworks based upon Pressure-State-Response model proposed for use at country, regional or municipal levels by the OECD (OECD, 2001). Pressure indicators measure environmental pressures from human activities influencing the environment through emissions and exploitation of natural resources. State relates to the state of the environment, such as the quality and quantities of natural resources while response measures the extent to which society is responding to environmental changes and concerns. In 1997, another approach, life cycle assessment (LCA), was designed for evaluation and possible reduction of environmental impact of the entire life cycle of products, processes, projects and services (ISO 14040:1997). It is standardized method that includes life cycle impact assessment (LCIA) phase where potential impacts are aggregated and quantified (ISO 14042:2000). Four components of LCA include goal and scope definitions, inventory analysis, impact assessment and improvement analysis (results interpretation). Several LCA studies on urban water systems estimated environmental loads from urban water systems although mainly addressing specific wastewater systems (Lundin et al., 2000, Godin et al., 2011, Feijoo, 2013) while fewer studies on water supply have been published (Lundie et al., 2004).

Although LCA is a rather complex and time-consuming analysis, it can provide a systemic foundation for selection of relevant indicators of environmental performance, including measurement techniques at company level (ISO 14040:1997). In this paper we propose a selection of ESI as a less complicated method through an iterative technique based upon simplified LCA methodology.

2. FRAMEWORK FOR A SCREENING LCA OF URBAN WATER SUPPLY SYSTEMS

Acknowledging that the life cycle perspective is important for environmental sustainability, the challenge is to adapt the LCA methodology and simplify its use. With a simplified or screening LCA it would not be possible to retrieve detailed results of the environmental performance of a product or a system and comparative statements according to ISO 14044 cannot be based upon it. This type of study yields an estimate of environmental performance (EeBGuide Project, 2012). A suggested framework for using the simplified LCA method for urban water supply system is described in Figure 1.

The screening LCA commences with specifying the goal and scope of the iterative process, as presented in Figure 1. The goal here is to conduct an initial overview of the environmental sustainability of the urban water supply system in order to support investment decision-making at the level of a water utility and beyond. Attempts to define general sustainability criteria for urban infrastructure systems have been presented in several studies e. g. Sahely et al (2004) but here we limit to the quick screening of environmental sustainability of an urban water supply system which include major environmental impacts along life cycle.

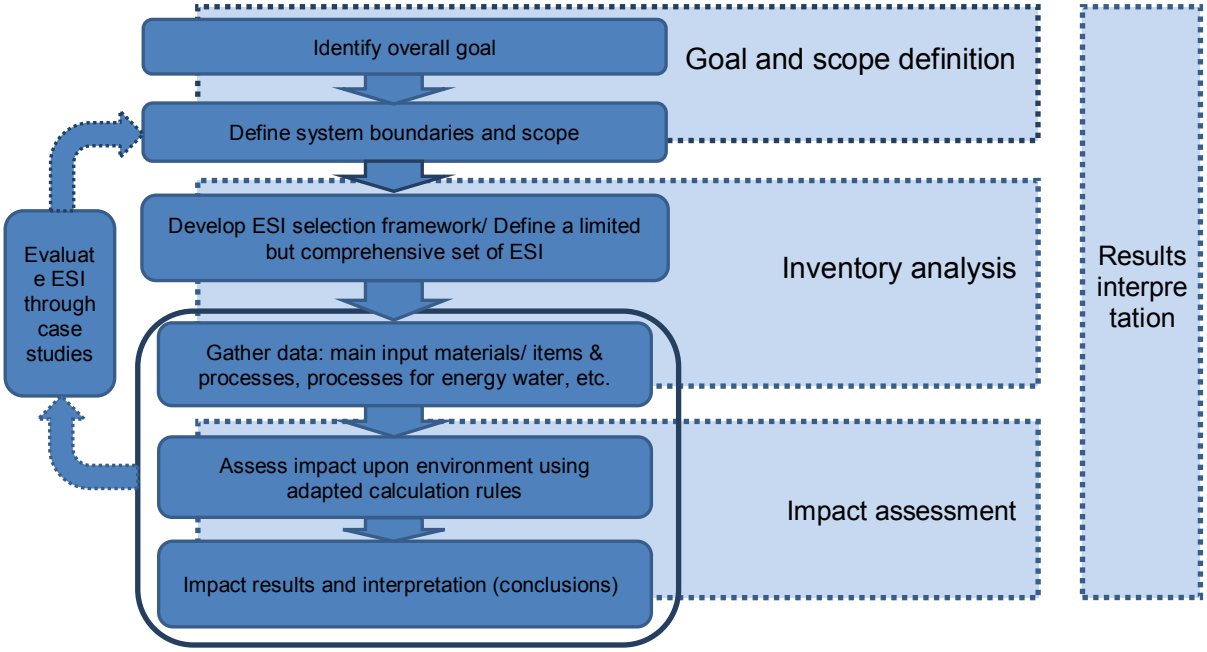

Figure 1 – Framework for environmental sustainability screening of an urban water supply system based on the Life Cycle Impact Assessment phases (square dotted), *source ISO 14040/14044*

The next step is definition of system boundaries, which encompasses time, spatial and life-cycle boundaries. In the planning and design of an urban water supply system a time perspective of several decades is usually considered. Spatial boundaries of a water supply system are limited to include one or several municipalities or watershed area. The life cycle boundaries define the unit processes which are to be included in subject system and for a water supply system life cycle starts with extraction of water from groundwater or surface water source including water treatment. In this case, the lifecycle ends with distribution of potable water to consumers: households and industry. Of course, different choices could be made for system boundaries to include wastewater treatment, disposal of sewage sludge to landfill or agricultural land and surrounding technical and agricultural system.

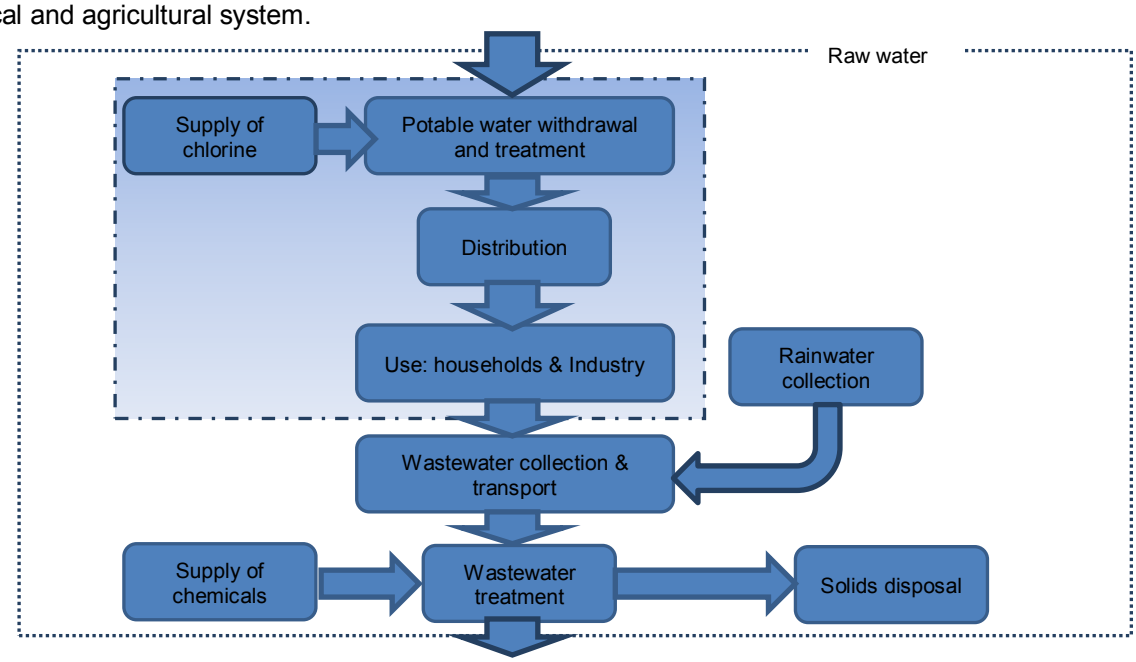

Figure 2 – System boundaries used in this paper (dash-doted rectangle)

The following step is developing framework for selection of ESI, which is a kind of a structure from which relevant indicators are selected through identifying most important issues for the stated purpose, such as the water quality, water resources and energy use. General frameworks used for sustainable development indicators have adopted a conceptual driving force-state-response approach widely used for environmental indicator development, such as the Pressure-State-Response (PSR) model developed by OECD (2001). This has led to selection of 10 key environmental indicators extracted from the OECD Core Set of environmental indicators (approx. 40 indicators), which covers the issues of climate change, ozone depletion, air and freshwater quality, waste generation, freshwater, forest and energy resources and biodiversity. Examples of indicators related to water quality and resources are presented in Table 1.

Table 1 – OECD indicators related to water quality and resources and their place in PSR framework (source OECD Environmental Indicators, 2001, pp 41-51)

Set of indicators	Selected Indicators	Place in framework
Water quality	Quality of surface waters (oxygen and nitrate content)	S
	Sewerage treatment and network connection rates	R
	Public expenditure on waste water treatment	R
Water resources	Intensity of use of water resources	P
	Water supply prices	R

Similar frameworks have evolved from PSR approach to one focusing on four primary dimensions of sustainability - social, economic, environmental and institutional. Within these categories, indicators were then classified in accordance to their driving force, state and response characteristics (UNCSD, 2001). LCA framework includes all major impacts/ benefits on environment occurring throughout the life-cycle, and relates them to functional units or performance characteristics, such as per person, day, etc. Functional units set the scale for comparison of two or more systems including improvement to one system (EEA, 1997)

Following framework development, appropriate ESIs can be selected from the previous LCA case studies, literature reviews and indicators already used within an organization. It is important that a limited but comprehensive set of ESIs is selected so that the most important aspects are addressed. The indicators should allow for comparisons through use of aforementioned functional units. In this paper we have chosen a list of 20 indicators for urban water systems categorized in terms of four environmental and technical systems: freshwater resources, potable water, waste water and development, proposed by Lundin (1999, p. 37). Each system was represented by certain dimensions broken down into indicators. Then, 6 of 20 initially proposed environment sustainability indicators have been short-listed in order to quickly appraise environmental sustainability of Bratunac water supply system (Table 2). Of course, hereunder proposed set of indicators does not include all aspects of environmental sustainability of an urban water supply system.

Table 2 - ESIs used in this paper (adapted from Lundin, 1999, p. 37)

Suggested indicator	Data availability	Type	Suggested reference value
Freshwater withdrawal	Available	Pressure	<100% of raw water quantity
Water consumption	Available	Driving force	Above WHO standard (20 l/capita/day)
Potable water quality	Available	State	% of tap tests within WHO or national regulation
Energy use for water supply	Available	Efficiency	As efficient as possible
Chemical use	Available	Efficiency	As efficient as possible
Leakage/ water losses, %	Moderately available	Efficiency	Low

After selection of ESIs, data were collected for the period available, and the impact upon the environment was assessed using different weighting methods. Data gathering and data quality is important for LCA as well as for EPI. Lundin and Morrison (2002, p. 149) conceptually described various levels of environmental sustainability for urban water systems as shown in Table 2.

Table 3 – Environmental sustainability levels of urban water supply infrastructure (adapted from Lundin, Morrison, 2002, p. 149)

Level	Infrastructure characteristics
A	Environmental and health objectives are met. Efficient use of resources.
B	Environmental protection standards are fulfilled and exceeded but focus is still on compliance with standards and end-of-pipe solutions. Potable water is regularly monitored.
C	Minimum environmental and health protection standards are fulfilled.
D	Basic standards ensuring human and environmental health and adequate water supply are not met. There is uncertainty in water supply on daily basis. Minimum environmental monitoring

3. EXAMPLE OF A SCREENING LCA: BRATUNAC URBAN WATER SUPPLY SYSTEM

The use of environmental sustainability indicators in infrastructure decision making is not applied widely in Bosnia and Herzegovina and surrounding countries. Main challenge here is collection and compilation of data at the urban water supply system level. A walkthrough energy audit of Bratunac urban water supply system is used as an example where data were compiled and synthesized from utility and municipal officials and from measurements taken in the field (Kovacevic et al. 2013).
The area of the municipality of Bratunac is supplied with potable water through an urban water supply system and several rural water supply systems. “Bjelovac” water source, located in the vicinity of the Drina River supplies the urban area with drinking water after chlorination treatment at the Bjelovac water intake plant. Urban water supply system covers the city area and most of the suburbs with a total population of 11,000 or 2,945 households, which is approx. 51% of the entire municipal population. The rest of population is supplied through rural water supplies which are not under jurisdiction of the “RAD” Bratunac Public Utility Company. Water supply system operates without major restrictions with maintained water quality regardless of annual rainy or draught periods. Apart from chlorination, water is used without any additional treatment.

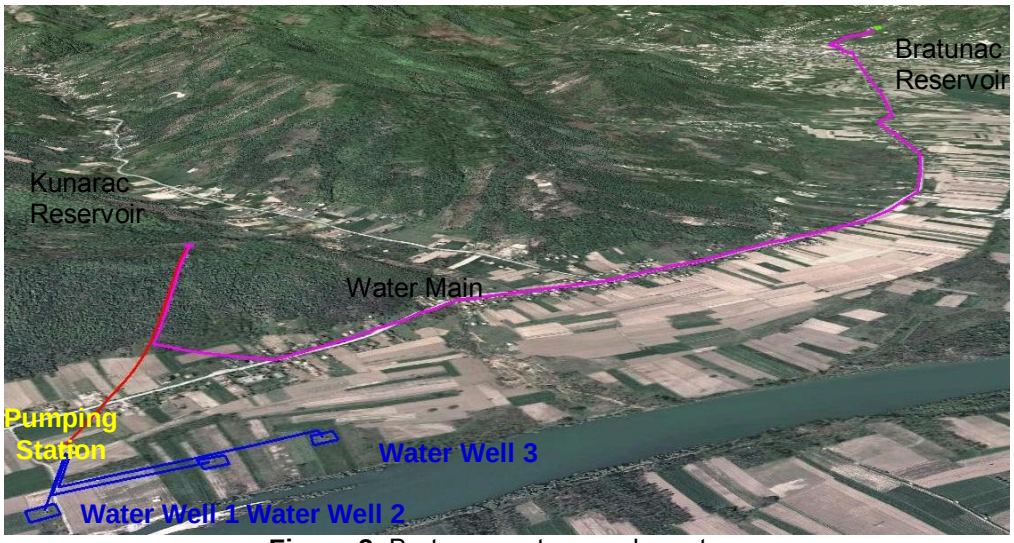

Figure 3: Bratunac water supply system

There are three freshwater wells of 3 meters in diameter and average depth of 10 meters, and of total capacity of 65 l/s. The wells are located in the protected area with strictly enforced sanitary rules. Withdrawn water is pumped through the 800 meters long thrust pipeline into the retaining reservoir of 100 m³, adjacent to the pumping station from which the water is pumped up to the Kunarac Reservoir of 120 m³ and further gravitationally transmitted into the Bratunac storage reservoir of 1.350 m³ through water main of 200, 300 and 350 (mm) in diameters and total length of 9,560 meters. Total length of distribution mains is around 30,500 m, made of pipelines of 50 through 350 (mm) diameters.

Major deficiencies of the existing water supply system are: inadequate quantities of extracted raw water at the water source, especially in the summer period, lack of adequate reservoir storage, undeveloped distribution network with under-dimensioned pipeline sections which causes unequal pressure distribution as well as high water losses of 55-60%. Urban water supply network is outdated and dilapidated as it was mostly built in 1962 through 1964. Detailed design for rehabilitation and reconstruction of Bratunac water supply distribution network was funded by United Nations Development Programme (UNDP) in 2011 while

the funds for reconstruction were secured through European Investment Bank (EIB) in 2012. The works are foreseen to commence in 2014.

3.1 Purpose of the screening LCA and system boundary definition

The aim of this screening LCA was to assess environmental performance of the Bratunac urban water supply over the last few years for which most of data were available. In accordance with the proposed framework, the water system was divided into two technical sub-systems following the life cycle of urban water management: (1) withdrawal and treatment of raw water and (2) distribution and consumption of potable water. For both sub-systems ESI were adopted in terms of environmental performance and pressure on the environment (Table 2).

3.2 Environmental Sustainability Indicators (ESIs)

3.2.1 Freshwater withdrawal

The freshwater withdrawal indicator is calculated by dividing the annual freshwater withdrawal by the annual available amount. It shows whether or not withdrawal is at an acceptable level or future shortages are expected. The withdrawal indicator also relates to population and population growth, the future demands for agriculture and industry and water losses in the system.

Total raw water withdrawal in 2011 was 1,903,673 m^3 with average withdrawal 61.20 l/s. Average daily quantities of withdrawn water were 5.400 m^3 a day. In accordance with the Long-term programme for drinking water supply of the population and industry in Bosnia and Herzegovina (Water management institute of BiH, 1988), Bratunac water supply system should completely rely on Bjelovac water source, with forecasted yield of 300 l/s, which satisfies the needs for water until the end of the programme period by 2020 and beyond. The reference value for this indicator is that the withdrawal should be less than 100% of the raw water quantity. Collected data show that the withdrawal volume has been around one fifth of total available water resources which is at the satisfactory level.

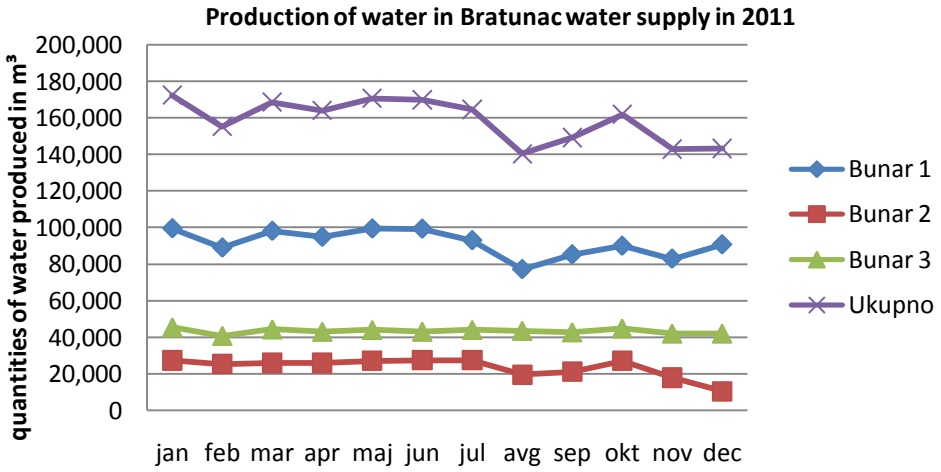

Figure 4 – Monthly production of water in 2011 in m^3 (Kovacevic et al. 2013)

3.2.2 Water consumption

With population increase and economic development increased quantities of water will have to be supplied for domestic and industrial purposes. Since the consumption of potable water affects use of energy and resources, it is directly linked to the environmental sustainability of the water system. Suggested water use indicator is *l/capita/day*, which is compared to target.

Consumption was calculated by dividing inflow values at the Bjelovac reservoir by Bratunac population estimate, which was adjusted in accordance with the projected population increase (1.30%). Water consumption (including industrial use) has increased from approximately 166 l/capita/day (2005) to 175 l/capita/day (2013) and is forecasted to 200 l/capita/day for the next two decades (Table 1), which significantly exceeds a minimum for basic level of service given by WHO (2003, p. 25). This is slightly above the European average as urban water use has decreased in the 1990s in many European countries as a result of measures to reduce demand and because of economic restructuring. The largest amount of household water used is found in Spain with 265 l/capita/day (Figure 5.11), followed by Norway (224 l/ capita/day), Netherlands (218 l/capita/day and France (164 l/capita/day). Lithuania, Estonia and Belgium with

85, 100 and 115 l/ capita/day, respectively, have the lowest household water use in those European countries with available information.

Table 4 – Calculation of needed quantities of water for Bratunac water supply system (Kovacevic at al. 2013)

Description of consumption	Unit of measure	Projected population increase				
		2005	**2013**	**2015**	**2025**	**2035**
Number of residents connected to system		**11,436**	**12,199**	**13,013**	**14,807**	**16,848**
Average specific residential consumption	l/capita/day	166	175	180	190	200
Access to urban water supply system	%	100.00	100.00	100.00	100.00	100
Average household consumption	l/s	21.97	24.71	27.11	32.56	39.00
Average industrial consumption - 20 % of household consumption	l/s	4.39	4.94	5.42	6.51	7.80
Total average consumption: households + industry	**l/s**	**26.37**	**29.65**	**32.53**	**39.07**	**46.80**
Total daily average consumption: households + industry	**m^3/day**	**2,278**	**2,562**	**2,811**	**3,376**	**4,044**
Total monthly average consumption: households + industry	**m^3/month**	**69,291**	**77,921**	**85,494**	**102,686**	**122,993**
Total annual average consumption: households + industry	**m^3/year**	**831,489**	**935,047**	**1,025,924**	**1,232,227**	**1,475,916**
Seasonal household consumption unevenness coefficient		1.50	1.50	1.50	1.50	1.50
Maximum daily household consumption	l/s	32.96	37.06	40.66	48.84	58.50
Seasonal industry consumption unevenness coefficient		1.25	1.25	1.25	1.25	1.25
Maximum daily industry consumption	l/s	5.49	6.18	6.78	8.14	9.75
Total maximum daily consumption: households + industry	**l/s**	**38.45**	**43.24**	**47.44**	**56.98**	**68.25**
Total average water losses in the system	%	57.84	40.00	35.00	30.00	25.00
Total average needs for water in the Bratunac water supply system	**l/s**	**62.54**	**49.42**	**50.05**	**55.82**	**62.40**
Total maximum needs for water in Bratunac water supply system including losses	**l/s**	**91.20**	**72.07**	**72.99**	**81.40**	**91.00**

3.2.3 Energy use

Data relevant for use of energy were gathered from water utility officials and measurements of electrical parameters were taken, such as currents, voltages, powers (active, reactive and total power) and actual energy use. Also current, voltage and power waveforms were measured at the engines running the thrust pumps in the Bratunac water supply system. Engines and pumps were scanned using a thermal camera. Energy consumption analysis was based on monthly electrical energy use bills taking into account energy tariff group of the consumer as well as changes in energy prices during the observed period.

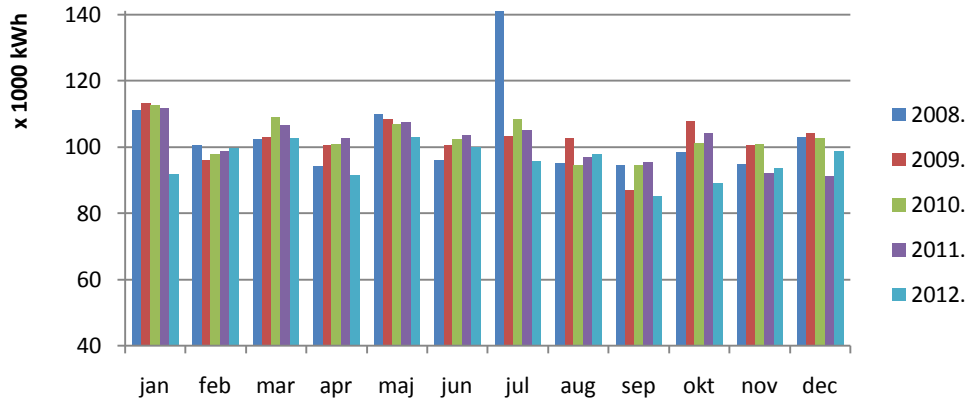

Figure 5 – Monthly electrical energy use in kWh for period from 2008 to 2012

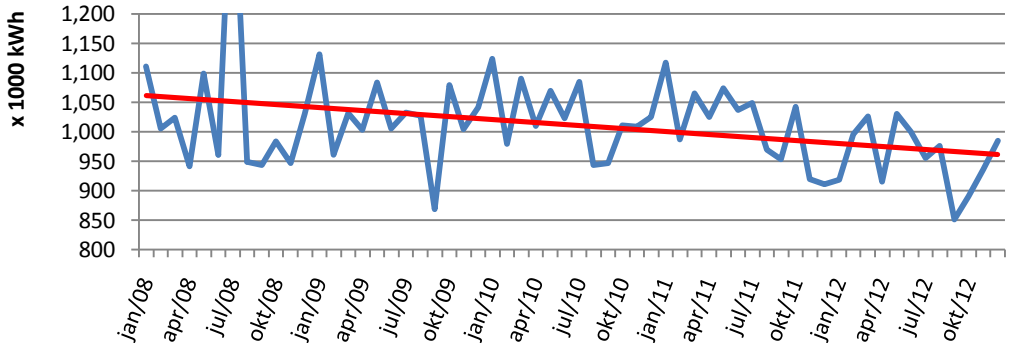

Figure 6 - Electrical energy use in kWh for period from 2008 to 2012

Electrical energy use was quite equally spread throughout the year and there was no typical division between summer and winter months. However, a general notion of decrease in energy use can be observed, especially since January 2011. This trend seems to have been influenced by the changed regime in power supply system i.e. third thrust pump was occasionally shut down during the night hours. Energy Use Assessment Tool developed by the US Environmental Energy Agency (EPA) for assessment of energy use in small to medium water supply systems was utilized in the analysis of electrical energy use, produced water and costs in order to determine the areas with the highest potential for savings. The highest energy consumers were the thrust (circulating) pumps with 85% of total consumption then the water well pumps with 11% while the remaining 4% of energy relates to other consumers (lighting, heating, etc.).

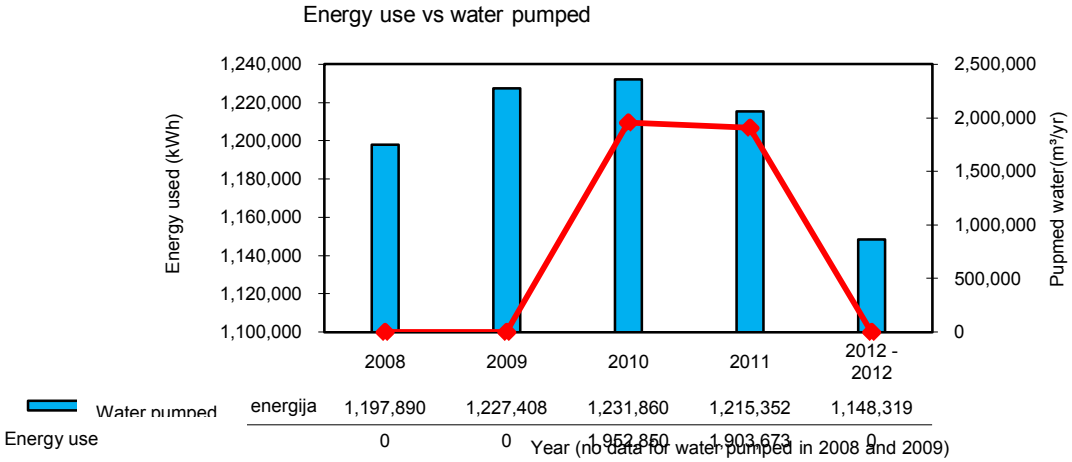

Figure 7 – Energy use vs. water pumped (source Kovacevic et al. 2013)

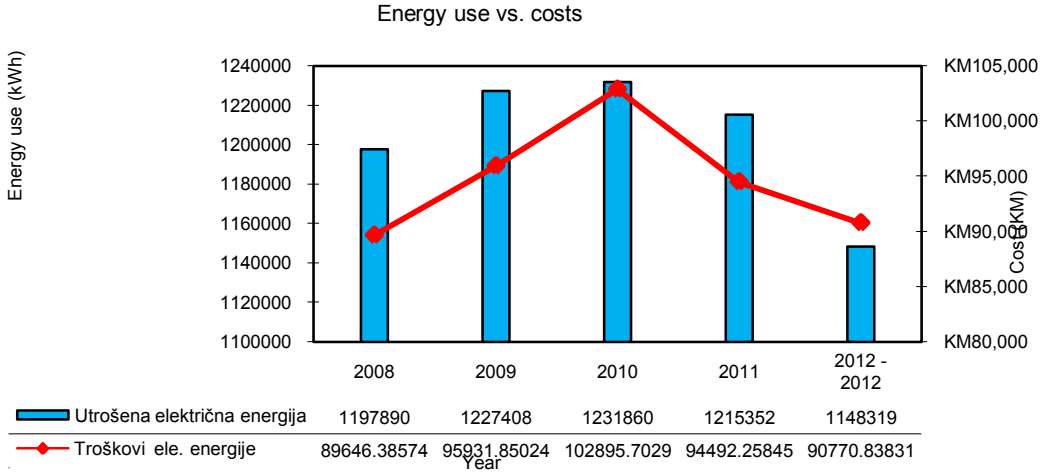

Figure 8 – Energy use vs. costs (source Kovacevic at al. 2013)

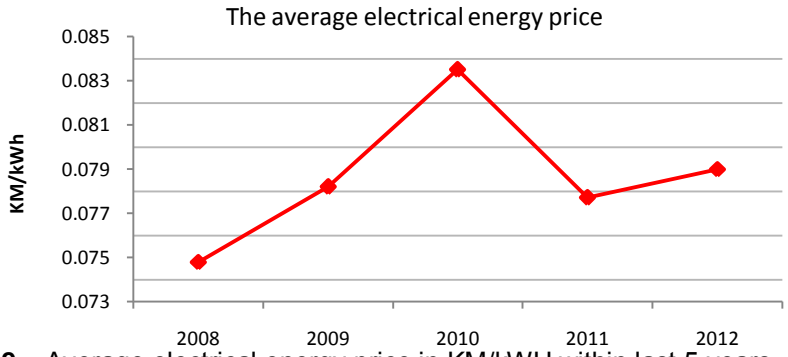

Figure 9 – Average electrical energy price in KM/kWH within last 5 years

Water distribution is therefore the most energy intensive process in the urban water supply system. In 2010, average electrical energy use to operate pumps was 0.63 kWh/m^3. This average is above the average value in the engineering literature, which is around 0.48 kWh/m^3 although this value is illustrative since it does not incorporate critical elements such as the distance the water is transported, which vary greatly from site to site (World Business Council for Sustainable Development, Water, Energy and Climate Change, 2009). During 2010, 1.952 Mm^3 was pumped directly from Bjelovac pumping station into the transmission system.

Higher or lower electrical use costs (Figure 8) appear to be directly related with the average annual electrical energy price expressed in KM/kWh (Figure 9).

3.2.4 Potable water quality

The quality of potable water is highly important as it directly impacts human health. It should be within tolerable limits of bacteria and chemicals. Bulk potable water is sampled at the water intake facility but because it may deteriorate before reaching consumers due to corrosion or contaminations caused by leakages, water is also sampled at the tap at 2 independent locations within the system twice a month.
Bratunac water utility performs regular water quality tests through the Public health institute of Republika Srpska and the test results satisfy in over 95% cases. The results of recent physical-chemical analysis from February 2014 showed that the level of nitrate are below the hygienically regulated maximum of 50 mg NO_3/l and that the concentrations of residual chlorine seem to be below regulated maximum of 0.5 Cl_2 mg/l.
Generally, potable water quality in Bratunac is considered to be good. The recently conducted microbiological analysis from February 2014 showed that there were no either coliform of other bacteria in water system.

3.2.5 Chemicals use

This indicator is affected by raw water quality and the degree of protection of freshwater resources. Since the raw water withdrawn from Bjelovac water wells is of high quality, only chlorine is utilized in the water treatment for Bratunac water supply. The dosage of chlorine has been relatively stable during the observed period (0.3 mg/l Cl_2). Efficiency improvements introduced gas chlorinators which apply dosage in accordance with the withdrawn water quantities. The current chemicals use for water quality in Bratunac water supply system can be considered efficient.

3.2.6 Leakage/ water losses

Large volumes of water are lost due to leakage in pipes which leads to increased pumping costs, loss of water (and revenue), loss of pressure and increased risks of contamination by bacteria and corrosion products (e.g., copper, iron and zinc). Data on water production is obtained through a water flow meter installed at the water intake facility next to the water pumps on thrust pipelines. The meter displays cumulative flow values recorded on daily basis. Also, at the exit of Bratunac reservoir there is a flow meter which registers data on quantities of water flowing into the distribution system. Accuracies of both meters having been checked through ultrasound flow meters, it was concluded that the flow values were identical; however, the installed meters need to be calibrated. Water use, namely quantities of water delivered to consumers, is registered through water meters and where there is no water meters installed water use is calculated as flat rate service. Water meters are read quarterly.

Table 5 – Water losses in the distribution system (source Kovacevic et al. 2013)

Time of year		Water production			Water losses in the system					
					Distribution network			Household installation		
Month	No. of days	m^3/month	m^3/day	l/s	m^3/mth.	l/s	%	m^3/mth.	l/s	%
January	31	157,140	5,069	58.67	59,366	22.16	37.77	26,255	9.80	16.71
February	28	148,150	5,291	61.24	58,898	24.35	39.76	23,715	9.80	16.01
March	31	172,090	5,551	64.25	74,316	27.72	43.14	26,255	9.80	15.26
April	30	175,100	5,837	67.55	80,167	30.93	45.79	25,408	9.80	14.51
May	31	171,420	5,530	64.00	73,646	27.50	42.97	26,255	9.80	15.32
June	30	170,210	5,674	65.67	75,271	27.68	42.15	25,414	9.80	14.93
Total	**181**	994,110			421,664			153,303		
Average:			**5,492**	**63.57**		**26.96**	**42.42**		**9.80**	**15.42**

Month		Total losses		
	No.of days	m^3/mth.	l/s	%
January	31	85,621	31.97	54.49
February	28	82,613	34.15	55.76
March	31	100,571	37.55	58.44
April	30	105,575	40.73	60.29
May	31	99,901	37.30	58.28
June	30	100,685	38.84	59.15
Total	**181**	574,967		
Average			**36.77**	**57.84**

Data from Table 4 shows that water losses in Bratunac water supply system are in range 55 - 60 % i.e. water losses exceed water loss levels from European urban water networks level (Figure 9) thus increasing costs and decreasing revenues of the water utility and negatively impacting raw water resources.

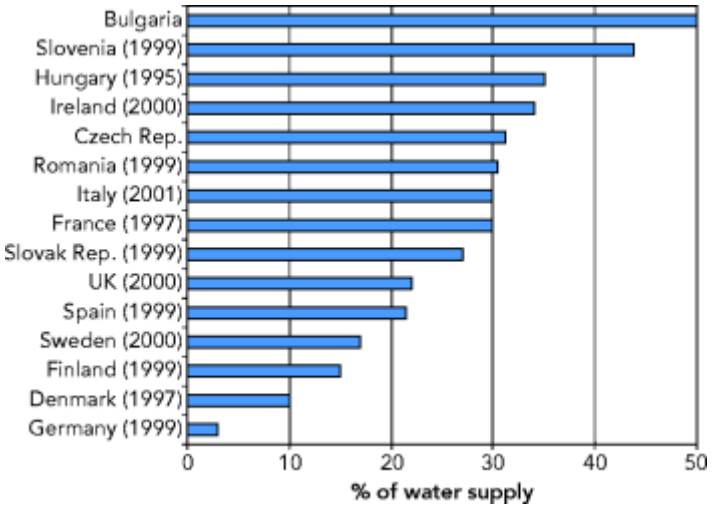

Figure 9 – Losses from urban water network in Europe (source EAA, factsheet, 2003)

Such high losses negatively impact upon the water balance within the Bratunac water supply system as shown in Table 6. This indicates that there is no point in pumping additional quantities of water into the system until the leakage is reduced down to acceptable level.

Table 6– Water balance within Bratunac water supply system (source Kovacevic et al. 2013)

Water supply system	Max. Daily needs for water (l/s)				Water intake withdrawal In Bjelovac (l/s)				Needed quantities of water (l/s)			
	2005	2013	2020	2035	2005	2013	2020	2035	2005	2013	2020	2035
Bratunac	91.20	72.07	82.18	91.00	63.57	63.57	63.57	63.57	-7.63	-8.50	-18.61	-27.43

4. CONCLUSION

In this paper an LCA based, iterative procedure for selecting ESIs for environmental sustainability screening of urban water supply systems has been proposed and exemplified by a screening LCA on Bratunac water supply. The concept of environmental sustainability has been defined by a small set of quantifiable and measurable indicators that enabled quick overview of environmental sustainability of the water supply system over time. Most indicators were easy to apply as data were readily available. All indicators were found to be useful for the subject water supply system and were recommended for future studies.

By taking a look at the chosen set of environmental indicators (Table 1) and the levels of environmental sustainability in Table 2, Bratunac urban water supply system falls within the level C of environmental sustainability, characterized as a reactive decision-making system which meets minimum environmental protection standards and health objectives and which relies on consumer complaints. This means that the system is not moving towards sustainability and there is much room for improvements in terms of water and energy efficiency, primarily in the management of water losses.

REFERENCES

American Society of Civil Engineers (ASCE) (1998). *Sustainability Criteria for Water Resource Systems, prepared by Task Committee on Sustainability Criteria*. Virginia, USA: ASCE.

Energy-Efficient Building European Initiative (2012). EeB Guidance Document: Operational guidance for life cycle assessment studies of the Energy-Efficient Buildings Initiative. Retrieved March 19, 2014 from http://www.eebguide.eu/?page_id=659

European Environmental Agency (1998). Life Cycle Assessment (LCA). A guide to approaches, experiences and information sources. Environmental issue report No 6. Retrieved March 8, 2014 from http://www.eea.europa.eu/publications/GH-07-97-595-EN-C

Feijo, G., (2013). *Life Cycle Assessment and Wastewater treatment: Applications and methodological improvements*. Unpublished doctoral dissertation. Unversidade de Santiago de Compostela. Spain. Retrieved March 14, 2014 from USC database.

Godin, D., Bouchard, C., Vanrolleghem, P., A., (2011), LCA of wastewater treatment systems: introducing a net environmental benefit approach. In *8th IWA Symposium on Systems Analysis and Integrated Assessment, 20-22 June 2011*. Donostia – San Sebastian, Spain.

ISO 14040 (1997). *Environmental management – Life cycle assessment – Principles and framework*. Geneva, Switzerland: International Organization of Standardization.

ISO 14042 (2000). *Environmental management – Life cycle assessment – Life cycle impact assessment.* Geneva, Switzerland: International Organization of Standardization.

ISO 14044 (2006). *Environmental management – Life cycle assessment – Requirements and guidelines.* Geneva, Switzerland: International Organization of Standardization.

Kovacevic, B., Markovic-Kovacevic, I., (2013). Preliminarni (walkthrough) energetski audit pumpnog postrojenja i distributivnog sistema vodovoda Bratunac [Walkthrough energy audit of the Bratunac water pumping facility and distribution system]. In *13th International Conference on Water Supply and Sanitation Systems, 22-24 May 2013* (pp. 196-203) Jahorina, Pale, Bosnia and Herzegovina.

Lundie, S., Peters, M., G., Beavis, C., P., (2004). Life Cycle Assessment for Sustainable Metropolitan Water Systems Planning. *Environmental Science & Technology, 38,* 3465-3473. Retrieved March 6, 2014 from Aseanenvironment.info database.

Lundin, M., Bengtsson, M., Molander, S., (2000). Life Cycle Assessment of Wastewater Systems: Influence of System Boundaries and Scale on Calculated Environmental Loads. *Environmental Science & Technology, 34*, 180-186. Retrieved March 5, 2014 from Research Gate database.

Lundin, M., Morrison M. G. (2002). A life cycle assessment based procedure for development of environmental sustainability indicators for urban water systems. *Urban Water, 4*, 145-152.

Lundin, M. (1999). *Assessment of the Environmental Sustainability of Urban Water Systems.* Unpublished licentiate thesis. Chalmers University of Technology. Goteborg, Sweden. Retrieved March 6, 2014 from Universidade de Pernambuco Escola Politecnica database.

OECD (2001). *Environmental Indicators. Towards Sustainable Development.* Paris, France: Organization for Economic Co-operation and Development.

Sahely, H., Kennedy, C., Adams, B., (2005). Developing sustainability criteria for urban infrastructure systems. Canada Journal of Civil Engineering, 32, 72–85.

UNCSD (2001). *Indicators of Sustainable Development: Framework and Methodologies. Background paper no. 3.* New York, USA.

WHO (2003). *Domestic water quantity, service level and health.* Geneva. Switzerland.

Zavod za vodoprivredu SR BiH (1988), *Dugoročni program snabdijevanja pitkom vodom stanovništva i privrede u BiH [Long-term programme of drinking water supply of population and industry in Bosnia and Herzegovina].* Sarajevo, Bosnia and Herzegovina.

SUSTAINABLE WASTE MANAGEMENT - SURVEY ON WASTE COLLECTORS' WORK SATISFACTION IN THE PUBLIC UTILITY COMPANY

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Abstract: *In this paper, the main research subject is sustainable waste management, and consequently utility workers' perception on public behaviour in regards to habits they perform in waste disposal. Due to the increasing amount and harmfulness of waste to the environment, it is considered to be one of the most important problems of the modern world. Waste is generated at all levels, national and local, in households, manufacturing facilities, public administration, retail stores, educational institutions, tourism organizations and enterprises, medical institutions, military institutions, etc. Disposal of municipal and industrial waste without any impact to the environment is one of the major issues facing modern society. More than 150 waste collecting workers covering the territory of 10 Belgrade municipalities participated in the survey. In order to evaluate the results of the survey, statistical software package SPSS 20 was used. And discussion on results is presented in the conclusion of the paper.*

Keywords: communal waste, municipal workers, job satisfaction, cost effectiveness, waste management, environment.

1. INTRODUCTION

Waste management is the implementation of measures prescribed for the treatment of waste within the collection, transport, storage, treatment and disposal of waste, including supervision of such activities and maintenance of waste management facilities.

Waste is generated at all levels, national and local, in households, manufacturing facilities, public administration, retail stores, educational institutions, tourism organizations and enterprises, medical institutions, military institutions, etc. Waste generation depends on the level of industrial development, living standards, lifestyles, social environment, energy and other parameters within every community. The amount of waste can vary significantly between countries, but also within the parts of the same country.

The basic classification of waste is the following:

According to the place of origin:

- Municipal waste - household waste, as well as other waste which, based on its nature or composition, is similar to waste from households.
- Commercial waste - waste generated by businesses, institutions and other organizations that are wholly or partially engaged in trade, services, office affairs, sport, recreation or entertainment, except for household and industrial waste.
- Industrial waste - waste from any industry, except for the tailings and associated minerals from mines and quarries.

According to characteristics that affect human health and the environment, waste can be (UNESCO – UNEP., 1993; UN., 1992):

- Non-hazardous waste - waste which, because of its quantity, concentration or physical, chemical and biological nature, as opposed to hazardous waste, does not threaten human health or the environment and does not have the characteristics of hazardous waste.
- Inert waste - waste that is not subject to any physical, chemical or biological changes; Insoluble, does not burn or in other ways physically or chemically react, is not biodegradable or adversely affect other matter which it comes into contact with in a way that could lead to pollution of the environment or endanger human health; does not possess any of the characteristics of hazardous waste (acute or chronic toxicity, infectivity, is carcinogenic, radioactive, flammable, explosive); the content of pollutants in its water extract may not exceed the statutory level.

• Hazardous waste - waste which by its origin, composition or concentration of hazardous substances can cause harm to the environment and human health, and has at least one of the hazardous characteristics (explosive, flammable, tendency to oxidation, organic peroxide, acute toxicity, infectivity, tendency to rust in contact with air, releases flammable gases in contact with air or water, releases toxic substances, contains toxic substances with delayed chronic action and eco toxic properties), including the packaging in which hazardous waste is or was packed.

Municipal waste is divided into (Marković Luković Lj., 2010):

• organic (biological or biodegradable waste - food scraps, yard waste, grass, leaves, cut off branches, trees, and paper packaging contaminated with food, paper towels, and dust from combustion of wood);
• paper and cardboard (newspapers, books, magazines, commercial printing, office paper, wrapping paper, cleaning paper, corrugated paper);
• plastics (packaging materials, boxes, bottles, plastic bags, foil and other plastic products);
• glass (bottles, jars, containers for beverages, flat glass);
• metal (tin cans, aluminium, iron and other metals);
• textiles and leather;
• other (dirt, ashes, street sweepings, dust, unidentified materials).

Waste material is usually found in solid state, but can also take the form of liquid and the form of sludge. Collection, transport and treatment of the latter require special equipment.

Table 1: Quantity and composition of municipal waste by countries, (EC., 2002).

Waste characteristics		Countries	
		Developed	Developing
quantity per resident	kg/day	0.8-2.2	0.3-1.0
	t/year	0.3-0.8	0.1-0.4
Density	kg/m3	100-200	200-500
Humidity	% mass	20-40	40-80
calorific value	MJ/kg	8-12	3-10
composition:			
• paper, cardboard	% mass	20-40	10-30
• glass, ceramics		4-10	1-10
• metals		3-13	1-5
• plastic		4-10	1-8
• leather, rubber		1-5	1-5
• wood		1-5	1-5
• textiles		2-5	1-10
• bio-waste		20-50	40-85
• hazardous waste		0.5-3	0.5-1
• other inert waste		1-20	1-40

2. ENVIRONMENTAL INFLUENCE OF COMMUNAL WASTE

The impact of solid waste on the environment has multiple negative effects, and the primary reason for such impact in the Republic of Serbia is insufficient coverage of municipal services, which is causing illegal dumping, landfills, major disorders and low public awareness of the environmental issues.

Therefore, illegal dumping sites that are spreading uncontrollably on the municipal territories are created. Main landfills in villages and small urban areas are usually overloaded and without proper cattle burial grounds, all of which are potential source of infectious diseases affecting population and the environment.

Waste affects all categories of the environment: air, land and water. During the breakdown of organic matter, under aerobic and anaerobic conditions, gases are usually released from the waste into the environment: methane, which is explosive, and carbon dioxide. When decomposing, animal carcasses and food remains of animal origin release ammonia, hydrogen sulphide, aromatic acids and other substances that make the air extremely unpleasant to breathe and at higher concentration can be toxic or cause shortness of breath, impaired blood flow, fatigue and sleepiness.

Landfills that are poorly maintained and rarely treated with clay are prone to spontaneous combustion. Gases formed by rotting or by burning of landfills are released into the atmosphere and pollute the environment. Besides gas, the air is polluted with dust and odours. Thus, air pollution and harmful substances accumulated in the atmosphere can adversely affect human health. In places where organic matter decomposes regularly, flies, insects and various birds, rats and other rodents gather. Flies and rodents can become carriers and spread infectious substances (SEPA, 2013).

The key principle of waste management is the principle of sustainable development and it is based on six sub-principles. Sustainable waste management implies more efficient use of resources, waste minimization and handling of waste in such a way that it contributes to the objectives of sustainable development. Sustainable development is a coordinated system of technical-technological, economic and social activities in the overall development in which the principles of cost-effectiveness and the reasonableness of the use of natural and man-made values are met in order to preserve and enhance the quality of the environment for present and future generations (Dţ ozef & Ţarden, 2006; Đukanović.,1996; Milutinović., 2005; Đukić., 2008)

Waste management is based on the following principles:

- The principle of proximity and regional approach to waste management,
- The precautionary principle,
- The "polluter pays" principle,
- Principle of the hierarchy of waste management,
- Principle of the optimal option for the environment,
- The principle of accountability.

2. COMMUNAL WASTE MANAGEMENT IN THE REPUBLIC OF SERBIA

Disposal of municipal and industrial waste without any impact to the environment is one of the major issues facing modern society. Some villages and local communities, due to limited resources, are unable to independently provide all the services that should be a concern of municipal waste management and other projects that are of public importance. One of the strategies usually developed by the municipalities in order to increase the efficiency of service delivery is regionalization.

Also, the strategy discusses a need for institutional strengthening, development of legislation, education and public awareness. The National Strategy is the basic document that provides the conditions for the rational and sustainable waste management at the national level. In the next phase, the strategy should be supported by several implementation plans for the collection, transport, treatment and disposal of controlled waste.

In the Republic of Serbia there is a need for strengthening of the institutions, development of legislation, education and public awareness ("Sl. glasnik RS", br. 36/2009 i 88/2010). Furthermore, there is a need to determine economic and financial mechanisms necessary to maintain and improve waste management, and to ensure the system for domestic and foreign investment in the long-term sustainable activities.

The implementation of the basic principles of waste management set out in the strategic framework is essential (EEA., 2003), i.e. solving the problem of waste at the source, the principle of prevention, separate collection of separate materials, the principle of neutralization of hazardous waste, solving regional waste disposal and remediation of landfills, implementation of the basic principles of the EU in the field of waste and prevention of further danger to the environment and future generations.

The stated goals express strategic choices and main priorities of the Republic of Serbia for the next few years. A long-term strategy for the country in the field of environmental protection is to improve quality of life by providing desired environmental conditions and nature conservation based on sustainable environmental management.

Data on municipal waste of the Republic of Serbia is shown in Table 2 (NWMS, 2010)

Table 2: Data on municipal waste of the Republic of Serbia for the year 2012.

Waste quantities and composition			
1.	Total yearly quantities of collected waste	1... Measured 2... Estimated	Quantity t/year.
	Municipal waste, except bulky waste		583.738
	Municipal bulky waste		2.471
	Waste from businesses and institutions (except industrial)		No available data
	Industrial waste		143
	Waste from public areas		No available data
2.	Quantities of specific waste materials	t/year	%
	Paper	341	<1,00
	Glass	0	
	Plastic	159	<1,00
	Rubber	184	<1,00
	Metal (iron)	112	<1,00
	Metal (aluminium, etc.)	466	<1,00
	Organic waste (food, grass, etc.)	0	
	Construction waste	142.959	19,60
	Textile	0	
	Other	454	<1,00
	Total:	144.675	100%

Municipal waste is household waste, as well as other waste which, because of its nature or composition, is similar to waste from households. It is estimated that around 60 percent of municipal waste in the Republic of Serbia gets collected. The collection is organized mainly in urban areas, while rural areas are much less covered by the services of the municipal waste collection services. The largest number of local governments has the mechanisation and vehicles for waste collection, however, there is a lack of proper equipment.

Table 3: Data on generated municipal waste in 2012 in the Republic of Serbia (SORS., 2012)

Municipality	Number of residents	Mass of generated waste	Mass of waste per resident daily	Mass of waste per resident yearly
		(t/week)	(kg/resident/day)	(kg/resident/year)
InĆja	49 258	363	1,05	383
Sombor	56 734	269	0,67	246
Novi Kneţ evac	9 648	40	0,59	214
Šabac	123 155	463	0,59	209
Topola	25 292	51	0,29	105
Kragujevac	185 000	897	0,70	252
Bor	55 817	125	0,32	116
Niš	239 596	1 230	0,73	266
Novi Sad	314 192	2 560	1,16	424
Beograd	1 392 691	10 382	1,08	394

The social aspects of the national waste management strategy refer to:

- Use of materials, the generation and disposal of waste and other needs and requirements for waste management;
- Public participation in waste management through a variety of activities;
- Social conditions of workers employed in waste management.

Waste generation in the population is primarily a consequence of their consumption and thus their socio-economic characteristics. At the same time, the generation of waste is largely related to the attitude of people towards waste: their use of materials and waste handling, their interest for the reduction and minimization of waste, the extent to which they separate the waste and the level of unauthorized waste disposal. Their attitude affects not only the characteristics of the waste, but also the effective demand for waste collection services, and their interest and willingness to pay for waste collection. Their relationship can positively influence the development of public awareness campaigns and educational measures for avoiding the negative impacts of inadequate waste collection on human health and the environment and the value of

the effective disposal. Such campaigns should also inform people about their responsibilities as waste producers and their rights in relation to waste management services.

3. SURVEY OF WASTE COLLECTORS IN PUBLIC UTILITY COMPANY ON WASTE COLLECTION IN THE REPUBLIC OF SERBIA

The sample of this research is formed out of permanently employed municipal workers which work on waste collection in Belgrade, Serbia. According to the current data, the company has around 620 full-time employees working on waste collection. The sample used in this research consists of approximately 25 percent of full-time employees. More precisely, 150 waste collecting workers covering the territory of 10 Belgrade municipalities participated in the survey. Municipalities taken into account by the survey are Novi Beograd, Zemun, Zvezdara, Savski Venac, Rakovica, Stari grad, Vraćar, Voţdovac, Ćukarica and Palilula. The age range of the survey participants was 18 – 58. Out of 150 participants, 7,33 percent haven't graduated from elementary school, 63,33 percent have graduated from elementary school, while 27,33 percent have graduated from high school.

More than 78 percent participants states that citizens are extremely negligent when disposing their waste, while only 11.33 percent stated that citizens dispose their waste in a satisfactory manner.

Almost 90 percent of participants state that their job is so crucial for regular City functioning, that they believe that in only five days without proper waste disposal services, serious health and environmental threats would arise.

More than half of the participants involved in the survey state that the biggest problem that leads to the inappropriate waste disposal by citizens is the general lack of environmental and health awareness and the lack of awareness of the effects waste have towards environment and general public.

In the survey, some cases are noted where workers found weapons, hand grenades, dead animals, bricks, car parts and all other sorts of waste which certainly does not have its place in a container - a shot, stones, ashes etc. Improper sorting of waste can lead to various diseases among the workers, and most of them at least once in a lifetime encounter with a health care problem related to their profession.

More than 96 percent of participants believe that inappropriate waste disposal should be penalised in one way or another. On the question of what they think would be sufficient penalisation of inappropriate waste disposal, participants stated in 64 percent of cases that financial fine should be imposed, while 18 percent believe that community service (street cleaning, waste collection) would do better and 5.33 percent states that such behaviour in some cases should be treated as a criminal act as it can be health threatening to the entire public.

In order to evaluate the results of the survey, we used statistical software package SPSS 20. The relationship between two categorical variables was explored by chi-square test. Correlation, between two scale variables was done by parametric Pearson correlation, while correlation between two nominal variables was evaluated with non-parametric Spearman's rho correlation. A p value is used to indicate if the differences between two particular groups that were in this research are statistically significant (where $p<0.05$ is considered statistically significant at 95 percent confidence level). In order to calculate effect size we used Cohen's interpretation of Pearson correlation.

- When participants were asked whether they would participate voluntarily in educating the citizens through educational projects, seminars, public demonstrations by explaining their experience and elaborating on their attitudes in order for overall waste disposal improvement, statistically significant difference was noted in comparison of groups of waste collectors who have suffered certain health problems because of their profession and the ones that have not. The results are given in the following table ($p<0,01$).

We can note that 93.88 percent of the workers that experienced health problems would be willing to participate in educational process of the broader public on the proper waste disposal, while only 66.33 percent of those who haven't experienced health problems due to lack of public awareness would do the same. We see that both groups agree that further education and increasing awareness of the citizens would ease up the job that they do, but those that even had health problems significantly more have such belief. According to Cohen (1988), the influence of these differences is medium to large r=302 ($0.3<r<0.5$ medium to large effect size).

Table 4: Correlation of health experienced and willingness to participate in educating broader public

Experienced health problems and willingness to participate in education of the public					
Willingness to participate in education of the public					Total
			Yes	No	
Experienced health problems	Yes	Count	46	3	49
		Expected Count	37.0	12.0	49.0
	No	Count	65	33	98
		Expected Count	74.0	24.0	98.0
Total		Count	111	36	147
		Expected Count	111.0	36.0	147.0

4. CONCLUSION

Due to the increasing amount and harmfulness of waste to the environment, it is considered to be one of the most important problems of the modern world. The public shows willingness to participate in solving this problem only when threatened by it or when this is in their immediate interest. We must remember that each of us every day produce waste which means that every individual is responsible for the creation and disposal of waste. Today, the idea prevailed entirely, that the waste should not be destroyed, but it should be used. Waste is not garbage, but good natural resource with a small percentage of garbage that has no practical value.

Without greater involvement of the government, the economy and all the inhabitants of the country waste management plans cannot be achieved. The opening of new landfills to suit environment and sanitation is not the ultimate solution. The solution is to reduce huge quantities of waste production, technological advances in processing of waste and the development of civic environmental awareness, changing old habits and adopting new ones. This study has achieved its goal, to prove that we need to act now in order to preserve the environment for the future and future generations that have to be educated from an early age on how to properly manage waste.

REFERENCES

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Lawrence Earlbaum Associates.Đukanović M., (1996). Etika i ţivotna sredina.

Đukić M., (2008). Upravljanje otpadom,

Dţozef R., Ţarden D., (2006). Environmental ethics.

EEA., (2003). EEA (European Environmental Agency) on avoiding and reducing waste.

Europe Commission., (2002). European catalogue of waste.

Marković Luković Lj., (2010). Kategorizacija otpada.

Milosavljević M., (2010).Otpad – Klasifikacija i opasan otpad.

Milutinovic S., (2005). Metodoloski pristup proceni odrţivosti razvoja.

NWMS The Government of the Republic of Serbia, (National Waste Management Strategy) 2010.-2019.

Petrović N., (2007). Ekološki Menadţment. Fakultet organizacionih nauka, Beograd.

Petrović N., (2013). Upravljanje ekološkom podobnošću proizvoda, Zaduţbina Andrejević, Beograd.

Republic of Serbia, "Sl. glasnik RS", br. 36/2009 i 88/2010, Law on Waste Management, http://www.sekopak.com/files/Zakon_o_upravljanju_otpadom.pdf. 17.07.2013.

SEPA - Agency for Environmental Protection, Waste and Waste Management, http://www.sepa.gov.rs 05.04.2014.

SORS (Statistical Office of the Republic of Serbia), (2012). Statistics of waste and waste management in the Republic of Serbia. http://webrzs.stat.gov.rs/WebSite/repository/documents/00/00/61/95/Statistika_otpada.pdf. 17.05.2013.

UNESCO - UNEP (1993). Global change, International environmental education programme (EPD - 95 - WS/4) UNESCO, Paris

United Nations., (1992). United Nations efforts for a better environment in the 21st century, Federal Ministry for the Development, Belgrade.

TOWARDS A FRAMEWORK FOR EVALUATION OF SUSTAINABLE SOCIETY INDEX

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Abstract**:** *The Sustainable Society Index describes social progress along three dimensions: human, environmental and economic. Being a composite indicator, its aim is to be a comprehensive and quantitative measure of sustainability and a quality of life of a nation. The objective of this paper is to offer a new approach to a framework for objective evaluation of the SSI. To this end we have improved the SSI by implementing a statistical I-distance method that synthesizes several indicators into one quantitative indicator. The applied I-distance method offers the possibility to obtain an optimal set of variables for future revisions of the Sustainable Society Index. In addition, the differences in ranks between countries have been discussed. We hope that our results may initiate further studies concerning the framework of the Sustainable Society Index.*

Keywords*: Sustainable Society Index, I-distance, Ranking of countries, Sustainable development, Country's welfare*

1. INTRODUCTION

Since the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, the limitations of Gross Domestic Product (GDP) as a measure of *sustainable development* have been frequently elaborated (Davidson, 2000; Pissourios, 2013; Cameron et al., 2013). Therefore, many different frameworks for evaluating socio-economic development and welfare of countries have been introduced (Cracolici et al., 2010), with majority of them concerned with economic indicators (UNDP, 2008). As a counterpart of economic growth philosophy, the concept of sustainable progress was introduced in 1980's. It was defined by the Brundtland report as *"development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs"* (WCED, 1987; Petrovic et al., 2011). Social and ecological factors as well as economic ones must be taken into account for defining *sustainable development* (IUCN, UNEP and WWF, 1980). Over the past decades there has been considerable interest in analyzing the relationship between economic growth and environmental impact (Wang et al., 2013).

During the World Summit on Sustainable Development in 2002 (UN, 2002) sustainability was formalized on three pillars – social, environmental and economic. Economic sustainability, as economists see it, is focused on various kinds of ~~c~~apital" (man-made, natural, human, social) that should be sustained (World Bank, 2006). *Sustainable development* is fundamentally perceived as the use of renewable natural resources in a manner that does not eliminate or degrade them or otherwise diminish their usefulness for future generations. Furthermore, it requires a sufficiently slow-rate of depletion of non-renewable energy resources to ensure the high probability of an orderly social transition to renewable ones. A specific definition of a social dimension of *sustainable development* is a less clear-cut (Martin, 2001). Understandably, the diversity of economic, social and cultural conditions in individual countries makes development of a uniform definition of social sustainability very difficult. Black defined social sustainability as *"the extent to which social values, social identities, social relationships and social institutions can continue into the future" (Black, 2004)*. It is precisely the social ~~p~~illar" of sustainable development that is probably the most important and critical for long-term survival of human civilizations as shown in Jared Diamond's insightful study of the past (and contemporary) societies (Diamond, 2005). Last of the ~~t~~hree pillars" concept, the environment, has not been closely scrutinized as the previous two pillars. According to Goodland, environmental sustainability *"seeks to improve human welfare by protecting the sources of raw materials used for human needs and ensuring that the sinks for human wastes are not exceeded, in order to prevent harm to humans" (Goodland, 1995)*. He also identifies environmental sustainability as a set of constraints on the four major activities regulating the scales of the human economic subsystem: *"the*

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use of renewable and nonrenewable resources on the source side, and pollution and waste assimilation on the sink side".

Given the above mentioned it can be concluded that the problem of sustainability is multi-dimensional. Besides being formalized on three pillars, sustainability is more than a mere aggregation of the indicators because it encompasses their interlinkages (Singh et al., 2012). Also, the indicator should be able to serve as a benchmarking instrument, to show trends in time and set targets. Accordingly, there is a need for indicators that could cover the linkages between the environmental and the other two dimensions of sustainability (Moldan et al., 2004). To this end composite indicators have been used to measure sustainability.

According to *KEI (2005), "Indicators and composite indicators are increasingly recognized as a useful tool for policy making and public communication in conveying information on countries' performance in fields such as environment, economy, society, or technological development"*. According to *Meadows (1998) "Indicators arise from values (we measure what we care about), and they create values (we care about what we measure)"*. Another definition states that a composite index is a combination of multiple sources of information measured in or off a system in order to provide a summary of the system that itself is not directly measurable (Dobbie & Dail, 2013).

There is a strong political desire for the comprehensive assessment of changes in economic, environmental, and social (including institutional) conditions: an issue that cannot be clearly measured and difficult to improve (Böhringer and Jochem, 2006). The construction of a composite index is a dynamic process, which may be roughly simplified in three steps. In the first theoretical step, experts are often involved to select the most representative underlying variables (Yuan et al., 2003; Esty et al., 2005). The second step (operational step) involves data collection and handling. Once the variables are normalized, the resulting variables could be aggregated into an overall index by an aggregating method. Then, in the final step, the collected data are aggregated leading to a composite index.

Many of the sustainability composite indicators fail to meet fundamental scientific requirements. There are three central issues to be addressed. Firstly, in selecting input variables one should be conscious that the themes determine a thematic aggregation method, and the units determine a technical aggregation method. Secondly, as there are no general rules for normalization of these variables and their weighting these procedures should be treated in a transparent way, with a great reserve, and be subject to comprehensive sensitivity analysis. Thirdly, commensurability of input variables should be assured (Ebert and Welsch, 2004).

Bearing this in mind our paper will try to address several topics. Firstly, we will point out the significance of socio-economic composite indicators and how they are constructed. Secondly, we will review the *Sustainable Society Index* which has been developed since 2006 with the aim to be a comprehensive and quantitate method to measure and monitor the health of coupled human-environmental systems at national level worldwide.

In search of an adequate set of indicators to measure the level of sustainability of a country, the main existing indexes have been examined. However, the conclusion appears to be that none of them seem to fit the needs completely. The main shortcomings are a limited definition of sustainability, a lack of transparency, and absence of regular updates. For this reason, a new index — the *Sustainable Society Index (SSI)* — was developed in 2006. It aims at describing social progress along all the three pillars – human (social), economic and environmental. Since then the SSI has been refined methodologically in order to arrive at an index that is both conceptually and statistically sound (Saisana, Philipapas, 2012). Sustainable Society Foundations was released for the fourth time in 2012, having undergone a revision by the Joint Research Centre. The latest update concerns the used aggregation method which has been changed from arithmetic to geometric mean. The SSI integrates the most important aspects of sustainability and the quality of life of a nation in a simple and transparent way. Consisted of 21 indicators, grouped into 8 categories, three Wellbeing dimensions, it is based upon the definition of the Brundtland Commission, measuring and summarizing the complex concepts underlying a sustainable society.

The paper is organized as follows: Section 2 focuses on the methodology used to perform the analysis. Section 3 features the comparative analysis of the latest SSI rankings based on the revised methodology (Saisana and Philipapas, 2012) and the *I-distance* method applied on the 2012 database. The final section of the paper underlines conclusions of the paper.

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2. METHODOLOGY

Subjectivity in creating composite indicators may affect the measurements to a great extent. In order to overcome this problem the *I-distance* method can be used. It was originally defined by Ivanovic (Ivanovic, 1977) who devised this method to rank countries according to the level of development based on several indicators, where the main issue was how to use all of them in order to calculate a single synthetic indicator which will afterwards represent the rank.

The *I-distance* measurement is based on calculating the mutual distances between the entities being processed, whereupon they are compared to one another so as to create a rank (Seke et al., 2013). It is necessary to fix one entity as a reference in the observed set using the *I-distance* methodology. The ranking of entities in the set is based on the calculated distance from the referent entity (Jovanovic at al., 2012).

For a selected set of variables $X^T = (X_1, X_2, ...X_k)$ chosen to characterize the entities, the I-distance between the two entities $e_r = (x_{1r}, x_{2r}, ...x_{kr})$ and $e_s = (x_{1s}, x_{2s}, ...x_{ks})$ is defined as

$$D(r,s) = \sum_{i=1}^{k} \frac{|d_i(r,s)|}{\sigma_i} \prod_{j=1}^{i-1} (1 - r_{ji.12...j-1}) \qquad (1)$$

where $d_i(r,s)$ is the distance between the values of variable X_i for e_r and e_s e.g. the discriminate effect.

$$d_i(r,s) = x_{ir} - x_{is} \quad i \in \{1,...k\} \qquad (2)$$

σ_i the standard deviation of X_i, and $r_{ji.12...j-1}$ is a partial coefficient of the correlation between X_i and X_j, $(j < i)$ (Radojicic et al., 2012).

To overcome the problem of negative coefficient of partial correlation, which can occur when it is not possible to achieve the same direction of variables, it is a suitable to use the square I-distance (Jeremic et al., 2013). It is given as:

$$D^2(r,s) = \sum_{i=1}^{k} \frac{d_i^2(r,s)}{\sigma_i^2} \prod_{j=1}^{i-1} (1 - r_{ji.12...j-1}^2) \qquad (3)$$

3. RESULTS OF THE ANALYSIS

Within the aim of the paper to provide an appropriate framework for evaluating countries' sustainability, we applied the *I-distance* method on 151 countries and compared it to the official SSI rankings. The input data was obtained from the official 2012 SSI database. Table 1 contains 21 variables that enter the SSI framework, which are divided into eight categories and three wellbeing dimensions. This framework aims at picturing the global landscape of societies in regard to their sustainability level.

Table 1: Human, Environmental and Economic indicators for countries' wellbeing

Wellbeing dimensions	Categories	Indicators
Human Wellbeing	Basic Needs	Sufficient Food
		Sufficient Drink
		Safe Sanitation
	Health	Healthy Life

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		Clean Air
		Clean Water
	Personal & Social Development	Education
		Gender Equality
		Income Distribution
		Good Governance
Environmental Wellbeing	Nature & Environment	Air Quality
		Biodiversity
	Natural Resources	Renewable Water Resources
		Consumption
	Climate & Energy	Renewable Energy
		Greenhouse Gases
Economic Wellbeing	Transition	Organic Farming
		Genuine Savings
	Economy	Gross Domestic Product
		Employment
		Public Debt

The above variables have been chosen in an iterative process during the framework revision carried out by Joint Research Centre and the SSI team in order to achieve a conceptual and statistical coherence and arrive at SSI components that are relatively balanced (Saisana, Philipapas, 2012). We have applied the proposed *I-distance* method on the first ten officially ranked countries in 2012. Table 2 shows the results of the I-distance method, square I-distance value, I-distance ranks and official SSI ranks. According to the I-distance method Norway and Sweden top the list.

Table 2 : The results of the I-distance method, square I-distance value, I-distance ranks and official SSI ranks for year 2012

Country	I^2 - distance	I^2 - rank	SSI - rank
Norway	110.90	1	5
Sweden	107.95	2	2
Switzerland	107.02	3	1
Finland	103.77	4	8
Austria	100.04	5	3
New Zealand	94.50	6	11
Denmark	91.47	7	34
Luxembourg	91.04	8	27
Iceland	90.53	9	92
Netherlands	89.90	10	44

Table 2 shows that Sweden and Switzerland remained in the top three countries regardless the method applied. Countries among the top 10 by the official SSI ranking that are not in the same rank after applying the I-distance method are: Latvia (4), Costa Rica (6), Slovenia (7), Slovak Republic (9), Sri Lanka (10). They are replaced by New Zealand (6), Denmark (7), Luxembourg (8), Iceland (9) and the Netherlands (10). Several countries have significantly improved their ranking, with Iceland and the Netherlands leading the way.

Before we continue with the comparison of rankings and reasons for the differences in them, we should analyze a correlation between the official SSI ranking, the ranking obtained by applying arithmetic mean on the 2012 database, and the I-distance ranking. We carried out the Spearman's correlation test on these rankings to determinate whether there is a correlation and whether it is positive or negative.

As expected, the correlation between the 2012 SSI official and 2012 SSI arithmetic ranks is very strong ($r=0.835$, $p<0.01$). What makes the difference between them is the fact that the arithmetic mean approach does not penalize more uneven performance of countries, whilst the geometric does. Geometric mean is far better in representing the improvements of indicators, while the arithmetic

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mean compensates a good performance in one indicator by a poor performance in another indicator (Saisana and Philippas, 2012). The correlation important for this paper is the correlation between the 2012 SSI official and I-distance ranks, which is strong (r=0.666, p<0.01).

The SSI official methodology takes into account all three Wellbeing dimensions equally, while same do not apply to the *I-distance* method. Implicitly, SSI official methodology provides equal weight to all three wellbeing dimensions which could easily be challenged. The countries to top the list in official ranks have had a similar level of all three Wellbeing dimensions, while other countries performed well in the Economic, but at the expense of the Environmental Wellbeing. This inverted shaped relationship is named Kuznets curve (Kuznets, 1955), which is seen in most developing nations who still have economic growth corresponding to a degradation of environmental wellbeing.

We already pointed out that the *I-distance* approach proposed here, besides providing the ranking list of countries, can also explore in-depth significance of each observed indicator and its contribution to the final rank. By applying our method, we are able to point out crucial indicators of countries' sustainability and determine their significance. Thus, the dataset was further examined and correlation coefficients of each indicator with the I-distance value were determined. The crucial indicators which correlate highly (r>0.6) with the I-distance values are given in Table 3.

Table 3: The correlation between I^2-distance and input indicators

Indicators	r
Good Governance	0.851
Gross Domestic Product	0.760
Healthy Life	0.738
Gender Equality	0.734
Education	0.718
Organic Farming	0.692
Clean Water	0.667
Clean Air	0.615
Sufficient to Drink	0.606

The correlation coefficients between the *I-distance* and initial indicators demonstrate which indicators are important in analyzing a country's socio-economic and environmental development (Milenkovic et al., 2014). (Un)surprisingly the most important indicator for measuring countries' welfare is Good Governance with r=0.851 (p<0.01), followed by GDP r=0.760 (p<0.01) and Healthy Life r=0.738 (p<0.01). Countries that improved their ranks have significantly better scores in these indicators. The fact that more than 50% of top 10 countries are from northern Europe can be explained by the Scandinavian welfare model that has been in practice in these countries since the beginning of their development in 1960's and 1970's. At the core of this welfare model stands the principle of universalism and broad public participation in various areas of economic and social life, which is intended to promote an equality of the highest standards rather than an equality of minimum needs (Magnussen et al., 2009). Since in the Scandinavian model the state has a crucial role as a supplier of social service, it follows that the model leaves relatively high support for low-wage groups (Torben, 2004). Nordic health care systems are intrinsically related to the development of the welfare state, building on the same principles of universalism and equity. Central features have traditionally been an egalitarian ideology, promoting equal access to health services, low levels of cost sharing and high levels of tax-based financing to realize this ideology, public ownership of hospitals and decentralized responsibility for managing the services (Magnussen, Vrangbaek et al., 2009).

Luxembourg entered the top 10 nations in the list according to the I-distance method. These results are in compliance with previous studies which emphasized Luxembourg's welfare and economic openness as the goals other countries should try to achieve (Koster 2013). In particular, its GDP per capita is the highest in the EU and numerous researchers emphasize its importance as a driving force of socioeconomic development while still taking into account renewable energy and sustainable development aspects wherein Luxembourg excels (Djuran et al., 2013).

New Zealand, a country that moved up for 83 places, ranks above the OECD average in terms of health spending, with 10.3% of GDP spent on health in 2011. One of the key reasons New Zealand changed its rank so dramatically is not Healthy Life, but Good Governance indicator. Namely, its score on this indicator is 8.52 compared to the country which holds the same rank in the official SSI ranks with the score 6.22 (Costa Rica). Policy makers are increasingly attuned to social equity and welfare. Welfare reforms, besides education and training of youth at risk, have a goal to improve

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education, health, employment and social outcomes for large groups of Maori and other Pacific indigenous people in order to reduce social disparities (OECD Economic Survey, 2013).

The Netherlands found its place in the top 10 thanks to its high GDP (9.58) and Healthy Life (8.89) score. In 2006, the country's government introduced a structural health care reform. The reform can be seen as the realization of a long-standing political struggle to unite the health insurance fund and the voluntary private health insurance scheme. This reform gave results and health spending as a share of GDP in Netherlands was 11.9% in 2011 (OECD Health Data, 2013). The European Commission predicts a growth rate of 1 per cent in 2014, which is a recovery from rate of -0.8 per cent in 2013 (European Commission, 2013). Although it had a negative growth rate in the previous year, the Netherlands was ranked 17th on the World list based on the GDP in millions of US Dollars (UN, 2012).

4. CONSLUSION

Since the Rio Earth Summit environmental and sustainable development indicators have proliferated. All that with the purpose of providing decision-makers with tools for assessing sustainability from global to local integrated nature–society systems in short- and long-term perspectives in order to assist them to determine which actions should or should not be taken in an attempt to make society sustainable (Kates et al.,2001). While composite indicators are usually used to present sustainability, they still have drawbacks such as subjectivity, due to the assumptions in estimating the measurement error in data, mechanism for including or excluding indicators in the index, transformation and/or trimming of indicators, normalization scheme, choice of imputation algorithm, choice of weights and choice of aggregation system (Pissourios, 2013). Although there are international efforts on measuring sustainability, only few of them have an integral approach which takes into account environmental, economic and social aspects (Singh et al., 2012). Amongst many, the *Sustainable Society Index* stands out as a simple instrument, based on a solid definition, which is used for assessing a country's present sustainability, as well as its distance to full sustainability (Van de Kerk, Manuel, 2007)

This paper covers an assessment of the *Sustainable Society Index* by applying the *I-distance* method to it. This methodology can easily integrate economic, social and environmental variables with different measurement units into one composite indicator (Isljamovic et al., 2014) which represents the rank. As the SSI synthesizes 21 social, economic and environmental indicators in eight categories, then to three wellbeing dimensions and finally to one single number, we suggest that I-distance method be applied not only to all indicators, but also to these categories in order to get a deeper insight of rankings of countries within a category. Not only does this approach enable *ranking of countries*, but it also allows for a better exploration of the differences between them. The results obtained by applying I-distance method to the official SSI 2012 database clearly demonstrate that Scandinavian and certain Western European countries lead the rank list due to their high level of living standard.

The difference in ranks between the SSI official and I-distance rankings can be explained by the fact that the SSI official rewards a balanced score in all three Wellbeing dimensions, in contrast to the I-distance method which rewards the countries with the higher score in the indicators which have greater significance. The reason the SSI official uses this kind of methodology is that *"the sustainability of the whole depends on mutual assistance and reciprocity among the parts"* (Moldan et al., 2011).

Indicators of sustainable development should be selected, revisited and refined based on the appropriate communities of interest (Singh et al., 2012). As the I-distance approach can identify crucial indicators for the ranking process, which means it can be used to reduce the number of indicators used to calculate a certain indicator (Milenkovic et al., 2014). This feature can be used to further reduce the number of indicators of the SSI, which was already done in 2012 when the index was revised by JRC (Saisana and Philippas, 2012).

We hope that our research will contribute to further improvements of the SSI, all with the purpose of creating a complete *"equilibrium between social, economic and environmental goals which is needed to reach a true index of sustainable development"* (Bravo, 2014).

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REFERENCES

Black, A. (2004). The quest for sustainable, healthy communities, presented to Effective Sustainability Education Conference, NSW Council on Environmental Education, UNSW, Sydney, 18–20 February, 2004., 0814-0626

Böhringer, C., & Jochem, P. (2006). Measuring the immeasurable: a survey of sustainability indices. Retrieved from ftp://ftp.zew.de/pub/zew-docs/dp/dp06073.pdf

Bravo, G. (2013).The human sustainable development index : new calculations and a first critical analysis. Ecol.Indic.37, 145-150(2014). Doi :10.1016/j.ecolind.2013.10.020

Cameron, A. J.; Stralen, M. M. van; Kunst, A. E.; Velde, S. J.; Lenthe, F. J. van; Salmon, J. O.; & Brug, J.

(2013). Macroenvironmental factors including GDP per capita and physical activity in Europe. Medicine and Science in Sports & Exercise 2013 Vol. 45 No. 2 pp. 278-285 10.1249/MSS.0b013e31826e69f0

Cracolici, M.F., Cuffaro, M., & Nijkamp, P. (2010). The Measurement of Economic, Social and Environmental Performance of Countries: A Novel Approach. Social Indicators Research 95(2), pp. 339-356. doi:10.1007/s11205-009-9464-3.

Davidson, E.A. (2000). You can't eat GNP: Economics as if ecology mattered. Cambridge, MA: Perseus.

Diamond, J. (2005). Collapse: How Societies Choose to Fail or Survive. Viking Penguin/Allen Lane, New York and London.

Djuran, J., Golusin, M., Ivanovic, O.M., Jovanovic, L., & Andrejevic, A. (2013). Renewable Energy and Socio-Economic Development in the European Union. Problemy Ekorozwoju, 8(1), 105-114.

Dobbie, M.J., & Dail, D. (2012). Robustness and sensitivity of weighting and aggregation in constructing composite indices. Ecol. Indic. 29, 270–277.

Ebert, U. & H. Welsch (2004). Meaningful Environmental Indices: a Social Choice Approach. Journal of Environmental Economics and Management, 47: 270-283.

Esty, D.C., Levy, M.A., Srebotnjak, T., & de Sherbinin, A. (2005). Environmental Sustainability Index: Benchmarking National Environmental Stewardship. Yale Center for Environmental Law and Policy, Connecticut, New Haven. http://www.yale.edu/esi/ESI2005_policysummary.pdf

European Commission (2013). Economic and Financial Affair. doi: 10.2765/3931

Goodland, R. (1995). The concept of environmental sustainability. Annual Review of Ecology and Systematics 26, 1–24.

IUCN, UNEP, WWF (1980). World Conservation Strategy. International Union for the Conservation of Nature, Gland. DOI: 10.2305/IUCN.CH.1980.9.en

Ivanovic, B. (1977). Classification Theory. Belgrade: Institute for Industrial Economic.

Isljamovic, S., Jeremic, V., Petrovic, N., & Radojicic, Z. (2014). Colouring the socio-economic development into green: I-distance framework for countries' welfare evaluation, Quality & Quantity, DOI 10.1007/s11135-014-0012-0

Jeremic, V., Jovanovic-Milenkovic, M., Martic, M., & Radojicic, Z. (2013). Excellence with Leadership: the crown indicator of SCImago Institutions Rankings IBER Report. El Profesional de la Informacion, 22(5), 474-480.

Jovanovic, M., Jeremic, V., Savic, G., Bulajic, M., & Martic, M. (2012). How does the normalization of data affect the ARWU ranking? Scientometrics, 93(2), 319-327.

Kates, R.W., Clark, W.C., Corell, R., Hall, M.J., Jaeger, C.C., Lowe,I., McCarthy, J.J., Schellnhuber, H.J., Bolin, B.,et al. (2001). Sustainability science. Science 292, 641–642.

Knowledge Economy Indicators (KEI, 2005). Work Package 7, State of the Art Report on Simulation and Indicators. http://www.uni-trier.de/fileadmin/fb4/projekte/SurveyStatisticsNet/KEI-WP7-D7.1.pdf

Koster, F. (2013). Economic openness and welfare state attitudes: A multilevel study across 67 countries. International Journal of Social Welfare, In Press, DOI: 10.1111/ijsw.12040.

Kuznets,S. (1955). Economic growth and income inequality. The American Economic review 45(1): 1-28

Martin, J.P. (2001). The Social Dimensions of Sustainable Development. Speech delivered to the Conference on the European Social Agenda and EU˘ıs International Partners. Brussels, 20–21 November 2001.

Magnussen, J., Vrangbeak, K., & Saltman, R., B. (2009). Nordic Health Care System

Meadows, D. (1998). Indicators and Information Systems for Sustainable Development – A Report to the Balaton Group. The Sustainability Institute, Hartland, USA, http://www.sustainabilityinstitute.org/resources.html#SIpapers.

.

Milenkovic, N., Vukmirovic, J., Bulajic, M., & Radojicic, Z. (2014). A multivariate approach in measuring socio-economic development of MENA countries, 38, 604-608.

Moldan, B. et al. (2004, November). Composite indicators of environmental sustainability, Paper presented on OECD World Forum on Key Indicators, Palermo, Italy

Moldan, B. et al. (2012). How to understand and measure environmental sustainability : Indicators and targets. Ecological Indicators,17, 4-13.

OECD[a] (2013). OECD Health Data. DOI: 10.1787/data-00541-en

OECD[b] (2013). Economic surveys and country surveillance - Economic Survey of New Zealand 2013. http://www.oecd.org/economy/surveys/economic-survey-new-zealand.htm

Petrović, N., Išljamović, S., Jeremić, V., Vuk, D., & Senegačnik, M. (2011). Ecological Footprint as indicator of students environmental awareness level at Faculties of Organizational Sciences, University of Belgrade and University of Maribor. Management - časopis za teoriju i praksu menadžmenta, 16(58), 15-21.

Pissourios, I.A. (2013). An interdisciplinary study on indicators: a comparative review of quality-of-life, macroeconomic, environmental, welfare and sustainability indicators. Ecological Indicators, 34, 420-427.

Radojicic, Z., Isljamovic, S., Petrovic, N., & Jeremic, V. (2012). A novel approach to evaluating sustainable development. Problemy Ekorozwoju - Problems of Sustainable Development, 7(1), 81-85.

Saisana, M., Philippas, D. (2012). Sustainable Society Index (SSI): Taking societies' pulse along social, environmental and econimic issues, DOI: 10.2788/6330

Seke, K., Petrovic, N., Jeremic, V., Vukmirovic, J., Kilibarda, B., & Martic, M. (2013). Sustainable development and public health: rating European countries. BMC Public Health, 13:77, DOI: 10.1186/1471-2458-13-77.

Singh, R.K. (2012). An overview of sustainability assessment methodologies. Ecological Indicators, 15(2012), 281-299

Torben, M., A. (2004). Challenges to the Scandinavian welfare model. Department of Economics, University of Aarhus, DK-8000 Aarhus C, Denmark, 20 (2004) 743 – 754

UN (2002). Report of the World Summit on Sustainable Development. Johannesburg, South Africa, 26 August-4 September 2002. United Nations, New York.

UNDP (2008). Human development report. United Nations Development Program.

Van de Kerk, G., & Manuel, A. (2008). A comprehensive index for a sustainable society: The SSI – the Sustainable Society Index. Ecological economics 66 (2008) 228–242

Wang, Y., Kang, L., Wu, X., Xiao, Y. (2013). Estimating the environmental Kuznets curve of ecological footprints at the global level: A spatial econometric approach. Ecol. Ind. 34 (13) 15-21

WCED (1987). Our Common Future. World Commission on Environment and Development. Oxford University Press, Oxford. http://conspect.nl/pdf/Our_Common_Future-Brundtland_Report_1987.pdf

World Bank (2006). Where is the Wealth of Nations? Measuring Capital for the 21st Century. WB, Washington,D.C. http://siteresources.worldbank.org/INTEEI/214578-1110886258964/20748034/All.pdf

Yuan, W., James, P., Hodgson, K., Hutchinson, S.M., & Chi, C. (2003). Development of sustainability indicators by communities in China: a case study of Chongming County Shang Hai. Journal of Environmental Management 68, 253–261.

THE RESEARCH ON THE DEVELOPMENT OF ENVIRONMENTALLY RESPONSIBLE LOGISTICS IN SERBIA

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Abstract: *This paper presents the research on how environmentally responsible logistics will develop in Serbia, in the period of the following 10 years. According to the ways of application of environmentally responsible logistics, a Delphi research was conducted, in order to have a clear picture of occurrence of different, strategically important events. The result of the research shows that the most important aspects of environmentally responsible logistics and supply chain management are supposed to occur by the end of 2018, which will allow the application to progress at a regional level, as well.*

Keywords*: environment, logistics, Serbia, research, development, Delphi*

1. INTRODUCTION

The matter of environmentally responsible logistics is a very complex one, including numerous factors, which affect the creation of such, “green” supply chains. Scientifically, this field has been worked on, especially at the end of the 1990s (Rodrigue, Slack and Comtois, 2001), but the knowledge still remains parted, and the field still remains in the process of development. However, the topic has been connected to the matter of sustainable development, and as such, it has become more up-to-date.

Logistics has been proved to be environmentally the least responsible and the most damaging function of everyday business (Jovanović et al., 2013). Therefore, its development towards sustainability was a logical way of progress (Rodrigue, Slack and Comtois, 2001). The main factors that decide whether a supply chain can be called “green”, or environmentally responsible, are the “green” paradoxes of logistics, intermodal transportation systems with all of their components, the development of information and communication technologies in sustaining an overall interconnection and the development of eco-innovations, laws, regulations and standards on an international level (Jovanović et al., 2013).

Since the topic is still new and underdeveloped, the most certain way of forecasting for its crucial events in Serbia was the Delphi method, where the experts were taken from within the educational system, rather than the economy. All of the experts are the representatives of the University of Belgrade and the Faculty of Organizational Sciences in Belgrade.

2. TECHNICAL DETAILS AND THE EXPERT PANEL

The years taken for the framework of the research were all in range from 2014, as the base year, to 2023, as the final year. The research has been conducted from February to April 2014, which included the preparation of the questionnaire, selection of the expert panel, sending the questionnaire, gathering and analysis of the answers, returning the answers and the questionnaire to the experts for the second round and final analysis of all the answers gathered.

The expert panel consisted of professors and teaching assistants of the Faculty of Organizational Sciences, so that different perspectives of the problem would be met. They were selected accordingly to their scientific development and fields of teaching and scientific work, regarding logistics, technological development, innovations, environmental management and other related topics. The final list of the expert panel, arranged according to their titles and Serbian alphabet, is PhD Lečić-Cvetković Danica, PhD Levi Jakšić Maja, PhD Marinković Sanja, PhD Mijatović Ivana, PhD Stošić Biljana, MSc Jovanović Milica, MSc Milutinović Radul, MSc Petković Jasna, MSc Rakićević Jovana and MSc Rakićević Zoran.

With the opening of the research, the maximum potential number of rounds was three, where the first round would contain 3 answers (o, m and p), and all the others only 1 (x). However, with a high level of consolidance for most of the questions after round 2 and close similarity of respective answers from both rounds, it was decided that the research ends after round 2 (Somerville, 2007).

3. THE QUESTIONNAIRE

The questions sent to the expert panel were followed by additional information. This was sent due to the fact that environmentally responsible logistics is still not very developed in the world, and the scientific contribution is what can best be relied on. There were 10 questions, examining the time of occurrence of 10 different factors, which affect the settlement of an environmentally friendly supply chain (Rodrigue, Slack and Comtois, 2001). The questions, along with their respective additional information, are in the following text.

1. When do you think the topic of environmental responsibility within logistics and supply chain management will become a syllabus part of subjects, related to the matter, in technical faculties in Serbia?

Additional information 1: Even when it comes to worldwide renowned Universities, there is not much data about mandatory subjects, which study this matter in particular (Rodrigue, Slack and Comtois, 2001). However, many papers concerning it, in the past few decades, show us that there is progress in this area. Furthermore, lately there has been interest for this topic, which can be infered from the SPIN'13 conference in Belgrade and other, similar symposia.

2. When do you think a hub-and-spoke network will be developed in Serbia, in the transportation of goods and people?

Additional information 2: A hub-and-spoke network considers merging a number of small terminals to one, much bigger and more complex, especially an airport or a haven. This structure has a negative impact on the environment, focusing a large number of people and quantities of goods to one point, thus increasing the level of pollution (Rodrigue, Slack and Comtois, 2001). Furthermore, according to population listings from 2011. almost ¼ of overall population of Serbia lives in Belgrade.

3. When do you expect the companies in Serbia will start developing their own “green” programs within supply chains?

Additional information 3: DHL Serbia has already started implementing the GoGreen program, but on a worldwide basis, DHL has been actively implementing other CSR programs. The GoGreen program was started five years ago in the world. Within this program, DHL sends CO_2 emission reports to their clients, according to which it forms eco-optimization of fuel spending for their own vehicles. Furthermore, they offer “become carbon-neutral” services. For more information, you can open the following link http://www.dhl.rs/sr/about_us/green_solutions/gogreen_products_services.html.

4. When do you believe the laws, which regulate certain rights and obligations related to “green” logistics operations, will be implemented in Serbia?

Additional information 4: In Serbia, there are already certain environmental laws, such as the Law on environmental protection, but there are still no laws that regulate the development of intermodal transportation, limitations of E-commerce etc. in the Parliament’s agenda.

5. When do you expect that E-commerce will start exponentially growing in Serbia?

Additional information 5: Although E-commerce has started to develop in Serbia during 2011 and 2012, many believe that it will never live in its real form. E-commerce has a negative impact on the environment, since it means increasing the number of shipments and thus using additional fuel (Jovanović et al., 2013).

6. When do you believe the companies in Serbia could start implementing intermodal supply chains?

Additional information 6: Intermodal transportation means using more than one type of transportation for the shipment of the same goods, in such a manner that the overall effect is not only related to the increase of efectiveness, but also environmental responsibility (Rodrigue, Slack and Comtois, 2001). For example, transporting one shipment by truck to the closest railway station, after which it will be transported further by train to the city of its final destination, and then by truck again to the warehouse is much more environmentally responsible than transporting the same shipment by truck entirely (Jovanović et al., 2013). Some of worldwide renowned companies, such as DHL and COSCO already use their own intermodal supply chains (LiSiyi and WeiYi, 2011).

7. When do you suppose the first company in Serbia will be able to manage its own intermodal supply chain?

Additional information 7: Bear in mind that this is how COSCO and DHL function globally (LiSiyi and WeiYi, 2011). By opening the following link http://www.coscologam.com/page/view/intermodal you can see how the intermodal supply chain of COSCO, which is based on a number of different services, works.

8. When do you expect that the first international and other standards for the development of ICT in the transportation sector (especially intermodal) will be acknowledged?

Additional information 8: The Strategy of development of rail, road, water, air and intermodal transportation in the Republic of Serbia for the period from 2008 to 2015 already exists. More information on it can be accessed to by clicking the following link http://www.putevi-srbije.rs/strategijapdf/Strategijatransport_lat.pdf. Global coordination is one of the key points in the development of intermodal transportation, which could lead to harmonizaton and seamlessness in organizing such a transportation model. Even when it comes to a global level, there are still only ideas about solving this problem (Jovanović et al., 2013).

9. When do you believe that there will be competition in the railway sector in Serbia?

Additional information 9: Intermodal transportation cannot be adequately developed as long as the railway sector is downsized to monopoly (Rodrigue, Slack and Comtois, 2001). This way, the consumers of railway transportation are "condemned" to not only one price, but also the applying quality and reliability (Jovanović et al., 2013). In 2013, the government in Serbia was discussing opening the railway market.

10. In which year do you believe the companies in Serbia will start working on eco-innovations, especially within transportation systems?

Additional information 10: The question relates primarily to local Serbian companies, which do not have a central counterpart, from which they could take over the ideas. On the other hand, when it comes to the eco-innovations of big worldwide companies, DHL has developed its own programs of waste decrease, especially in the manner of paper and packaging, water consumption and increase in biodiversity. For more information, you can access the following link http://www.dpdhl.com/en/responsibility/environmental-protection/improving_efficiency/other_environmental_impacts.html.

4. RESEARCH RESULTS – ROUND I

Once again, as mentioned before, the Delphi research was conducted in two rounds. The results will be shown and elaborated on, in order for the whole concept to be understood. After the results of the second round have been shown, the results of both rounds will be analysed in comparison to one another, in order to best present the conclusions of the research. The results of the first round will be presented in Table 1, the results of the second round in Table 2, and the comparative results will be presented in Table 3.

Table 1: Research results in round I

Question/ Indicator	Expected time of occurrence	Year of occurrence	Dispersion	Standard Deviation
1	3.1	2017	1.3085	1.1439
2	3.9667	2017	1.1348	1.0653
3	2.3333	2016	0.9832	0.9916
4	2.2667	2016	0.9638	0.9817
5	2.85	2016	1.0723	1.0355
6	3	2017	1.3081	1.1437
7	2.7833	2016	0.996	0.998
8	3.6333	2017	1.2991	1.1398
9	4.3667	2018	1.1542	1.0743
10	4.15	2018	2.0179	1.4205

As we can infer from the table, all of the events are supposed to occur in a range starting in 2016 and ending in 2018. What can further be inferred is that the level of dispersion is relatively low, meaning the experts have a high level of consolidation in their own opinions, especially since the answers were 3 values – o (optimistic), m (expected) and p (pessimistic). On the other hand, many questions still do not fulfil the condition of consensus, which is dispersion having a value lower than 1 (Hsu and Sandford, 2007).
Analysing the answers one by one, we can say that "green" logistics should become a part of teaching syllabus in technical universities in Serbia in early 2017. However, the value of dispersion is about 1.3, so this question will have to undergo a second round, in order to reach a more accurate answer.

With a similar level of agreement as for the first question, we can say that a hub-and-spoke structure will be created in Serbia at the end of 2017. With hub-and-spoke network being an environmentally damaging structure, the authorities should take care of this problem in the early stages, as soon as possible (Jovanović et al., 2013). However, a second round will have to prove the accuracy of this answer.

When it comes to environmental responsibility in logistics, within the corporate sector in Serbia, it is expected to occur at the beginning of the second quarter of 2016. Furthermore, the level of consensus is reached for this question, so it can be treated as the final answer. However, since the value of dispersion is close to 1, the question will be repeated in round II.

The law is expected to change, in a more environmentally responsible manner for logistics, at the beginning of the second quarter of 2016. Again, the consensus, with the dispersion value close to 1, has been reached, and therefore another round will be conducted for this question as well, in order to verify the result.

The exponential growth of E-commerce is predicted for the end of 2016. The level of dispersion is 1.07, which means the answer could be tolerable. However, it will undergo a second round, as well, since the result needs to be verified when the experts can only use one answer.

When it comes to companies in Serbia using intermodal transportation systems, we can say that this is expected to occur at the beginning of 2017. However, the dispersion level is not as low for this answer as it is for the ones prior to it, and thus round II will verify it.

In contrast, there is a high level of agreement, a consensus on the matter of the first company in Serbia using an intermodal supply chain for its own operations, and this event is predicted for the end of 2016. However, round II will provide a sharper image of this matter.

The time of implementing standards of ICT within the transportation sector in Serbia is expected in the second half of 2017. The dispersion level is 1.29, which means that a more accurate answer is expected in round II.

The level of agreement on the matter of appearance of competition in the railway sector in Serbia is not very high. The value of dispersion is close to 1, but it can still not be taken as consensus. The proximity of the answer from round II will show a more precise picture. For now, it is predicted for the second quarter of 2018.

Finally, companies are predicted to start working on eco-innovations, in terms of transportation systems, with the beginning of 2018. However, this answer has the highest dispersion of all 10 answers, and since the value is higher than 2, the second round will have to show a more accurate result. Again, the proximity of the answer from round II followed by a lower level of dispersion will have the same effect.

Generally speaking, the level of dispersion was not very high for most questions, especially since all the questions were supposed to be answered with 3 answers, thus creating internal dispersion. It is expected that the dispersion level will decrease in round II and that the answers will present a sharper image (Hsu and Sandford, 2007).

5. RESEARCH RESULTS – ROUND II

In the following text, Table 2 presents the answers from round II.

Table 2: Research results in round II

Question/ Indicator	Expected time of occurrence	Year of occurrence	Dispersion	Standard Deviation
1	3.1	2017	0.69	0.8307
2	3.7	2017	0.61	0.781
3	2.5	2016	0.65	0.8062
4	2.3	2016	0.61	0.781
5	2.9	2016	0.49	0.7
6	2.9	2016	0.69	0.8307
7	2.6	2016	1.04	1.0198
8	3.5	2017	0.65	0.8062
9	4.3	2018	1.21	1.1
10	4	2018	1.6	1.2649

As noticeable, the figures from Table 1 were sharpened, meaning they have fewer digits after the comma. This is conditioned by using only one answer, instead of an optimistic, the most expected and a pessimistic one. This has decreased the dispersion level of each answer, and thus the overall dispersion, per question. What we can also notice is the fact that almost all questions have reached a level of consensus, indisputably. Another conclusion is that the answers have almost not been changed.

In order to better present both rounds of the research, a new table, showing answers from both rounds, and the final year of occurrence of each event will be presented and elaborated on. As of now, what can be mentioned is that round III has not been undertaken, since respective answers from rounds I and II are have not been changed significantly, and the levels of dispersion, in almost all cases, have been reduced relevantly. As of questions 9 and 10, for which a consensus has not been reached in either round, and explanation of why round III has not been undertaken will follow.

6. COMPARATIVE RESEARCH RESULTS FROM ROUNDS I AND II

In the first round, consensus has been reached for only 3 out of 10 questions, while in round II consensus was reached for 7 out of 10 questions. Furthermore, the figures in round II are more precise than the ones in round I and the answers have been either slightly changed, or completely unchanged. The comparative results, comparing the expected times and dispersions for each respective question in the two rounds and the final year of occurrence of each event, follow.

Table 3: Comparative research results from rounds I and II

Question/ Indicator	Expected time I	Dispersion I	Expected time II	Dispersion II	Year of occurrence
1	3.1	1.3085	3.1	0.69	2017
2	3.9667	1.1348	3.7	0.61	2017
3	2.3333	0.9832	2.5	0.65	2016
4	2.2667	0.9638	2.3	0.61	2016
5	2.85	1.0723	2.9	0.49	2016
6	3	1.3081	2.9	0.69	2016
7	2.7833	0.996	2.6	1.04	2016
8	3.6333	1.2991	3.5	0.65	2017
9	4.3667	1.1542	4.3	1.21	2018
10	4.15	2.0179	4	1.6	2018

Once again, we can claim that environmental responsibility as an aspect of logistics and supply chain management will become a part of subjects in technical faculties in Serbia at the beginning of 2017. However, despite the fact that the answer is the same in both rounds, consensus has been reached in round II. In case that the answers were different, the one from round II would have been taken as final.

There was a slight change in the hub-and-spoke structure occurrence answer. Namely, round I suggested the structure would occur at the very end of 2017, while round II infers it will occur some time earlier, at the end of the third quarter of 2017. With dispersion of 0.61 from round II being lower that 1.13 from round I, the end of the third quarter of 2017 will be taken as the final answer, rather than the very end of 2017.

Eco-awareness programs in Serbian companies were almost certain to start being worked on at the beginning of the second quarter of 2016. However, with a higher level of precision, the experts have decided that this will rather occur a few months later, at the beginning of the second half of 2016.

The consensus for question 4 from round I has also been corrected, or, better said, sharpened. The laws that define certain rights and obligations when it comes to logistics operations are expected to be implemented in the second quarter of 2016. The answers from both rounds are very approximate, but a higher agreement level has been reached in round II.

The exponential growth of E-commerce was expected for the end of 2016, and the second round has confirmed this expectation, with a lower level of dispersion. With this answer, we can be very certain of the prediction.

The first implementation of an intermodal supply chain in Serbia was predicted for the beginning of 2017 by the answers in round I. Round II, however, suggests that the event will occur at the very end of 2016. However, since the difference between the answers is only slight and the dispersion level in the second

round is lower, and in the consensus zone, we will say that an intermodal transportation system will be operational in Serbia at the very end of 2016.

When it comes to the question of a company having an intermodal transportation system, used for its own operations, something interesting occurred during the research. Namely, the dispersion level shifted from the level of consensus (0.996) in round I to a level outside of consensus (1.04) in round II. However, since the dispersion difference is only slight, and the answers are approximate to one another, we can use them to set a time framework for the occurrence of this event. Furthermore, since there was a consensus in round I, we will take that answer as final and say that the first company in Serbia will have its own intermodal transportation system in the final quarter of 2016.

International standards in the field of ICT are expected to be implemented at the beginning of the second half of 2017. Since the answers from rounds I and II are not in a dissonance from one another (3.63 and 3.5 respectively, and the dispersion in the second round is in the level of consensus, we will take the middle of 2017 as the final answer.

When it comes to the matter of the occurrence of competition in the railway sector in Serbia, there has not been a consensus in either of the rounds. In fact, the dispersion from round II is slightly higher than the one from the first round. On the other hand, both dispersion levels are only tolerably close to the value of consensus, and the answers are almost the same. Therefore, we can say that if the third round was undertaken, the answer would be close to the ones from the first two rounds. Also, the dispersion level would most probably be close to the two values. In conclusion, the third round will not be started for this question, and the answer from round I will be taken as final, since the dispersion was slightly lower in the first round. This means that competition in the railway sector in Serbia is expected to emerge in the second quarter of 2018.

Finally, the question of eco-innovations as a driver of development of “green” logistics is the last one, again, never reaching a consensus. The answer from round I indicates that this event should occur at the beginning of 2018, but with a high level of dispersion (2.02). The answer from round II, again, shows that the event will occur at the beginning of 2018, only with a lower level of dispersion (1.6). Neither of the two answers is within the tolerance, or the consensus zone. However, with the two answers indicating the same period of time and the dispersion level decreasing significantly in the second round, we will assume that if the third round was to be undertaken, the experts would have given the same answer, potentially only with a lower level of dispersion, or even within the level of consensus. Therefore, the third round will not be started at all, and the beginning of 2018 will be announced as the expected time when the companies in Serbia will start working on eco-innovations in order to support the creation of intermodal supply chains and “green” logistics.

7. CONCLUSION

In this research paper, we have inspected the times when certain events, crucial for the development of environmentally responsible logistics, are supposed to occur, by using the Delphi method and sending the questions to the teaching staff of the Faculty of Organizational Sciences in Belgrade, who have shown interest in the topic prior to the research, through their contribution to scientific work.

The factors included in the research, concerning environmentally responsible, or “green” logistics were scientific approach, “green” paradoxes of logistics operations, standardization and the legal system in Serbia, eco-innovations, intermodal transportation with all of its components and factors and eco-innovations. These factors were differentiated into 10 questions, sent together with additional information, to keep the experts on the right track, which has resulted in answers having a high level of consensus even in the first round of the Delphi research.

Finally, the answers show us that all of the examined factors will occur in less than 5 years from now, or, precisely, from 2016 to 2018. In fact, most of the examined factors, even 5 out of 10, are supposed to occur in 2016, according to the predictions. What can be expected in Serbia in 2016 is the implementation of environmental responsibility programs in the corporate sector, implementation of the laws, regulating some of the “green” logistics problems, exponential growth of E-commerce and the establishment of intermodal supply chains, within and among companies.

Furthermore, in 2017, we can expect the problem of “green” logistics to become a part of subjects taught in the technical faculties in Serbia, the occurrence of a hub-and-spoke structure and the implementation of international standards in this field.

Finally, in 2018, the railway sector in Serbia should become more competitive and partially privatized, in order to increase the quality of service. Furthermore, the companies in Serbia are expected to start working on eco-innovations, especially in the transportation and supply chain sector, in 2018, as well.

Since environmentally responsible logistics is still only given in a theoretical framework, rather than a practical innovation matter, there needs to be put more effort in its scientific development, prior to its use in practice. The matter still has a complex character. Therefore many more researches need to be undertaken before logistics operations would become completely "green", minimizing the environmental damage to the lowest possible level. This scientific contribution should be followed and continued, in theory and practice, so that one day logistics will turn from "environmentally the least responsible field of business" to a completely "green" operation.

REFERENCES

Grisham, T. (2008). The Delphi technique: A method for testing complex and multifaceted topics. Grisham Consulting Inc., St. Pete Beach, Florida, USA.

Hsu, C.-C., Sandford, B. (2007). The Delphi Technique: Making Sense of Consensus. Practical Assessment, Research & Evaluation. Vol. 12.

Jovanović, I., Petrović, N., Petković, J., Slović, D., Ćirović, M. (2013, November). Environmentally responsible logistics. Paper presented at IX Symposium of Business and Science SPIN'13.

LiSiyi, WeiYi (2011). The comparison of Chinese environmental logistics and developed countries' logistics – Bachelor thesis in industrial management and Logistics. Faculty of Engineering and Sustainable Development. University of Gavle.

Rodrigue, J.-P., Slack, B., Comtois, C. (2001). Green Logistics (The Paradoxes of). The Handbook of Logistics and Supply Chain Management.

Wang, C. Q., Carroll, R. J. (1995). Prospective Analysis of Case-Control Studies. American Statistical Association. Vol. 90.

Somerville, J. A. (2007). Effective Use of the Delphi Process in Research: Its Characteristics, Strengths and Limitations. Excerpt from Somerville, J. A. (2007), Unpublished doctoral dissertation. Oregon State University, Corvallis, OR.

ECO-INNOVATIONS AS A SOURCE OF COMPETITIVE ADVANTAGE IN ENTERPRISES

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Abstract: *The paper aims at assessing the impact of eco-innovations on the competitiveness of enterprises, and especially at answering the question which advantages resulting from ecological innovations businesses find decisive for their competitiveness. A review of mainstream literature on eco-innovation as well as on competitive advantages will be conducted followed by document-based research. The paper focuses on various and complex dependencies between the competitiveness of businesses and their eco-innovative activities. Resorting to numerous empirical studies, one may observe that an increase in the significance of ecological innovations in the process of building corporate competitiveness becomes noticeable. Enterprises undertake innovative actions in the field of sustainable growth, and especially ones related to environmental aspects, in this way increasing their market credibility and attractiveness. These results have important implications for business strategy decisions. Therefore, this paper contributes to existing literature on corporate sustainable development by achieving competitive advantages resulting from eco-innovative activities of enterprises. The presented benefits of competitive advantage resulting from eco-innovation activities of businesses may be used among others for a further study of the dependencies between the implementation of eco-innovations and increase in the competitiveness of businesses, as well as for the appropriate adjustment of business strategies to the changing conditions of the environment.*

Keywords: *eco-innovation, competitiveness, competitive advantage, sources of competitiveness, indicators, enterprises*

1. INTRODUCTION

Competition is a phenomenon present in many fields of everyday life: social, political, economic, cultural, etc. It is the foundation for the operation and development of market economy. Competition between enterprises is a special area of current interest of many economists, as businesses are generally considered the main source of real economy, and it is on their behaviours that the condition, directions, and pace of development of national economies and the standard of life of populations depends to a major extent. Thanks to the presence of competition, ever higher quality goods are delivered, and companies are forced to innovate and run reasonable pricing policies (Teece, 2010, p. 186). The capacity of an individual business for competition depends not only on how it achieves its basic economic goals (e.g. profits, profitability, and liquidity), but also on whether it considers a variety of political, legal, economic, and social influences as well as the impact of interest groups that represent them. Due to the growing environmental-oriented requirements on behalf of various stakeholders, whose number includes staff and investors, in their operation an increasing number of enterprises account also for questions related to environmental protection. These changes have made business perceive environmental protection as an important competitive factor, while executive boards and shareholders consider it a strategic managerial duty. Beyond doubt, the changes that take place in business macro- and micro-environment, the growing requirements expressed by customers, and increasingly strong restrictions concerning environmental protection enforce new methods of managing production and environment, which contributes to a more effective management of environmental resources (Bata, 2011, pp. 265-267). Positioning of businesses thanks to a more effective environmental protection and/or ecological products and services may bring a range of competitive advantages, including acquisition of new markets, cost reduction, legal safety, image enhancement, and efficient organisation (Shrivastava, 1995; Dangelico & Pontrandolfo, 2013).

A significant role in achieving a competitive advantage in businesses is ever more often played by the eco-innovative activities they undertake (OECD, 2009, p. 11). As any innovations, the ones in the area of ecology should first of all provide an added value for the clients, be more competitive, and contribute to the creation of profit for the innovators. Their main characteristic feature is their environmental aspect. The goal behind eco-innovation is reduction of the negative impacts on the environment, establishment of new markets opportunities, products, services and/or processes focused on environmental matters, and improvement of environmental impact (OECD, 2009, p. 11). Generally, ecological innovations are integrated with new environmentally-friendly products and services that aim at the improvement of the natural environment by saving energy and other resources, and reducing pollutants and waste (Urbaniec & Gerstlberger, 2011).

These grounds allow a claim that eco-innovations, being an answer to both environmental and socio-economic challenges, play a significant role in building the competitiveness of enterprises. The paper aims at assessing the impact of eco-innovations on the competitive advantages of enterprises, and especially at answering the question which advantages resulting from ecological innovations businesses find decisive for their competitiveness. Thus, the study focuses on various and complex dependencies between the competitiveness of businesses and their eco-innovative activities. To achieve this, the paper first presents the significant circumstances of enterprise competitiveness, and the multi-aspect character of ecological innovations.

2. THE ESSENCE AND SIGNIFICANCE OF ENTERPRISE COMPETITIVENESS

In general, the competitiveness is a feature that distinguishes entities operating within the field economy from the point of view of the results obtained, and the capacity for achieving them in future (Atkinson, 2013, p. 5). As views on the subject diverge, literature proposes an array of definitions of the notion, usually in reference to macroeconomics systems. Approaching the notion of competitiveness at enterprise level, the OECD defines competitiveness as ~~-a~~bility of companies, industries, regions, nations, and supranational regions to generate, while being and remaining exposed to international competition, relatively high factor income and factor employment levels on a sustainable basis" (Hatzichronoglou, 1996, p. 20). This definition fully illustrates a view on competitiveness of businesses that depends mainly on the skills and ways of using the internal potential. The greater the competitiveness of an enterprise, the easier it can operate on the market. Moreover, a high degree of competitiveness is perceived in a better light by the potential investors and/or shareholders. That is why improving the competitiveness is of profound significance for businesses and influences their external perception and position in the market.

In the traditional economic approach, a competitive business is one whose economic activity leads to long-term increase of market value. The following are most frequently taken into account while assessing the changes in the competitiveness of businesses: analysis of changes in sales revenue, changes of financial results, changes of the level of investment outlay, changes of market share, etc. (Bressler, 2012). These parameters make it possible to assess the vector of competitiveness changes, while an increase in sales revenue is not always tantamount to an increase in goodwill (as the costs necessary to achieve the increase matter), nor does always a surge in investment outlay lead to a rise of goodwill (as investments may be failed, and companies have been known to overinvest, thus negatively affecting their liquidity).

Although many authors in economic sciences examine various aspects and circumstances of competitiveness, there is no consensus on the question of the definition (Atkinson, 2013, p. 2; Feurer & Chaharbagh, 1994, p. 49). Due to the complexity of the problem in literature, the definition proposed by Feurer and Chaharbagh (1994) seems most adequate. The authors claim that the competitiveness of an enterprise is a multi-dimensional trait, unique for the given enterprise, that results both from its internal properties and the skill of coping with external circumstances (Feurer & Chaharbagh, 1994, p. 58; Pulaj & Kume, 2014, p. 48-49). Moreover, it must be mentioned that the works of M.E. Porter – who claimed that competitiveness must primarily be perceived in the capacity to be innovative, to increase continuously the level of innovation and to the acquisition of an appropriate level of effectiveness in its result (Porter, 2008) – had a significant impact on the studies of competitiveness in economy. According to Porter, the foundation of the competitiveness is productivity – the efficiency in consumption of resources – and in the final appraisal, it is what decides about the competitiveness of businesses.

Thus, a competitive edge can be construed as a higher rank of a business in the sector, achievement of better results, and the skill of doing something better than the competitors. The factors that determine competitiveness of businesses known from literature cover a multitude of various approaches and classifications (Gupta, Guha & Krishnaswami, 2013), that can be synthetically divided into those directly dependent on the enterprises (internal, the potential of the enterprise) and those that are independent of them (external, resulting from the environment), (Birkinshaw, Hood & Young, 2005, pp. 228-233). The following can be counted among the basic sources of the competitiveness (Piercy, Kaleka & Katsikeas, 1998):

- technological sources (R & D, innovativeness)
- production-related sources (e.g. effect of the scale of production)
- distribution-related sources (developed distribution network, advanced logistics)
- marketing sources (efficiently implemented marketing activities)
- place in the market (trademark, patents, reputation),
- the unique quality of the company and its products (high level of differentiation)
- quality of management (managerial talents, closely knit organisation)

- know-how and information (the skill of aggregating and processing)
- time management (speed of reaction to changes in the environment).

The factors presented above depend to a great extent on the businesses themselves. Nevertheless, the competitiveness may also be influenced by circumstances that are independent of businesses, whose number includes, for example, the international economic climate, technological progress, fluctuations in supply and demand structure, and changes of principles of cooperation and competition in the market (Jeanjean, 2011). Moreover, an important role is played by the impact of the national policy on the creation and/or disappearance of the competitive edge by the development of a legal and institutional environment, and macroeconomic, structural and social policy, which is related to the participation of the given country in the sharing of the benefits stemming from international trade.

As far as current challenges, going beyond the economic conditions, are concerned, from business perspective, competitive advantage can be said to be increasingly often assessed on the grounds of a business's capacity for long-term sustainable development, where the scope of analysis goes beyond commercial issues, and covers not only an increase in the market share and profitability, but also environmental and social goals (Miron, Petcu & Sobolevschi. 2011). This means that the matrix of enterprise goals should also include the elements of environmental friendliness, e.g. cuts in the consumption of natural resources and pollution of the environment resulting from the production and managing by-products/waste. Thus, in the context of activities in support of the environment, the innovative activity, being the subject of the following chapter, plays a significant role in achieving a competitiveness.

3. MULTI-ASPECT DIMENSION OF ECO-INNOVATION

Much like in the case of innovation, literature and economic practice know many definitions of eco-innovation, which differ in their scope and degree of detail. Generally, they concern innovation that brings benefit to the environment. Ecological innovations were for the first time a subject of research already in the late 1970s. Strebel defined the so-called „economic innovations in environmental protection" as innovations that are related to the conscious implementation of environmental-oriented activities, and also to the environmentally friendly products and production processes to decrease or prevent environmental pollution, and thus achieved cost reduction (Strebel, 1979, p. 5). A more extensive definition of ecological innovations was formulated in the latter half of the 1990s and covers „all measures of relevant actors (firms, politicians, unions, associations, churches, private households) which; develop new ideas, behavior, products and processes, apply or introduce them and which contribute to a reduction of environmental burdens or to ecologically specified sustainability targets" (Rennings, 2000, p. 322).

According to the OECD, ecological innovations cover all the innovations that have a favourable impact on the environment, independent of whether the effect itself is the main purpose of the innovation or not (OECD, 2008, p. 8). Thus, eco-innovations are defined as „the creation of new or significantly improved, products (goods and services), processes, marketing methods, organisational structures and institutional arrangements which – with or without intent – lead to environmental improvements compared to relevant alternatives" (OECD, 2008, p. 19). Moreover, they are not limited only to innovations in products, processes, and marketing methods, but also include innovations in social and institutional structures. This definition is promoted mostly as part of the Environmental Technology Action Plan (ETAP), in whose view every investment made by a given organisation is bound to a choice (intended or not) between more and less environmentally friendly technologies. Therefore, an eco-innovation does not need to be a global novelty nor be a result of purposeful activity or strategy of an enterprise (Kemp & Pearson, 2007, p. 7). With the definition presented above in mind, one can claim that any innovation that contributes to environmental benefits as compared to significant alternative possibilities is an eco-innovation (e.g. environmental technologies, organisational innovations, product and service innovations, and green systemic innovations), (Kemp & Pearson, 2007, pp. 10–11).

In line with the OECD Innovation Strategy, eco-innovations are a significant element supporting the environmental-oriented, i.e. „green", economy. A key element of the OECD Innovation Strategy, in the Green Growth Strategy, is accounting for the instruments that introduce price-related incentives, encouragement for businesses promoting greater involvement in „green activity", and the financing of basic scientific research (OECD, 2010). At the level of the European Union, eco-innovations are perceived as innovations supporting the comprehensive objectives of the Lisbon Strategy supporting competitiveness and economic growth. Moreover, they play a specific role in the Europa 2020 document of the European Commission, defining the strategy of smart and sustainable economic growth. The document covers three mutually intertwined priorities (European Commission, 2010 a, p. 5):

- smart growth: developing an economy based on knowledge and innovation

- sustainable growth: promoting a more resource-efficient, greener and more competitive economy
- inclusive growth: fostering a high-employment economy delivering social and territorial cohesion.

With respect to the growing role of eco-innovations, especially in the context of Europa 2020 strategy, Eco-innovation Observatory (EIO) was developed at the level of the European Union in 2010 as a framework for analysing eco-innovation across the European Union. The EIO Methodological Report (EIO 2010) defined eco-innovation as ~~t~~the introduction of any new or significantly improved product (good or service), process, organisational change or marketing solution that reduces the use of natural resources (including materials, energy, water, and land) and decreases the release of harmful substances across the life-cycle" (European Commission, 2010 b, p. 7.). The Eco-innovation Scoreboard (Eco-IS), a system of indicators that provided the first tool for assessment of eco-innovation, was developed as part of the project (European Commission, 2011, pp. 21–22). At the preliminary level, the results of EIO works were presented in the Eco-innovation Scoreboard 2010 through 13 indicators, a number that was expanded to 16 in the following years. The Eco-innovation Scoreboard is an index based on indicators in five areas (European Commission, 2013, p. 18): eco-innovation inputs, eco-innovation activities, eco-innovation outputs, environmental outcomes, and socio-economic outcomes (see Figure 1).

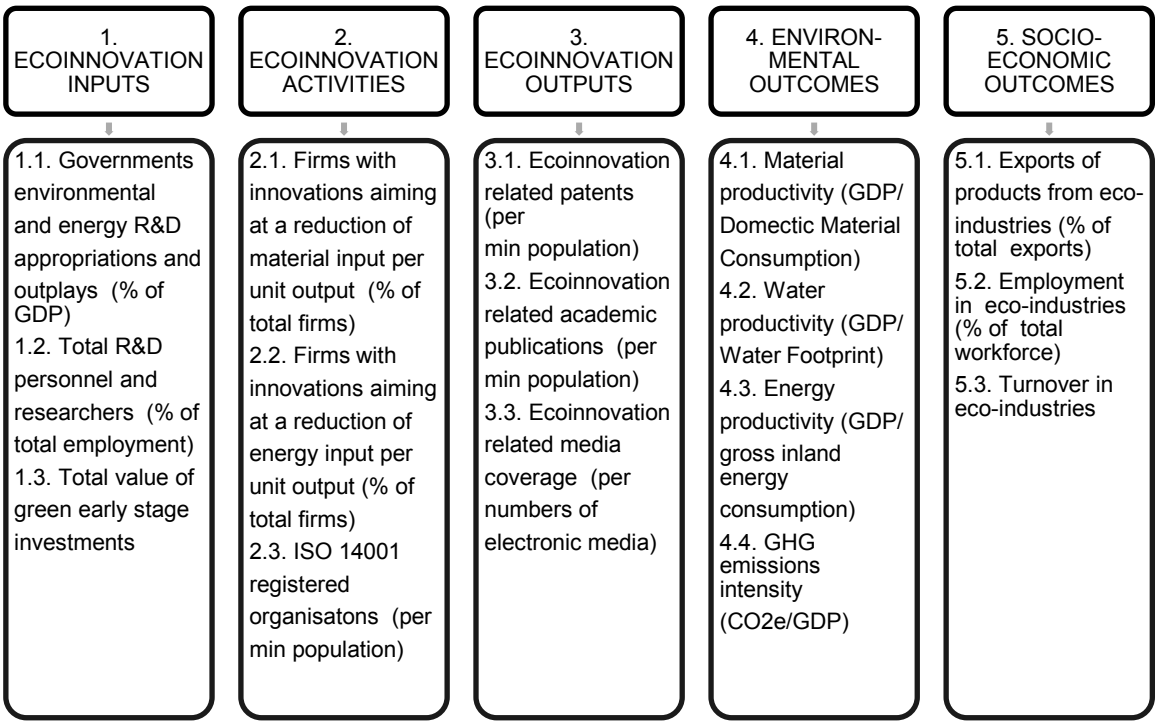

Figure 1: Structure and indicators of the Eco-innovation Scoreboard

It needs emphasising that only the first three groups of indicators concern eco-innovation directly, as the remaining two show the impact of introduced eco-innovations. Therefore, the Eco-IS score is calculated on the grounds of the previously mentioned 16 constituents indicators for all the EU states in reference to EU average, which allows the identification of strengths and weaknesses in ecological innovations in individual EU states.

Moreover, it should be noted that national statistical offices (institutes) and/or appropriate ministries in EU states are involved in statistical research in innovation in line with the international programme of statistical studies in innovation (Commission Regulation (EC) No 1450/2004 of 13th August 2004 implementing Decision No 1608/2003/EC of the European Parliament and of the Council concerning the production and development of Community statistics on innovation), (European Commission, 2004). The studies are conducted according to methodological guidelines used in OECD countries and the EU, presented in a series of OECD manuals known as the Frascati Family Manuals (OECD, 2002).

Recapitulating, one must notice that despite the numerous and varied definitions present in literature, eco-innovation may be defined for the needs of this paper as innovations that lead to the improvement of the quality of natural environment and have been implemented to increase the environmental efficiency of an

enterprise. This is justified by the fact that an ever greater number of businesses implement eco-innovative projects that contribute to the development of their brand among clients and to the improvement of the company's image. These and other advantages are decisive for the competitive superiority of eco-innovative businesses, and are the subject of the following chapter.

4. COMPETITIVE ADVANTAGES RESULTING FROM ECO-INNOVATIVE ACTIVITIES

Should we assume that ecological innovations are related to a complex pattern of determinants, the political, market, and social environment provides a particular system that is the grounds for defining the factors that have a bearing on ecological innovations. What must additionally be mentioned here are enterprise-specific factors. Due to a large number of relevant studies, attention in this chapter is turned to the significant factors that influence the competitiveness of businesses, as specified in – mostly English – literature.

The main constituents of competitiveness that belong to the so-called systemic (i.e. enterprise independent) determinants include environmental rules. In this context, the so-called Porter's hypothesis requires special attention. In its light, restrictive rules concerning environmental protection may increase efficiency and encourage introduction of innovations that help to improve the competitiveness of businesses. To quote: „The new paradigm has brought environmental improvement and competitiveness together. It is important to use resources productively, whether those resources are natural and physical or human and capital. Environmental progress demands that companies innovate to raise resource productivity – and that is precisely what the new challenges of global competition demand" (Porter & van der Linde, 1995, p. 133). This hypothesis suggests that restrictive regulations on environmental protection help to identify and introduce ever more environmentally-friendly technologies, and improve the condition of the environment. The results of innovation make production processes and the products themselves more effective. The savings that can be achieved in this way are sufficient to compensate for the costs both related directly to observing the new rules and to introducing the innovations. Porter and van der Linde emphasise that appropriately designed legal regulations in this area may have a bearing on the direction of innovations among others through (Porter & van der Linde, 1995, p. 128):

- signalling of the current lack of efficiency in resource use and possibility of technological improvements to businesses
- raising the awareness of businesses and undertaking of remedial actions wherever legal regulations are aimed at providing information
- decreasing the uncertainty of net returns on investment
- motivation to implement innovation and achieve progress
- ensuring a level playing field, which is necessary in the context of limited compensations.

Besides the legal regulations concerning environmental protection, literature knows many other factors that also influence the shaping of corporate competitiveness. It is commonly assumed that innovations are a source of competitive advantage at the level of the enterprise. Zollo and Winter pointed out that innovations of varied value may lead to a lasting competitive edge (Zollo & Winter, 2002, pp. 339–351), while homogeneous innovations are developed rapidly and account only for a temporary competitiveness for innovators (Grave, 2009). To create a varied value, one needs to adjust the resources and potential of business, so as to make it difficult to copy or transfer. Similarly, the competitors' slow pace of reaction may provide innovators with a competitive advantage. On the other hand, building a competitiveness requires quick diffusion, which means that innovations should be quickly embraced by the clients. According to Shrivastava, the competitiveness may be developed along the supply chain, i.e. the use of raw materials, processes of production, and final effects of the production. At the input (e.g. raw materials) stage, the competitive edge may result from cost-effective use of materials and energy, which is reflected in cost reduction (Shrivastava, 1995, pp. 183–200; Bata, 2011, p. 267). Cost reduction as well as generation of savings are a significant stimulus for the development of ecological innovation. At the stage of production process of, application of environmentally friendly technologies contributes among others to environmentally-friendly and cleaner production by improving production efficiency and minimisation of waste and other pollutants. In turn, competitive advantage at the final stage of the process of production may result from better design of products and business models.

Moreover, Porter and van der Linde point to the improvement of revenue resulting from the advantage of being the first mover in the market (Porter & van der Linde, 1995, p. 127). The authors explained that environmental aspects may be perceived as potential competitive advantages. Especially companies leading in new markets may expect benefits from the title of being the first movers and improvement of the corporate image, which lets them charge higher prices for ecological products. For that reason, ecological innovations

may be used as a tool for a differentiating strategy, which helps to increase the market share (Peattie, 2001, pp. 187–199; Pulaj & Kume, 2014, p. 51), and therefore to obtain a competitive advantage.
Empirical studies provide grounds for the conclusion that obtaining a competitive advantage through ecological innovation is measured through various indicators. Depending on the context of the studies conducted, various types of indicators can be identified: ones that are enterprise-dependent (internal, e.g. costs) and ones that are not (external, e.g. market share).
The aggregated list of constituents of competitive advantage in businesses was presented by Wagner, who listed four basic types of benefits. They were operationalised with respect to the following (Wagner, 2009, pp. 296–297):

- market factors: regarding sales, new potential in the market, and market share
- image: related to the corporate image, and product and/or service brands that aim at differentiating the enterprise and its products from those offered by competition/competitors
- risk-related factors: related to financing options and terms of insurance
- efficiency-related factors: with impact on profitability, cost efficiency, and other financial indicators.

Therefore, it can be assumed that the four types of benefits stemming from the competitive advantage may lead to better results obtained by the enterprises in a longer term. Falling back on the presented classification of constituents of competitive advantage from the title of carrying out eco-innovative activities, other classifications of factors that influence the competitive advantage of businesses are also possible.

5. CONCLUSIONS

The competitiveness of an enterprise is a basic goal defining the strategy of its development. With the consumers increasingly aware of the need to protect the natural environment, businesses must be capable of meeting the requirements of the market. It is already generally known that businesses capable of offering their clients products that fulfil the aforementioned requirements become more competitive in the given market. The motivation motivating companies to undertake eco-innovative activities is an increasing sense of intensifying international environmental protection regulations, greater levels of ecological awareness among consumers, and expectation of earlier benefits which will let eco-innovators favour setting higher prices for their products (Valentine, 2010, pp. 284–298).

Ecological innovations play an important role not only in the process of minimising the negative impact of the company‘s operation on the environment but also contribute to increasing competitiveness. Resorting to numerous empirical studies, one may observe that an increase in the significance of ecological innovations in the process of building corporate competitiveness becomes noticeable. Enterprises undertake innovative actions in the field of sustainable growth, and especially ones related to environmental aspects, in this way increasing their market credibility and attractiveness. The presented benefits of competitive advantage resulting from eco-innovation activities of businesses may be used among others for a further study of the dependencies between the introduction of ecological innovations and increase in the competitiveness of businesses, and to the appropriate adjustment of business strategies to the changing conditions of the environment.

In summary, one may maintain that ecological innovations can be perceived as an instrument of a differentiating strategy serving the improvement of the competitive position of the enterprise. Enterprises perceive an array of environmental-oriented solutions as a significant stimulus to improve the competitiveness, because only thanks to those they are capable of standing up to the challenges of building the future, and react successfully to the dynamic developments in the market, scientific progress, ecological requirements, and social changes. For that reason, embarking on innovative solutions in such a manner that development of new products and/or methods of productions accounts not only for economic but also ecological and social goals is what remains the main challenge for businesses.

REFERENCES

Atkinson, R.D. (2013). *Competitiveness, Innovation and Productivity: Clearing up the Confusion*. Washington: The Information Technology & Innovation Foundation.

Bata, R. (2011). Modeling of environmental impacts of waste paper transport. *WSEAS Transactions Environment and Development*, Issue 9, Volume 7, 265-274

Birkinshaw, J.; Hood N., & Young S. (2005). Subsidiary entrepreneurship, internal and external competitive forces, and subsidiary performance. *International Business Review*, Vol. 14, 227–248.

Bressler, M.S. (2012). How small businesses master the art of competition through superior competitive advantage. *Journal of Management & Marketing Research*, Vol. 11, 1-12.

Dangelico, R.N., & Pontrandolfo, P. (2013). Being ‗Green and Competitive‘: The Impact of Environmental Actions and Collaborations on Firm Performance. *Business Strategy and the Environment*. doi: 10.1002/bse.1828

European Commission. (2004). *Commission Regulation (EC) No 1450/2004 of 13 August 2004 Implementing Decision No 1608/2003/EC of the European Parliament and of the Council concerning the production and development of Community statistics on innovation*. Official Journal of the European Union, L 267.
European Commission. (2010 a). *Communication from the Commission Europe 2020, A strategy for smart, sustainable and inclusive growth*, COM(2010) 2020 final.
European Commission. (2010 b). *Methodological Report. Eco-Innovation Observatory*. Funded by the European Commission, DG Environment, Brussels.
European Commission. (2011). *The Eco-Innovation Challenge: Pathways to a resource-efficient Europe. Eco-Innovation Observatory*. DG Environment, Brussels.
European Commission. (2013). *Europe in transition: Paving the way to a green economy through eco-innovation*. Annual Report 2012, Eco-Innovation Observatory. Funded by the European Commission, DG Environment, Brussels.
Feurer, R., & Chaharbagh, K. (1994). Defining Competitiveness: A Holistic Approach. *Management Decision*, Vol. 32 No. 2, 49-58.
Grave, H.R. (2009). Bigger and safer: The diffusion of competitive advantage. *Strategic Management Journal*, Vol. 30(1), 1-23.
Gupta, P.D.; Guha, S., & Krishnaswami, S.S. (2013). Firm growth and its determinants. *Journal of Innovation and Entrepreneurship*, Vol. 2(15). doi:10.1186/2192-5372-2-15
Hatzichronoglou, T. (1996). *Globalisation and Competitiveness: Relevant Indicators*. OECD Science, Technology and Industry Working Papers, 1996/5, Paris: OECD Publishing.
Jeanjean, F. (2011). Competition Through Technical Progress. Retrieved from http://dx.doi.org/10.2139/ssrn.1677985
Kemp, R., & Pearson, P. (2007). *Final report MEI project about measuring eco-innovation*. Retrieved from http://www.oecd.org/env/consumption-innovation/43960830.pdf
Miron, D.; Petcu, M., & Sobolevschi, I.M. (2011). Corporate Social Responsibility and the Sustainable Competitive Advantage. *Amfiteatru Economic*, Vol. XIII, No. 29, February, 162-179.
OECD. (2002). *Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development*. Paris.
OECD. (2008). *Environmental innovation and global markets*. Working party on global and structural policies. Paris.
OECD. (2009). *Sustainable Manufacturing and Eco-Innovation, Framework, Practices and Measurement*. Synthesis Report, Paris.
OECD. (2010). *Interim Report of the Green Growth Strategy: Implementing our commitment for a sustainable future.* Meeting of the OECD Council at Ministerial Level, 27-28 May 2010, C/MIN(2010)5, Paris.
Peattie, K. (2001), Golden goose or wild goose? The hunt for the green consumer. *Business Strategy and the Environment*, 10(4), 187-199.
Piercy, N.F.; Kaleka, A., & Katsikeas, C.S. (1998). Sources of Competitive Advantage in High Performing Exporting Companies. *Journal of World Business*, Vol. 33(4), 378-393.
Porter, M.E. (2008). *On Competition*. Updated and Expanded Ed. Boston: Harvard Business School Publishing.
Porter, M.E., & van der Linde, C. (1995). Green and Competitive. Ending the Stalemate. *Harvard Business Review*, September-October.
Pulaj (Brakaj), E., & Kume, V. (2014). Basic Tools and Frameworks for Analyzing and Understanding Competitiveness Within the Industry. *European Journal of Sustainable Development,* Vol. 3, 1, 47-56. doi: 10.14207/ejsd.2014.v3n1p47
Rennings, K. (2000). Redefining innovation — eco-innovation research and the contribution from ecological economics. *Ecological Economics*, Vol. 32, 319–332
Shrivastava, P. (1995). Environmental technologies and competitive advantage. *Strategic Management Journal*, Vol. 16(S1), 183-200.
Strebel, H. (1979). *Innovation und ihre Organisation in der mittelständischen Industrie – Ergebnisse einer empirischen Untersuchung*. Berlin: Marchal und Metzenbacher Wissenschaftsverlag.
Teece, D.J. (2010). Business Models, Business Strategy and Innovation. *Long Range Planning*, 43, 172-194
Urbaniec, M., & Gerstlberger, W. (2011). Innovation in environment-oriented networks: Influence factors from case study and survey research. *Management of Environmental Quality: An International Journal,* 22(6), 686-704
Valentine, S.V. (2010). The green onion: A corporate environmental strategy framework. *Corporate Social Responsibility and Environmental Management,* Vol. 17(5), 284–298.
Wagner, M. (2009). Innovation and competitive advantages from the integration of strategic aspects with social and environmental management in European firms. *Business Strategy and the Environment*, Vol. 18(5), 291–306
Zollo, M., & Winter, S.G. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, Vol. 13(3), 339-351.

CONSTRUCTED WETLANDS AS APPROPRIATE WAY OF WASTE WATER TREATMENT IN RURAL REGIONS

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Abstract: *Article discusses the possibilities of more frequent use of constructed wetlands for waste water treatment in Slovenia and Serbia. Situation about the use of drinking water and production of waste waters both in Slovenia and Serbia is briefly presented. Principles of functioning of constructed wetlands are briefly shown as well as their structure and types. At the end is also given information about cost for a typical individual constructed wetland object.*

Keywords*: Constructed wetlands, Waste water treatment, Environmental protection, Rural areas, Touristic destinations, Drinking water*

1. INTRODUCTION

Constructed wetlands present a very convenient mode for treatment of waste waters in areas with dispersed settlement. Therefore they are particularly applicable in rural regions as well as in areas with high density of touristic objects and are very efficient in treatment of sewage and agricultural waste waters. In the case of individual houses, groups of houses, villages, hotels, touristic camps, farms or similar objects where collection of waste waters and connection to central waste water treatment plant is not possible . In such occasions constructed wetlands are much more convenient and environment friendly solution as are septic tanks.
Constructed wetlands enable efficient secondary and tertiary part of waste water treatment. This is efficient way to prevent pollution of water and to protect underground waters and resources of drinking water.

2. SOURCES OF DRINKING WATER AND GENERAL DATA ABOUT MUNICIPAL WASTE WATERS IN SLOVENIA AND SERBIA

As has been already mentioned constructed wetlands present ideal solution for solving problems of waste water treatment in areas of dispersed settlement where the use centralized systems for treatment of waste waters is not able due to geographic or economic reasons. This is particularly important today as the use of drinking water is in continual increase. In Slovenia the use of drinking water according to the data from 2012 was 84,8 millions m^3/year which presents about 50% of the total quantity of water pumped in Slovenia. The total production of municipal waste waters was 200,9 millions m^3/year which presents 32,6% increase in comparison to the previous year (SORS, 2012). As much as 84,9 millions m^3 of waste waters (42,2%) remained untreated. According to the accessible data from 2005 the total quantity of municipal waste water was more than 360 millions m^3/year and less than 10% (5,6%) of these quantity was adequately treated. In Serbia only about 75% households in cities and 9% households in rural areas is connected to centralized sewage systems (Veljković, 2005).

Constructed wetland plants for waste water treatment seem very convenient for rural areas both in Slovenia and in Serbia, as in these regions waste waters are released in the environment and present potential danger for ground water pollution. Constructed wetlands present adequate solution also for villages which already have not adequate waste water treatment systems. This is important because of protection of drinking water resources as purified water from constructed wetlands can be used in agriculture. In such way can be reduced consumption of water from primary resources. Constructed wetlands can also help to meet legislative requirements which determine obligatory treatment of waste waters from individual houses until 2018. This can be also interesting solution for owners of individual houses as taxes for waste waters treatment in the case of constructed wetland use can be reduced as much as for 85%.

At this moment Slovenia in comparison to Serbia has on disposal enough qualitative sources of drinking water. Nevertheless, the fact the quality of drinking water is decreasing and that quantity of waste waters grows continually can be a matter of serious concern. According to the data for 2012 in Slovenia the average water use is 114 liters/day per person (41 m^3 /year per person) which is still much less than average use per

person in Serbia 350 liters/day (400 liters/day in cities, 200 liters/day in rural regions). The quality of drinking water in Serbia seems at least very questionable - according to the data from 2007 results of drinking water analysis for various samples indicate on certain chemical pollution. In many samples have been obtained also positive results according to the microbiological test (possible bacterial pollution) (Trofej, 2014). The results of the survey of local and public water sources in Serbia are still more alarming as they show very bad quality for all of the 1.092 samples. In Slovenia except some individual houses the great majority of villages use water from public sources what is in Serbia not the case. However, the quality of drinking water must always be the matter of permanent concern.

Constructed wetlands are as mentioned particularly applicable on rural regions as they can solve the problem of waste water treatment as well as reduce the use of drinking water. In Serbia according to the data of Serbian statistical institute only 46% of households is connected to the centralized waste water treatment system. Thus many households have to search their own solution for the treatment of waste waters and this is also in Slovenia considerable problem as unsuitable treatment of waste water jeopardizes ground water.

3. PROJECTION AND DIMENSIONING OF CONSTRUCTED WETLANDS

In the course of projection and dimensioning of constructed wetland population equivalent (PU) is used as a unit. PU presents the degree of average water pollution caused by a person per day. It is expressed as BOD_5 (Biological oxygen demand – mg of oxygen used for oxidation of biologically degradable pollutants present in 1 liter of waste water, included are only those pollutants which are biochemically decomposed in the period of 5 days). 1 PU unit is equal to 60 g BOD_5 per person per day (Roš, 2001).

However, this pollution is not unique for all countries. By example, in Slovenia PU is according to the use of drinking water between 110 and 150 litres per day meanwhile in United States as much as 400 litres/day. In Serbia this quantity is 350 litres/day (Trofej, 2014). The quantity of used drinking water in particular country can be also indicator of environmental awareness of citizens.

The treatment of 1 PU requires the surface of 2-2,5 m^2 which depends also on meteorological conditions. Constructed wetlands operate during the entire year independently of weather conditions. As the majority of water treatment process is driven by micro-organisms and not by plants constructed wetlands are effective also during winter period. However, in winter different species of micro-organisms are present in the system. The purifying efficiency of wetland is in winter 15-20% lower because of vegetation break. This fact must be respected in the process of dimensioning of constructed wetland.

In Figure 1 is schematically shown constructed wetland for waste water treatment from individual house.

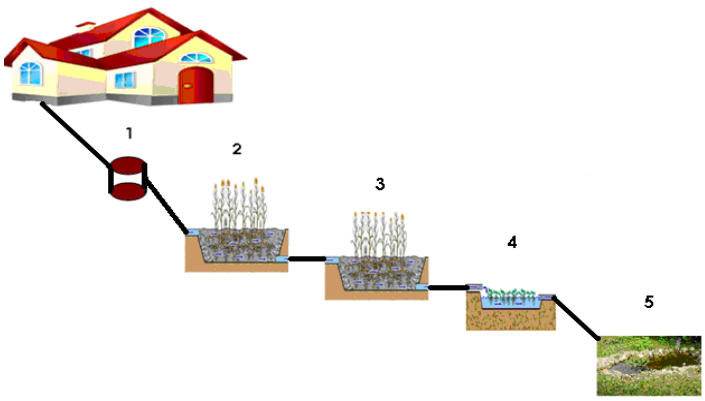

Figure 1: Principle of operation of waste water treatment by constructed wetland for individual house (1 – existing septic tank, 2-filtration bed-secondary pollution, 3-treatment bed, 4-polishing bed, 5-purified water – outflow (pool or environment).

4. MECHANISM OF WASTE WATER TREATMENT IN CONSTRUCTED WETLANDS

Mechanisms of waste water treatment are mutually connected and include:

- Sedimentation of suspended insoluble particles
- Filtration and chemical precipitation
- Chemical transformation
- Adsorption or ion exchange in surface of plants, substrate, sediments and waste plants

- Decomposition and transformation of pollutants and nutrients due to micro-organism or plant activities
- Natural decay of pathogens
- Biological reactions: photosynthesis, respiration, fermentation, nitrification, denitrification and microbiological removal of phosphorus.

Municipal waste waters need at the beginning mechanical purification. Septic tanks, Imhoff tanks, rough horizontal rock filters and anaerobic lagoon are used into this purpose. The basic composition of constructed wetland includes impermeable layer (foil) on which are positioned layers of sand and gravel (substrate). This presents adequate environment for plants. Various species of plants which like moist condition can be used as are common reed (phragmites communis), sedge (carex), water hyacinth (eichhornia crassipes), bulrush (typha latifolia) etc.

Important parameter for functioning of wetland is the time of waste water flow through gravel, substrate and roots of plants as there are located bacteria which take the main role in water treatment process. When the time is adequate the plants can use nitrogen and phosphorus for their growth and development. Therefore, in the case of too intensive growth the number of plants per area unit should be reduced by harvesting.

Lagoons are water treatment plants where processes of purification take place on natural way. They are constituted from various parts. In the first part sedimentation of rough particles takes place. The second lagoon is also called facultative anaerobic lagoon and there oxidation of organic substances by oxygen takes place. Oxygen enters in the water from air by diffusion or is provided by photosynthesis from algae. Bacteria and algae function in symbiosis as bacteria utilize oxygen and transform it into carbon dioxide meanwhile algae vice versa transform carbon dioxide into oxygen. According to the oxygen quantity contained lagoons can be divided into anaerobic and facultative anaerobic lagoons (Limnos, 2010).

Constructed wetlands for waste water treatment imitate self-purification ability of natural systems. They operate without any mechanical and electric equipment. Therefore, their construction, operation and maintenance are rather unsophisticated and cheap. The constructed wetland system consists of sequential pools which are isolated by foil and filled with substrate. Because of avoiding undesired gaseous emissions and dissemination of insects the subsurface flow of water is often used. The purification of water to the degree determined by adequate standards is reached due to natural physical and chemical processes and by function of microorganisms and wetland plants. The majority of purification process – 80% is performed by microorganisms and the additional 20% by plants. Those species of plants which like wet environment are mainly used as are common reed (phragmites communis), sedge (carex) water hyacinth (eichhornia crassipes), bulrush (typha latifolia) etc. Poisonous substances are partly decomposed during purification process or they are absorbed by plants. A certain part of noxious substances remain in the substrate from where they are periodically removed. Sludge resulted from the mechanical treatment of water is composted. Constructed wetland presents an appropriate environment for many animal species. In the case of additional pollution the constructed wetland can be simply upgraded.

4.1 Substrates used in constructed wetlands

Various kinds of sand are usually used as a substrate in constructed wetlands (according to the dimensions of particles, as is shown in Table 1):

Table 1: Composition of substrate used in constructed wetlands

Substrate type	Dimensions of particles (mm)	Porosity (%)	Hydraulic conductivity ($m^3/m^2/d$)
Sand (fine particles)	2	32	1
Sand (large particles)	8	35	5
Gravel (small particles)	16	38	7,5
Gravel (medium particles)	32	40	10
Gravel (large particles)	128	45	100

4.2 Preparation of municipal waste water for treatment in constructed wetland

Municipal waste waters require mechanical treatment before purification in constructed wetland. This can be performed by septic tank, Immhof tank, coarse horizontal gravel filter or anaerobic lagoon. Usually wetland contains foil at the bottom where substrate (gravel or sand) is located. This presents adequate environment for wetland plants.

The important parameter for operation of constructed wetland is the time of flow of water through medium – substrate and roots of plants as there are located bacteria which perform the majority of water purification process. When the flow of water is slow plants can use nitrogen and phosphorus for their growth and development. In the case of intensive plant growth they should be diluted, most often by harvesting.

4.3 Implementation of project in practice

In the course of projection of constructed wetland it is necessary to obtain the adequate information about:

- Number of citizens living in households connected to the wetland
- Quantity of used water
- Classification of users (households, agriculture, livestock, craft activities).

Constructed wetland can be used in different ways

- as individual objects in the case of dispersed settlement,
- in clusters for villages
- or some combination of both ways can be used.

In Figure 2 example of the project for a small village is shown. In the case shown in Figure 2 adequate infrastructure – the main (central) pipe – already exists but it is not yet used in practice. As can be seen from Figure 2 certain households can be directly connected to the main pipe meanwhile in the case of other households due to their distant location or other geographical conditions connection to the central system is not possible or reasonable. In these cases individual systems can be used. It should be emphasized that in the case of increase of inhabitants in the area and consequent increased degree of water pollution waste water treatment systems can be simply upgraded. This upgrading is possible due to modular type of construction. Upgrading can be performed in a very short period of time.

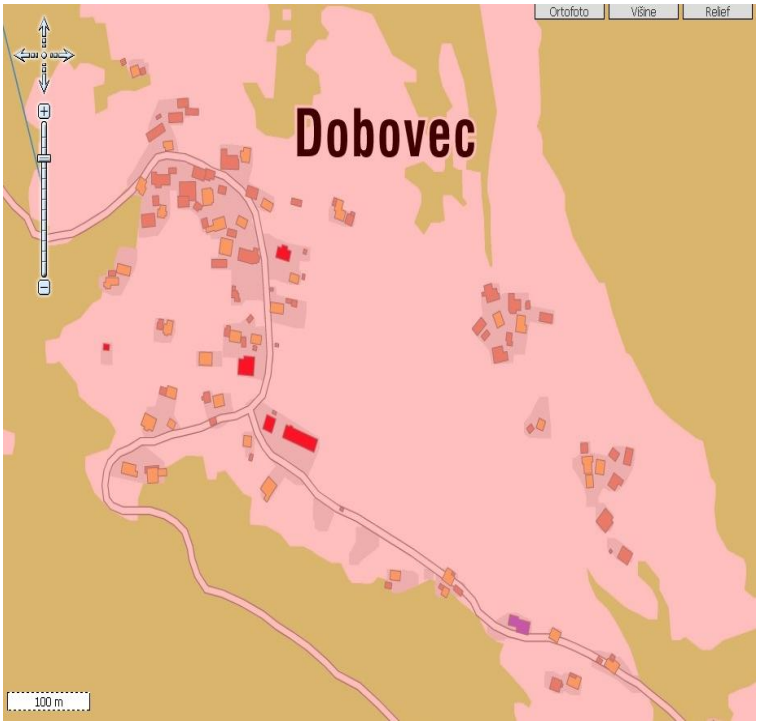

Figure 2: The example of connections to the constructed wetland for waste water treatment (village Dobovec in central Slovenia)

4.4 Types of constructed wetlands

Constructed wetlands can be basically classified in two groups:

- wetlands with surface flow of water (**f**ree **w**ater **s**urface, FWS)
- wetlands with subsurface flow of water (**s**ub**s**urface **f**low, SSF)

In the case of FWS water flows in the level of the ground or a bit lower, meanwhile in the case of SSF underground flow of water is used. SSF enable more efficient purification of organic pollutants and nitrogen

and at the same time prevent the contact of people with the polluted water as well as dissemination of insects. On the other hand, SSF are less convenient from the economic view point as the construction of wetlands with the underground flow of water is more expensive. Besides this, it is also more difficult to control the process of water purification.

FWS are more often used for central systems as they are usually located outside villages where surface flow of water is less annoying meanwhile SSF are more appropriate for individual systems in the case of dislocated households where connection to central systems is not possible.

a) b)

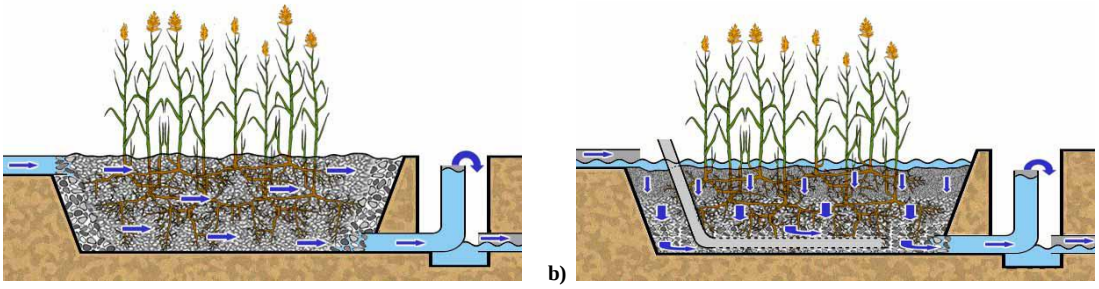

Figure 3: Constructed wetland with surface flow of water – FWS (a) and constructed wetland with underground flow of water – SSF (b) (Limnos, 2010).

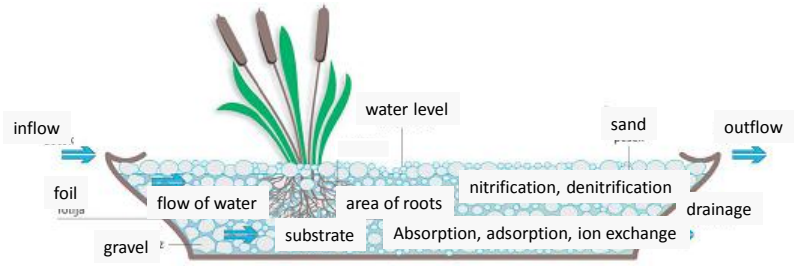

Figure 4: Cross-sectional drawing of constructed wetland (Vrhovšek & Vovk Korže, 2009)

According to the available data (April 2014) in Slovenia 130 constructed wetlands exist and the majority of them operate as individual objects.

4.5 Cost of construction

Cost of constructed wetland operating as an individual object with the capacity of 4 population units (PU): The investment costs for a typical constructed wetland for individual house is between 2.500 and 3.500 Euros (RČN, 2007).The difference in cost can be generated because of possible additional construction works which are sometimes necessary for connection between septic tank and constructed wetland. The average price for PU is 550 Euros. This price includes project outsourcing, material (substrates, plants) and monitoring. Monitoring is usually performed in the beginning of operation and later in three to nine-months periods for surveying of water purification efficiency. The price mentioned above does not include the cost of tank as existing septic tank can be used in the case that it is waterproof. When construction works are not

outsourced the costs of construction can be lowered. However, adequate control of works is necessary – (quality of used materials, fluidity of wetland). The costs of investment are refunded to the investor in a certain period of time due to 90% lowering of taxation for water pollution.

5 CONCLUSION

Constructed wetlands present ideal solution for waste water treatment in areas where central waste water treatment systems do not exist – as are areas with dispersed settlement or dislocated objects. The appropriate treatment of waste water is particularly important for the objects which are located in the vicinity of water protection areas.

Constructed wetlands because of their capacity for purification of water efficiently contribute to environmental protection. They can be easily incorporated in the environment and do not present a disturbing factor neither to the people neither to the animals. The use of constructed wetlands efficient helps to reduce consumption of drinking water, waste waters can be efficiently purified and re-used.

REFERENCES

LIMNOS (2010). LIMNOS – Company for applied ecology (Internal sources).

RČN (2007). Rastlinske čistilne naprave za čiščenje odpadnih voda, Letna konferenca katedre za biotehnologijo (Constructed wetlands for waste water treatment, Annual conference of the Chair for biotechnology – published in Slovene), Biotechnical Faculty, University of Ljubljana.

Roš, M (2001). Biološko čiščenje odpadne vode (Biological purification of waste waters – publishrd in Slovene), Ljubljana.

SORS (2012): Statistical Office of the Republic od Slovenia: Retrieved from: http://www.stat.si/eng/index.asp

TROFEJ (2013). Svetski dan vode – kvalitet vode u Srbiji (The world day of water – Water quality in Serbia.- Retrieved from http://www.trofej.info/index.php/vesti/razno/item/422-svetski-dan-voda-kvalitet-vode-u-srbiji#disqus_thread

Veljković, N (2005). Studija odpadnih voda i tehnički proces strategije održivog razvoja Srbije (Study of waste waters and technical process of strategy of sustainable development of Serbia).

Vrhovšek, D. & Vovk,Korže, A (2009). ; Ekoremediacije (Ecoremediations – published in Slovene), Maribor in Ljubljana.

GREEN INNOVATION AS THE TRIGGER OF ENVIRONMENTAL RESPONSIBILITY

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Abstract: *This paper's purpose is to present how the green innovation process triggers environmental responsibility within the corporate sector in the world. Environmental responsibility is one of the key factors of sustainable development, which tends to preserve the environment and its resources for future generations, rather than exploiting them carelessly. Green innovations and environmental responsibility are accompanied by a phenomenon called corporate social responsibility, which improves the business model of companies, helping them face market needs, accordingly satisfying the conditions of sustainability. This process also affects the creation of green economy, as a global phenomenon. Furthermore, we shall present an example of how companies actually fulfill these tasks and keep the market leadership.*

Keywords*: green, innovation, corporate social responsibility, eco-innovation, green economy*

1. INTRODUCTION

The aim of our research is to show how green innovations affect the environment and how they can be a trigger of corporate social responsibility (CSR) within companies. Green innovations can be characterized as innovations in technology and business, which are environmentally friendly and suitable for sustainable development. They are essential in modern business and they ensure a better competitive position in the market.

There are numerous definitions for the notion "eco-innovation". One of the first, provided by Fussler and James (1996) defines eco-innovations as "new products and processes which provide customer and business value, but significantly decrease environmental impacts" (Schiederig, Tietze, Herstatt, 2011).

In a similar manner Kemp and Pearson define eco-innovation as "the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organization (developing or adopting it) and which results, throughout its life cycle, in reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives" (Schiederig, Tietze, Herstatt, 2011).

The Europe INNOVA panel concludes that "eco-innovation means the creation of novel and competitively priced goods, processes, systems, services, and procedures that can satisfy human needs and bring quality of life to all people with a life-cycle-wide minimal use of natural resources (material including energy carriers, and surface area) per unit output, and a minimal release of toxic substances" (Schiederig, Tietze, Herstatt, 2011).

Eco-innovation in companies leads to reduced costs, improved capacity to capture new growth opportunities and enhances their reputation among customers. (Schiederig, Tietze, Herstatt, 2011). In recent years, eco-industries have emerged as an important segment of the European economy. This sector has an estimated turnover of around €227 billion, corresponding to 2.2% of the European Union's GDP, and employs 3.4 million people directly. Eco-innovation is therefore a powerful instrument, combining reduced negative impact on the environment with a positive impact on the economy and society (EC Europa, 2014). This means that eco-innovations are not only beneficial for the environment, but also help businesses to improve their processes and the economies to move to a new, more sustainable level, thus improving the overall quality of life and preserving natural resources for the future generations, as well.

It is thus understood that to eco-innovate is to go beyond the adoption of environmental technologies. In developed countries this is characterized by the transition from investments in pollution control technologies to addressing cleaner production processes, recycling systems, and products (Kemp, 2008).

2. SUSTAINABLE DEVELOPMENT

Sustainable development is in short: environmental, economic and social well-being for today and tomorrow. It has been defined in many ways, but the most frequently quoted definition is from Our Common Future (*p.43*), also known as the Brundtland Report (WCED, 1987):

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

- the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs."

All definitions of sustainable development require that we see the world as a system - a system that connects space; and a system that connects time (IISD, 2014).

It is about improving the standard of living by protecting human health, conserving the environment, using resources efficiently and advancing long-term economic competitiveness. It requires the integration of environmental, economic and social priorities into policies and programs and requires action at all levels - citizens, industry, and governments (EC, 2014).

3. BENEFITS OF CORPORATE SOCIAL RESPONSIBILITY

The idea of corporate social responsibility would have drawn a round of blank looks just a few years ago. But things are changing. Whether sparked by headline-grabbing protests against globalization and compounded by the attacks on America on September 11, we are waking up and wanting to know more about the major influence on our world. It's no longer just the radicals who are questioning the impact that business has on society (Financial Times, 2002).

CSR helps any business to be more competitive by supporting its efficiency; risk control is improved; stronger relationships with communities and an enhanced license to operate; better relations with investors and better access to funds; improved relations among employees; and improved reputation and branding.

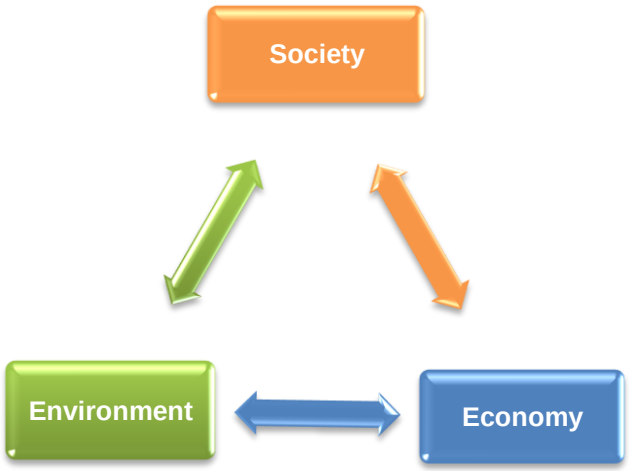

Figure 1: The interconnection of corporate social responsibility factors

Because of the uncertainty surrounding the nature of CSR activity, it is difficult to define CSR and to be certain about any such activity. It is therefore imperative to be able to identify such activity and we take the view that there are three basic principles which together comprise all CSR activity. These are: sustainability, accountability and transparency (Crowther and Aras, 2008).

4. ECO-INNOVATIONS AS A FACTOR OF GREEN ECONOMY

The European Environmental Agency (EEA) defines green economy as the increase in prosperity, with the preservation and sustainability of natural systems that surround us (O'Brien et al., 2012). In order to sustain natural systems, material resource spending needs to be reduced to a point where sustainable supply is met.

When compared with the current economy state, green economy has certain benefits. These benefits are mostly environmental, but also keep the operations at a functional and efficient level. A study, comparing the current and green economy in the European Union, follows (O'Brien et al., 2012).

Table 1: The comparison of current global economy and green economy in the EU

Aspect	Current global economy	Green global economy
Environment	One and a half planet is required to regenerate viable resources and absorb the CO_2 emissions at the global rate of resource exploitation.	Excavations and emissions are set within the planetary borders. For the European Union this requires the decrease in the level of overall exploitation of primary materials, land, water and energy.
Society	870 million people are chronically underweight, according to the data from 2012. 1.29 billion people live in extreme poverty (The World Bank, 2012). People in the industrialized countries spend up to 20 times more materials than the people in the least developed countries.	The available global resources should be distributed more adequately, on the global level. For the EU, this considers a significant decrease of overall resource consumption per capita.
Economy	The economic prosperity is mutually connected to the exploitation of resources.	The economic prosperity is detached from the primary resource consumption. For the EU, this considers the transformation of economy, in such a manner that helps increase the growth of the efficient consumption of resources, recycling, reuse and new business models.

The report of Eco-innovation Observatory (EIO) tells us in what way the eco-innovations will take part in the transition towards the green economy. Achieving efficiency alone will not be enough. The green economy will also have to find an alternative for the lack of moderation, which characterizes industrialized economies. Eco-innovations will most certainly play the key role in motivating and including all economy drivers to move towards the changes. This means that the green economy is only a framework for changes, and eco-innovations are the main instrument of igniting those (O'Brien et al., 2012).

Eco-innovation Observatory further identifies certain possibilities in cost decrease by implementing eco-innovations. A case study analysis in Germany has shown that a company can save around €200,000 per year simply by attaining material efficiency in the production sector. On average, these investments pay off after 13 months. However, when it comes to investing in eco-innovations, there is a gap in the quantity of investments and their results. In order to achieve better results with eco-innovations, some systematical changes need to be pushed, considering opening new markets, in parallel with upgrading the existing business models, so that they would be able to accept the current and the future global challenges (O'Brien et al., 2012).

Furthermore, while EIO is developing the new eco-innovation policy throughout the European Union, many companies see this as a new and growing field, but not many have felt the need for the systematic approach in public support of eco-innovations. The eco-innovations are still not considered to be a part of the strategy of social and economic transformation. As of now, the focus was on the research of the environment and employing technology with a financial support, without any further need to adapt the overall conditions of the economy to eco-innovations (O'Brien et al., 2012).

Many authors claim that the next "innovation wave" will actually be "the green wave", and that the concentration of innovative forces will be on the achievement of sustainability. The following decade will be the potential test for green economy, when it comes to using the synergy of social-economic and environmental goals. On the other hand, it is obvious that many innovations worked on as we speak actually have the completely opposite goal from sustainability, and not all radical innovations will be developing in this direction.

There are innovations and discoveries, such as new types of unconventional fuels, which are only realized for their economic advantages, not the goal of sustainability. With the increase in efficiency of drilling techniques, especially horizontally, the relative gas costs in North America have been reduced significantly in the past few years. In the USA, heating methods have turned from coal to gas consumption. In fact, more and more chemical production systems, fertilizer and plastic companies have started running on gas. According to reports, the benefits for the US economy due to this kind of material consumption were over $100 billion worth, in 2010 solely. This example shows that economic benefits are sometimes chosen rather

than the social or environmental ones, and that there are different strategies, which can affect how companies run their business (O'Brien et al., 2012).

The strategy of the European Union, "EU 2020", promotes structural changes, with the focus on sustainability. In order to achieve these goals, the transition towards sustainable consumption of natural resources has to be in strong coordination with business practice and perceptions in the following five dimensions:

- Dynamics in the relative structure of production input costs
- Anticipated innovation trends
- Organizational criteria and principles
- Cooperation models
- Business models.

Dynamics in the relative structure of production input costs can lead to more efficient resource consumption and thus presents the most attractive choice for profitable innovations and investments, especially in the conditions of instability of material costs and expected price increase. In practice, this considers the decrease in material costs, through the eco-innovation process, reuse and recycling, and changes in material usage. Anticipated innovation trends expect the entrepreneurial advantages to be at a high level. Organizational criteria and principles consider a practice that shows how special management methods and structures are able to use the power of new eco-innovations for maximum efficiency and profit. Organizations that tend to expand the usage of eco-innovations help overcome the problems of coordination, which follow such changes. Cooperation models expect businesses and public organizations to be equally engaged in search for new partners for forming networks and coalitions among sectors and organizational value chains. The business models are supposed to help the organizations redefine their exported value and find new ways for delivering their services to the customers (O'Brien et al., 2012).

What directly affects a country's inability to ignite the development of eco-innovations is either the lack of funds (the economic factor), or the lack of will and strategy to deal with global problems (the social and environmental factors). In fact, some policies, such as unsustainable subventions, can directly affect the environmental impact. Furthermore, on a global level, the differences in solving this problem can be significant. Namely, while the US and Japan can directly work on solving these problems, the EU must coordinate between 27 different countries, thus including their needs and possibilities to worry about economic, social and environmental factors. There are many obstacles that have a direct influence on the strategy of a company. The lack of dedication to eco-innovations from the highest levels of management can be caused by different factors (O'Brien et al., 2012):

- Uncertainties about the future input prices (especially materials, but also other resources, such as carbon, or water)
- The lack of information from other departments concerning the profitability of production-integrated environmental technology, energy and materials, efficiency of changes and other innovation processes
- The lack of managerial capacities and capital, in order to start exploring the obstacles of eco-innovations
- The lack of orientation, concerning the long-term trends and key challenges.

5. ECO-INNOVATIONS FROM THE APPLE COMPANY

In recent years, many international companies have become concerned with the amount of carbon dioxide they produce in their business processes. Therefore, they have calculated the footprint of carbon dioxide generated in their facilities in order to innovate their processes so that the footprint is reduced to a minimum. In contrast, during their process of innovation, Apple has not only departed from the footprint of carbon dioxide in their facilities, or in production, but has considered the entire business process and their products' life cycles (Apple, 2014).

Figure 2: Total carbon footprint created by Apple, in percentage

Apple has, therefore, engaged in a comprehensive life cycle analysis of their own operations, in order to determine where the emissions of greenhouse gases come from. What can be seen as a part of a business process in that matter are manufacturing, transportation, usage and recycling of products, in addition to monitoring the amount of the gases that arise within their business facilities.

If we consider the impact of all Apple operations on the environment, it can be concluded that most of the carbon dioxide footprint by as much as 61% comes from manufacturing, 5% from transportation, 30% from product usage, 2% from recycling and 2% from commercial buildings. Because of this way of observing the big picture of its ecological processes, this company can be categorized as environmentally very responsible.

The Apple Company is trying to reduce its negative environmental impact and to improve the environmental performance of its products. Therefore, in the production of these products, it uses fewer materials, ships the products in smaller packages, and designs them to be energy efficient and recyclable. What Apple saw as the potential benefits and process innovation is that with the faster growth than the market and the industry in general, products should be created as much more environmentally friendly, with the least negative consequences for the environment.

Although the profit of the company has increased in the past decade, emissions per dollar of revenue in 2008 have declined by 21.5%. In addition to this fact, Apple is the only company in the industry, of which the entire product line meets, and also exceeds the strict energy limit, set by the ENERGY STAR specification.

Creating smaller, thinner and more energy-efficient products does not only reduce carbon dioxide footprint, but it also means that products can be transported in smaller packages. The way Apple ensures high quality of these smaller product is by employing teams of experts from the fields of design and engineering, developing packages that are thinner and lighter, which, on the other hand, provide very good protection. Efficient packaging design reduces material consumption and waste, and has an impact on the reduction of emissions that occur during transportation (Apple, 2014).

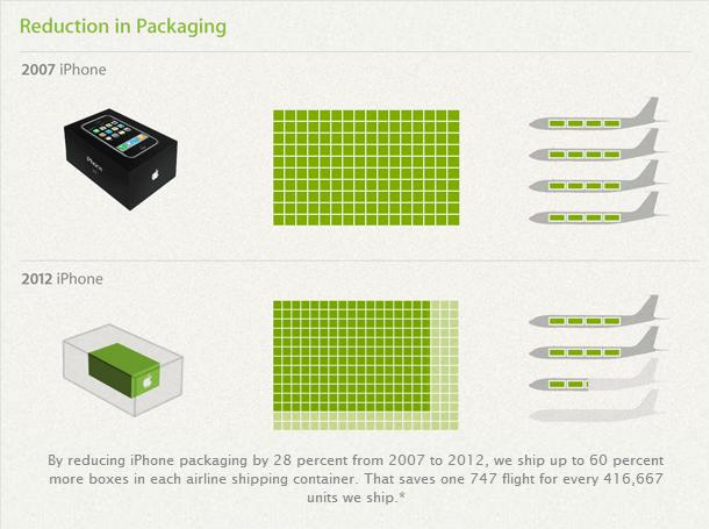

Figure 3: The decrease in iPhone packaging from 2007 to 2012

In the period from 2007 to 2012, iPhone packaging has been reduced by 28%, enabling the delivery of up to 60% more boxes in each container by air transportation systems. This implies the fact that for every 416,667 transported units of this product, a full Boeing 747 is "saved". Furthermore, this causes lower carbon dioxide footprint, which means that in this way, the Apple Company has a double impact on the reduction of emissions, producing additional environmental contribution.

The Apple Company does not only monitor its own CO_2 emissions in order to minimize them, but by using the life cycle approach, it measures the footprint produced by its consumers, while using its products. Looking at this branch of industry, it is not recorded that any other company goes as far in measuring the carbon dioxide footprint. Apple has managed to reduce the emissions produced by its users, by designing hardware and operating system on its own, in such a manner that they work together to save energy and thus reduce the CO_2 emissions (Apple, 2014).

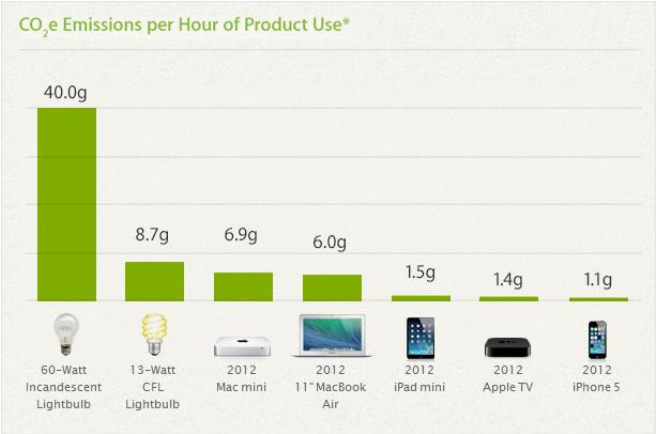

Figure 4: CO_2 emissions of Apple's products, compared to emissions of light bulbs

Since 2008, Apple has managed to reduce the average fuel consumption of its products by 40%, demonstrating the fact that one of its goals is to create the most energy efficient devices. As a result of this procedure, it was found that the carbon dioxide emissions, resulting from the use of Apple's products have declined by 43% since 2008. Furthermore, not only do all of Apple's products generate less CO_2 emissions than a regular 60-Watt or the frugal 13-Watt light bulb during their life cycle, but iPhone 5, from 2012, produces almost 40 times less carbon dioxide than a regular light bulb.

The Apple Company controls its own regulatory programs of collecting e-waste around the world, where all the waste is processed and recycled in the region where it is collected. This means that no waste is transported to other parts of the world for either disposal or recycling, which affects not creating new carbon dioxide emissions.

In addition to this, the company provides its own very strict procedures for recycling its products, which are based on health and safety laws. Furthermore, the company itself does not allow prison labor at any stage of the recycling process of its products. Another method that Apple prohibits is discarding hazardous electronic materials to landfills or incinerators, and currently operates with 153 partners worldwide, whose objects are tested and evaluated on an annual basis, considering the health and safety of workers, material tracking, social responsibility and ecological needs and requirements.

Other ways in which Apple has improved their business processes are recycling programs and responsible disposal, which are bound to the cities and university settlements in 95% of the countries in which the company sells its products, which has shifted more than 151.504 tons of equipment from landfills, since 1994. As of the countries that do not have disposal and recycling centers, Apple organizes the collection, transportation and environmentally responsible disposal and recycling of electronic products that are at the end of their life cycle.

A goal of the Apple Company in 2010 was to achieve the level of recycling of 70% of the worldwide level. To calculate this, they have used the product, the expected life of usage of which is seven years. The total weight that Apple had recycled each year was compared to the total weight of the product that the company had sold seven years earlier. Therefore, in 2010, it was necessary to recycle 70% of the weight sold in the 2003. The goal of 2010 has not only met, but also exceeded. The figure that the Apple Company has reached is far beyond their nearest competitors, Dell and HP, whose figures did not exceed even 20%. Once they have set and continued to maintain this level in the coming years, their expectations were that this trend would continue at least until the end of 2015 (Apple, 2014).

While most companies focus on reducing CO_2 emissions in their facilities, Apple believes that turning the lights off and recycling office waste do not have an impact on the environment that is strong enough. As previously disclosed, Apple has discovered that business objects generate only 2% of the total carbon dioxide emissions, and have therefore turned the focus to environmental responsibility in other activities of the business process and supply chain.

Although it focuses primarily on innovations and improvements in product design, Apple has not neglected the business objects, but has taken the necessary steps to ensure that their emissions around the world have been reduced to a minimum. One way to achieve this is with, so-called, clean energy. The term actually refers to renewable energy, which Apple uses in its facilities and data centers.

The company has constructed new objects and upgraded old ones, in order to be able to fully utilize this kind of energy. This is achieved by building solar panels and fuel cells, along the existing object. Furthermore, in order to achieve the balance among its energy needs, Apple tends to sign many long-term contracts with energy suppliers, at least to the maximum extent that is permitted by the law. In this way, the company has managed to convert 75% of its total energy needs of their office objects and data centers into renewable energy.

When it comes to data centers, all in the ownership of the Apple Company are powered by 100% renewable energy. Using solar panels and renewable energy sources has led to the fact that in 2012, total emissions have been reduced by as much as 93 million kilograms of carbon dioxide.

We found that the Apple Company is not only very innovative, in terms of products and processes, but also socially responsible. Another aspect that shows the social and environmental responsibility of the company is the transportation system of its employees.

In the fiscal 2012, more than 13,000 employees have participated in the "Commute Alternatives" program, which has increased the number of participants by 30% in several years. In this way, the employees were going to work by taking transit options that reduce traffic congestion and carbon dioxide, using only one vehicle for this entire process, instead of one or more transit lines per person.

In this way, 1,600 employees have used free transportation to work by taking buses or shuttles that run on biodiesel fuel and 50,000 arrivals to and departures from work by bicycles, which the company has provided for its employees to use, were recorded. The overall effect of the program in 2012 was the prevention of the occurrence of more than 102,500 kilograms of carbon dioxide emissions, by using the electronic charging stations for these vehicles (Apple, 2014).

6. CONCLUSION

As mentioned previously, eco-innovations present the new “wave” of innovations, which tends to not only increase the efficiency and effectiveness of the business process, but also to fulfill the goal of sustainability, carefully consuming natural resources and keeping the planet viable enough for future generations. As such, the eco-innovations do not only trigger environmental responsibility, but also pose a critical factor for maintaining sustainability, corporate social responsibility (CSR), green economy and other global development tendencies.

Sustainable development, as a matter affected by eco-innovations, concerns technological development in such a way that not only natural resources, but also health and well-being of people are saved. Furthermore, long-term competitiveness is achieved by the development of technology, especially when it is viable and, even better said, sustainable.

Corporate social responsibility is a clouded expression, not being able to precisely describe its activities. Be that as it may, as long as an activity of a company concerns three factors – economic, social and environmental – it is considered a CSR activity. This helps the company achieve some of its main goals, such as efficiency and effectiveness, improved risk management, better relationships with stakeholders and many more. Corporate social responsibility (CSR) is, as sustainable development and green economy, enhanced by the effect of eco-innovations.

Finally, green economy is a global tendency of preserving the planet and sustaining natural materials and creating a “playing field” for global sustainable development. Eco-innovations are its key running factor, since they are what triggers the economy to change in a sustainable manner. The green economy is based on three main factors, as CSR, economic, social and environmental. Generally speaking, having a green economy tomorrow means lower consumption of natural resources and their better distribution today.

Furthermore, we have shown how the Apple Company works on its green innovations and improves its processes, giving a good example to the rest of the corporate sector, thus creating conditions for global sustainable development. Thinking outside the box, as one of its main parameters, has led the company to decrease its own carbon footprint, not only by decreasing it in its facilities, but also by decreasing it throughout the life cycle of its products. Therefore today, Apple is one of the most environmentally responsible companies in the world.

In conclusion, the eco-innovations run the process of creating a sustainable economy and development, thus increasing the level of environmental responsibility, within a company and globally, as well.

REFERENCES

Apple. (2014). Apple carbon footprint. Retrieved from http://www.apple.com/environment/our-footprint/

Bernauer, T., Engels, S., Kammerer, D., Seijas, J. (2006). Explaining Green Innovation. ETH Zurich

Crowther, D., Aras, G. (2008). Corporate social responsibility. Retrieved from http://bookboon.com/

EC – European Commission. (2014). Sustainable Development. Retrieved from http://www.ec.gc.ca/dd-sd/

EC Europa. (2014). EC Europa Environment Action Plan Objectives. Retrieved from http://ec.europa.eu/environment/ecoap/about-action-plan/objectives-methodology

Financial Times, 18 February 2002

IISD – International Institute for Sustainable Development. (2014). Definitions of Sustainable Development. Retrieved from http://www.iisd.org/sd/

Kemp, R. (2008). United Nations University. Retrieved from http://ourworld.unu.edu/en/measuring-eco-innovation

O'Brien, M., Bleischwitz, R., Steger, S., Fischer, S. (2012). Paving the way to a green economy through eco-innovation. Brussels.

Schiederig, T., Tietze, F., Herstatt, C. (2011). What is Green Innovation? – A quantitative literature review. Paper presented at The XXII ISPIM Conference 2011.

The World Bank. (2012). Annual Report 2012. Retrieved from http://issuu.com/world.bank.publications/docs/annual_report_2012_en?e=1107022/2001324

WCED - World Commission on Environment and Development (1987). Our common future. Oxford: Oxford University Press.

DEVELPOMENT IN RENEWABLE ENERGY PRODUCTION IN SERBIA WITH THE EMPHASIS ON BIOETHANOL

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Abstract: *Production and use of renewable energy sources has become an imperative for development around the world, including Serbia. The aim of this paper is to study the possibilities of production and use of renewable energy sources, especially bioethanol, as well as their place in the strategic objectives in the energy sector in Serbia. For this purpose, we will firstly frame the policies related to the production of renewable energy, and afterwards display the results of the cost-effectiveness of bioethanol production from the most important domestic biomass-based feedstock - corn. Our assumption is that, despite the existence of sufficient quantities of raw materials required for the production, knowledge, and the potential consumers of bioethanol in Serbia, its wider use will not be possible without the application of a systematic approach, especially without the development of adequate infrastructure in the production and use of energy resources.*

Keywords*: renewable energy, bioethanol, sustainable development, Serbia*

1. INTRODUCTION

Energy crisis and environmental pollution are two vital challenges the world is currently facing. Energy is a component of major significance for all sectors of modern economy and plays an essential role in improving the quality of life. The way energy is produced, supplied and consumed strongly affects the local and global environment and is, therefore, a key issue in sustainable development (Mojović et al., 2013). At the current rate of consumption, crude oil reserves, natural gas and liquid fuels are expected to last for between 60 and 120 years (British Petroleum Statistical Review, 2011).

Approximately 80% of world energy supplies rely on rapidly exhausting non-renewable fuel sources (e.g. coal, oil, natural gas) which are used to produce fuels, electricity, chemicals and other goods. Emission of greenhouse gases (GHGs) represents an additional challenge with fossil fuel consumption. Growing global energy needs and release of environmental pollutants from fossil fuels have finally directed the attention towards clean liquid fuel as a suitable alternative source of energy. Even though bioenergy from renewable resources currently already represents an alternative to fossil fuels, in order to meet the increasing need for renewable energy, new and abundant raw materials need to be considered. The alternative renewable energy sources, not only cut the dependence on oil trade and reduce the doubts caused by the fluctuations in oil prices, but also secure reductions in environmental pollution due to their high oxygen content (Huang et al., 2008; Boer et al., 2000).

In this context, the availability of renewable energy in its two main forms, wood and agro energy can offer cleaner energy services to meet basic energy requirements. Biofuels can be obtained from agricultural crops, crop residues and processing wastes from agroindustries, forests, etc. (Mekala et al., 2014). Interest in various agricultural crops such as cereals (maize, wheat, triticale, barley, rye, sugar cane, sweet sorghum, millet etc.) and some tubers (sugar beet, potato, Jerusalem artichoke, cassava, sweet potato etc.), as renewable and biodegradable feedstock for biofuel production are growing (Semenčenko V. et al., 2013). All petroleum-based fuels can be replaced by renewable fuels produced from biomass such as: bioethanol, biodisesel, biohydrogen etc. (Mojović et al., 2013).

Existing biofuel policies have been very costly; they produce slight reductions in fossil fuel use and increase, rather than decrease, in GHG emissions (Wuebbles and Jain, 2001). However, recent fluctuations and rise in international fossil fuel prices make biomass increasingly competitive as energy feedstock. Current renewable energy research around the globe should direct us toward reduced production costs, higher energy conversion efficiency and greater cost-effectiveness of biofuels (Mekala et al., 2014).

By implementation of the Kyoto Protocol, Serbia sends to international community and the EU a clear signal of readiness to implement the concept of sustainable development and monitor of global socio-economic trends, which will improve the investment climate and increase the confidence of potential foreign investors (Mojović et al., 2013).

2. DIFFERENT FORMS OF RENEWABLE ENERGY

There are many forms of renewable energy**.** Most of these renewable energies depend in one way or another on sunlight. Wind and hydroelectric power are the direct result of differential heating of the Earth's surface which leads to air moving about (wind) and precipitation forming as the air is lifted. Solar energy is the direct conversion of sunlight using panels or collectors.
Biomass energy is stored sunlight contained in plants. Organic matter holding bioenergy sources in side is known as biomass. We can utilize this biomass in many different ways, through something as simple as burning wood for heat, or as complex as growing genetically modified microbes to produce cellulosic ethanol (Adler et al., 2009). Since nearly entire bioenergy can be traced back to energy from sunlight, bioenergy has the key advantage of being a renewable energy source.
Other renewable energies that do not depend on sunlight are geothermal energy, which is a result of radioactive decay in the crust combined with the original heat of accreting the Earth, and tidal energy, which is a conversion of gravitational energy.

3. RENEWABLE ENERGY PRODUCTION IN EU

Heat and electricity production from biomass increased over the past 10–15 years by 2% and 9% per year, respectively, in the European Union between 1990 and 2000, and biofuel production increased about eight-fold in the same period. Today, the EU is the third producer of fuel-bioethanol in the world after the United States and Brazil; however its production is much lower than the first two (by a factor of about 10). Bioethanol production in EU was 4.97 billion liters in 2012, which is an 11% increase over 2011 (Mojović et al., 2013, Renewable Energy Magazine, 2013). However, although the amount of biofuels produced in the EU is growing; the quantities in general remain insufficient and low in comparison to the total volume of mineral-based transport fuel sold.
One of the significant regulations which impact the EU biofuels market is the European Directive 2009/28/EC on the promotion of renewable energy which aims at achieving a 20% share of energy from renewable sources by year 2020 in the EU's final consumption of energy and a 10% share of energy from renewable sources in each member state's transport energy consumption. In order to achieve that effect, EU members follow the Directive implementation with various political, fiscal and technical measures and incentives. Each EU Member State should adopt a National Renewable Energy Action Plan, setting out its national targets for the share of energy from renewable sources consumed in transport, electricity, heating and cooling in 2020 (European Biofuels Platform Technology, Gitiaux et al., 2012). More renewable energy will enable the EU to cut greenhouse emissions and make it less dependent on imported energy. Boosting the renewable energy industry will encourage technological innovation and employment in Europe.
On 27th of March 2013, the European Commission published its first Renewable Energy Progress Report under the framework of the 2009 Renewable Energy Directive. Since the adoption of this directive and the introduction of legally binding renewable energy targets, most Member States experienced significant growth in renewable energy consumption. Figures for the year 2010 indicate that the EU, as a whole, is on its trajectory towards the 2020 targets with a renewable energy share of 12.7%. Moreover, in 2010 the majority of Member States already reached their 2011/2012 interim targets set in the Directive. However, as the trajectory grows steeper towards the end, more efforts will still be needed from the Member States in order to reach the 2020 targets.
With regard to the EU biofuels and bioliquids sustainability criteria, Member States' implementation of the biofuels scheme is considered too slow.
In accordance with the reporting requirements set out in the 2009 Directive on Renewable Energy, every two years the European Commission publishes a Renewable Energy Progress Report. The report assesses Member States' progress in the promotion and use of renewable energy along the trajectory towards the 2020 renewable energy targets. The report also describes the overall renewable energy policy developments in each Member State and their compliance with the measures outlined in the Directive and the National Renewable Energy Action Plans. Moreover, in accordance with the Directive, it reports on the sustainability of biofuels and bioliquids consumed in the EU and the impacts of this consumption (European Comission, 2013).

4. BIOETHANOL

Bioethanol accounts for the majority of biofuel use worldwide (Margeot et al., 2009, Semenčenko et al., 2011). It is a liquid biofuel which can be produced from several different biomass feedstocks and conversion technologies. Nearly all bioethanol is produced by fermentation of corn glucose in the United States, or sugar cane sucrose in Brazil, but any country with a significant agronomy-based economy can use current technology for bioethanol fermentation (Balat and Balat, 2008). This biofuel is produced by fermentation of simple sugars present in biomass or the sugars obtained by prior chemical or enzymatic treatment of the

biomass. The bioethanol fermentation is performed by microorganisms, traditionally by yeasts (*Saccharomyces strains*) (Mojović et al., 2013).
Bioethanol has the potential to be a sustainable fuel, as well as a fuel oxygenate that can replace gasoline, in transport sector which is considered one of the largest energy consumers as well as environmental pollutant (Kim and Dale, 2004). According to the International Energy Agency statistics (2008), the transport sector accounts for about 60% of the world's total oil consumption. It is responsible for about one fifth of CO_2 emission on a global scale (Joint Research Centre, EU Commission, 2007).
The production of bioethanol has been increasing over the years, and has reached the level of 85 billion litres in 2013. According to the Global Renewable Fuels Alliance (GRFA), this level of the bioethanol production was predicted to reduce GHG emissions by 100 million tonnes in 2013 (Renewable Fuels Association - RFA, 2013). An increase in bioethanol production up to more than 125 billion litres until 2020 has been predicted assuming the production support by governmental policies and exemptions (Demirbas, 2013). The fact that the existing fossil fuel infrastructure, eventually with minor modification, can be used for bioethanol distribution and utilization puts this biofuel in front of other energy alternatives (IEA, 2008).
The economic and temporal constraints that crop feedstocks pose are the main downfalls in terms of the commercial viability of bioethanol production (Harun et al., 2014).Even though bioethanol production for decades mainly depended on energy crops containing starch and sugar (corn, sugar cane etc.), new technologies for converting lignocellulosic biomass into bioethanol are under development today.5 As an alternative to crop feedstocks, significant research efforts have been put into utilizing algal biomass as a feedstock for bioethanol production.
With the exception of sugar cane, corn provides the highest bioethanol yields compared to any other traditional feedstocks being used (US Grains Council, 2012). Alternative fuel - bioethanol is mostly produced from starchy parts of the maize grain leaving significant amounts of valuable by-products such as distillers' dried grains with solubles (DDGS), which can be used as a substitute for traditional feedstuff. Maize grain consists of approximately 70% of starch, which makes it a very suitable feedstock for the bioethanol production (Radosavljević et al. 2008). Renewability of maize and growing environmental pollution by oil products represent two principal reasons for maize becoming one of the major raw materials for the energy production (Radosavljević et al. 2009).
The rapid increase in biofuels production from traditional feedstocks during the last few decades has brought dramatic changes to food and agricultural systems especially in countries that are the biggest bioethanol producers (e.g. United States and Brazil).
Studies have found that, in general, with increased ethanol expansion, the prices of both the agricultural feedstock commodities and their competing crops increase with implications for land allocations, food prices, and the environment.(Elobeid and Hart, 2007, Elobeid et al., 2007).
Recent increases in biofuel production, particularly the dry grind corn-to-ethanol process, creates a sizable stockpile of its co-product in the form of dried distillers' grain with solubles (DDGS), which is made by blending distillers' wet grains (DWG) and syrup and drying the mix (Liu et al., 2012). A gallon (3.78 L) of bioethanol produced from corn kernels generates about 7.4 pounds (3.36 kg) DDGS (Pimentel 2003). During the production of bioethanol, starch is removed from the grain and converted to alcohol and carbon dioxide. As a result of starch removal, the concentration of the remaining nutrients in the grain increases approximately three-fold. The DDGS contains higher percentages of protein, fibre and lipid contents than those in corn (Liu et al., 2012).
Application of DDGS in livestock and poultry diets in concentrations greater than traditional could positively affect the economic viability of this biofuel production, but also stabilize the current imbalance in the food and animal feed market. However, DDGS feedstuff should not be treated as a perfect substitute for corn, because the complexity of ration formulation determined at the farm or feedlot level is driven by energy and protein and other nutrient requirements, as well as their relative costs in the ration (Semenčenko et al., 2013 a).

5. RENEWABLE ENERGY PRODUCTION IN SERBIA

Serbia and other Balkan countries interested in joining the EU, has accepted the obligation to follow EU policies and programs, including those that oblige them to introduce the production and use of fuels from renewable energy sources. Among renewable energy sources in Serbia, the most important are biofuels, especially bioethanol. Apart from natural resources, research and development within the National Innovation System of the Republic of Serbia are of great importance (Semenčenko D. et al., 2009). Starting from the first National Innovation Systems, energy has played an important role in stimulating the economic development. National innovation systems of today must, as well, demonstrate a significant level of innovation in research and application of new renewable energy sources (Semenčenko D., 2009). Better coordination between institutions and academic and private sector is a very important step in order to realize cost-effective bioethanol production in Serbia (Mojović et al., 2013). By implementation of the Kyoto Protocol, Serbia sends to the international community and the EU a clear signal of readiness to implement the concept

of sustainable development and monitor of global socio-economic trends, which will improve the investment climate and increase the confidence of potential foreign investors.
With the ratification of the Agreement established by the Energy Community (Coordinating European Council - CEC, 2006), Serbia has, among other things, accepted the obligation to implement the Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources and Directive 2003/30/EC on the promotion of the use biofuels and other fuels from renewable energy sources in the transport sector, to ensure the emergence of a certain quantity of biofuels on the market - 5.75 % of the total fuel used in traffic by the end of 2010. This directive is in accordance with the Kyoto protocol signed in 1997, with the aim to reduce emissions of gases that contribute to the greenhouse effect, which Serbia is a signatory. However, in 2009 European Commission has adopted a new Directive 2009/28/EC, which was established to promote the use of energy from renewable sources. This directive changes and consequently abolishes Directives 2001/77/EC and 2003/30/EC, by establishing a common framework for the promotion of energy from renewable sources. It sets obligatory national targets for the overall share of energy from renewable sources in gross final energy consumption, and for the share of renewable sources in transport: at least 20 % share of energy from renewable sources in gross final energy consumption in the Community and a 10% share of energy from renewable sources in energy consumption for transportation of each member country by the year 2020. In addition, sustainability criteria for biofuels and bioliquids have been established. Serbia has adopted the Directive and it is embedded in the Biomass Action Plan which was adopted in 2010.

6. BIOETHANOL PRODUCTION IN SERBIA

Today in Serbia, the bioethanol production is being conducted in seven plants, with total production capacity of 23,225 t per year. Raw materials predominantly used in these plants are molasses and cereals. In these plants, 96% vol. bioethanol is produced, and it is subsequently being used mainly for alcoholic beverages and medical and pharmaceutical purposes (Mojović et al., 2013). Bioethanol production in Serbia from fermented substrates amounted 8.69 million liters in 2011, which is only 30% of annual production capacity in Serbia. This indicates that the capacity utilization of bioethanol plants is rather small. The highest bioethanol production of 19.17 million liters was achieved in 2007 (Statistical Office of the Republic of Serbia, Biomass Action Plan for the Republic of Serbia 2010-2012). It is important to point out that despite current low level of industrial production of bioethanol, Serbia has main prerequisites to develop and improve this production since it possess a large feedstock potential, tradition and also educated human potential.
In Serbia, conventional energy crops such as starch-based raw materials are the most suitable and available agricultural raw material which can be used for industrial bioethanol production. However, a growing demand for the corn and wheat on global market are currently increasing their price and make these feedstocks less appropriate. For these reasons, possibilities of using cheaper substrates such as damaged crops and for example, triticale are being investigated (Pejin et al., 2009, 2012).
By applying the methodology used by the International Energy Agency – IEA, estimation of the amount of bioethanol that could be produced in Serbia in the future (from 2015 to 2030) was performed (Mojović et al OECD/IEA, 2010). The agency in its regional and global estimates of energy potentials used data recommended by FAO that assume global annual crop growth of about 1.3% and about the same global growth of agricultural biomass (waste). For Serbia, this analysis assumed slightly lower amount of crop growth of 0.9%. The estimation of first generation bioethanol production in Serbia based on available feedstocks taking advantage of surpluses of crops and use of marginal land showed there is a great potential for bioethanol production in Serbia of $1,188,030 \cdot 10^3$ lifters, i.e. 937,356 tons in 2015. Similar analysis has been performed to estimate the country potential for the production of second generation of bioethanol. The analysis was performed for two possible scenarios, the first for the possible utilization of 10% of the lignocellulosic biomass for the production of bioethanol and the second for the utilization of 25% of the biomass for the production of bioethanol. Results calculated for year 2015 were $258,385 \cdot 10^3$ lge (liter of gasoline equivalent), i.e. $645,962 \cdot 10^3$ lge, for these two scenarios, respectively.
Recently conducted studies revealed that Serbia will need to build new bioethanol plants in order to produce enough bioethanol for use as a fuel and thus follow the aims of the European Directive 2009/28/EC. Based on the given replacement of 20% of gasoline by bioethanol by year 2020 according to European directive 2009/28/EC, it has been reported (Dodić et al., 2009) that it will be needed to produce 233,000 t of bioethanol until 2026. If it is assumed that the needs of the ethanol industry and pharmacy stay the same (52,000 t), total demand for bioethanol would be 285,000 tons, which is 12 times the installed capacity in Serbia.
There is a great interest in the world today in the development, selection and cultivation of maize hybrids that can produce higher bioethanol yields. In that manner, maize hybrids with higher content of fermentable sugars are being developed. In the USA, two great companies "Pioneer" and "Monsanto" make efforts to identify and develop new corn hybrids, examine the impact of the environment on their growth, and the impact of corn varieties on the composition of useful by-products. Both companies have commercial corn varieties specifically cultivated for use in bioethanol production with obtained ethanol yield up to 4% higher than with conventional varieties (for the annual production of bioethanol of 150 million liters it means annual

profit increase of 1-2 million US dollars). Further research in the world should result in modification of properties of starch and other complex carbohydrates by methods of genetic engineering (Mojović et al., 2013).
Furthermore, significant efforts have been made at the Maize Research Institute, Zemun Polje, Serbia, in order to determine the suitability of local maize hybrids for bioethanol production. The calculation of average potential costs of bioethanol production from corn grain in Serbia performed on some of these hybrids is shown in Table 1.

Table 1: Average potential costs of bioethanol production from corn grain in Serbia calculated for 2012 prices, for most widely used local maize hybrids (Source: Semenčenko V, 2013)

Cost component	Average price, € l^{-1}
Feedstock costs	0.132
By-product credits	
DDGS	0.042
Carbon dioxide	0.001
Net feedstock costs	0.089
Cash operating expenses	
Electricity	0.011
Fuels	0.041
Waste management	0.001
Water	0.0007
Enzymes	0.008
Yeast	0.001
Chemicals	0.007
Denaturant	0.01
Maintenance	0.012
Labor	0.011
Administrative costs	0.008
Others	0.0009
Total	0.1116
Total cash & net feedstock costs	0.2006
Ethanol yield per hectare, l	3888.67
Ethanol production costs per hectare, €	778.69
Net income per liter, €	0.3094
Net income per hectare, €	1204.53

From the data presented in Table 1 it can be concluded that the average net income per liter of bioethanol produced from maize grain 0.3094 €, and the net income per hectare of 1204.53 €. The table shows the fact that the price of bioethanol fermentation by-product – dried distillers' grains with solubles (DDGS) amounts 0.042 € l^{-1} ethanol, which means that based on the total revenue from the sale of one liter of this fuel represents about 14%.

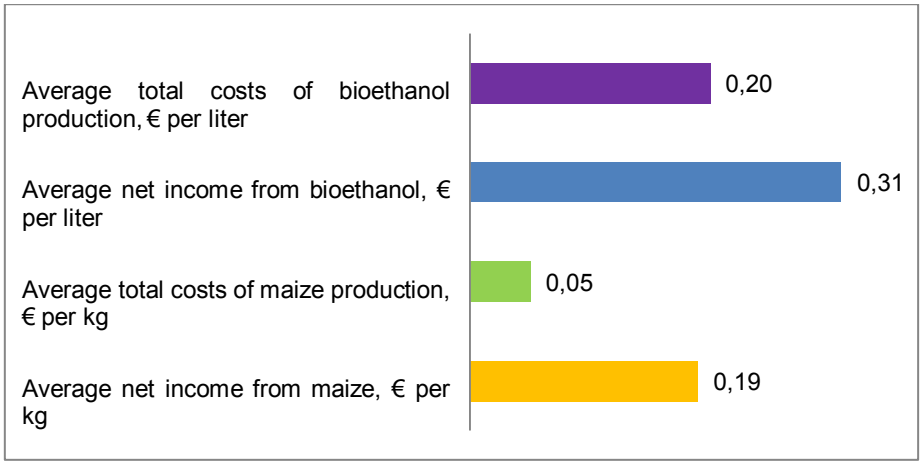

Figure 1: Average net income and costs of maize and bioethanol production in Serbia, calculated for prices from 2012 for most widely used local maize hybrids (Source: Semenčenko V, 2013)

From Figure 1 it can be concluded that by selling one liter of bioethanol higher profit can be achieved than by selling one kilo of maize grain. However, profitability per hectare of commercial maize grain sold is higher. This can be explained by the fact that for the production of one liter of ethanol was requires, on the average, 2.5 kg of maize grain.
In real terms it cannot be expected that all maize grain, intended primarily for human and animal nutrition will be used for the production of biofuels. The obtained results indicate that the production of a certain quantity of bioethanol from corn grain could be cost-effective, and it is necessary to design the production process in a way to find appropriate measures between the food industry and the alternative fuels production. Taking into account the fact that Serbia is a signatory of the Kyoto Protocol (1997), which refers to the reduction of greenhouse gas emissions and that the Biomass Action Plan (2010) established sustainability criteria for biofuels and bioliquids, the start of production of at least and the minimum amount of bioethanol would be a significant step towards achieving these goals (Semenčenko V, 2013).

7. CONCLUSION

Bioethanol production in Serbia is now at a very low level, even lower than the production scale at the very end of the twentieth century, and it is not sufficient enough to fulfil the country's ethanol needs for beverages, medical and pharmaceutical purposes. This is the main reason why in Serbia, there is still not an organized production and utilization of bioethanol or other biofuels for gasoline and diesel substitution. Recently conducted studies revealed that Serbia will need to build new bioethanol plants in order to produce enough bioethanol for use as a fuel and thus follow the aims of the European Directive 2009/28/EC. The obtained results, furthermore, indicate that the production of a certain quantity of bioethanol from corn grain could be cost-effective, and it is necessary to design the production process in a way to find appropriate measures between the food industry and the alternative fuels production. The revenues from corn bioethanol co-product – DDGS sold for animal feed could reach 14% of total income. In Serbia, it is necessary to introduce new strategies for the bioethanol production - large capacity plants that apart from bioethanol also include the production of animal feed and carbon dioxide; or introduce a network of small plants for the production of bioethanol within the petroleum industry.

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REFERENCES

Adler P.R., Sanderson M.A., Weimer P.J., Vogel K.P. (2009). Plant species composition and biofuel yields of conservation grasslands. Ecol. Appl. 19, 2202-2209.

Balat M., Balat H., Oz C. (2008). Progress in bioethanol processing. Prog Energ Combust Sci 34, 551–573.

Biomass Action Plan for the Republic of Serbia 2010-2012, Available at: http://www.ssllink.com/mre/cms/mestoZaUploadFajlove/BAPenglish.pdf

Boer G.J., Flato G., Reader M.C., Ramsden D. (2000). A transient climate change simulation with greenhouse gas and aerosol forcing: experimental design and comparison with the instrumental record for the 20th century. Clim. Dyn. 16, 405-425.

British Petroleum Statistical Review (2011). BP statistical review of world energy. Available at: http://www.bp.com/en/global/corporate/about-bp/statistical-review-of-world-energy-2013/statistical-review-1951-2011.html

Coordinating European Council - CEC (2006). Communication from the Comission: An EU Strategy for Biofules, Brussels.

Demirbas A. (2007). Producing and using bioethanol as an automotive fuel. Energy Sources Part B. 2, 391-401.

Dodić S., Popov S., Dodić J., Ranković J., Zavargo Z. (2009). Potential contribution of bioethanol fuel to the transpot sector of Vojvodina. Renewable and Sustainable Energy Reviews. 13, 2197-2200.

Elobeid A., Hart C. (2007). Ethanol expansion in the food versus fuel debate: How will developing countries fare? Journal of Agricultural & Food Industrial Organization, Vol 5, Article 6, special issue Available at: http://www.colby.edu/economics/faculty/thtieten/ec476/Ethanol LDCs.pdf.

Elobeid A., Tokgoz S., Hayes D.J., Babcock B.A., Hart C.E. (2007). The longrun impact of corn-based ethanol on the grain, oilseed, and livestock sectors with implications for biotech crops. Agric Bio Forum 10, 11–18

European Biofuels Platform Technology, Biofuels Policy and Legislation, Available at: http://www.biofuelstp.eu/legislation.html#RenEnDir.
European Commission (2013). Renewable energy, Progress reports, Available at: http://ec.europa.eu/energy/renewables/reports/reports_en.htm
Gitiaux X., Rausch S., Paltsev S., Reilly JM. (2012). Biofuels, climate policy, and the European vehicle fleet. Journal of Transport Economics and Policy. 46, 1–23.
Harun R, Yip J.W.S., Thiruvenkadam S, Ghani W.A.W.A.K., Cherrington T., Danquah M.K. (2014). Algal biomass conversion to bioethanol – a step-by-step assessment. Biotechnology Journal. 9, 73-86.
Huang, H.J., Ramaswamy, S., Tschirner, U.W., Ramarao, B.V. (2008). A review of separation technologies in current and future biorefineries. Sep. Purif. Technol. 62, 1-21.
International Energy Agency (IEA), Paris, OECD/IEA: 2008.
Joint Research Centre, EU Commission, 2007.
Kim S., Dale B. (2004). Global potential bioethanol production from wasted crops and crop residues, Biomass and Bioenergy, 26, 361 – 375.
Liu S.X., Singh M., Inglett G (2011). Effect of incorporation of distillers' dried grain with solubles (DDGS) on quality of cornbread. FoodSci Technol 44, 713–718.
Margeot A., Hahn-Hagerdal B., Edlund M., Slade R., Mono F. (2009). New improvements for lignocellulosic ethanol. Curr Opin Biotechnol 20, 372–380.
Mekala N.K., Potumarthi R., Baadhe R.R., Gupta V.K. (2014). Bioenergy Research: Advances and Applications, Chapter 1: Current bioenergy researches: strengths and future challenges, pp. 1-21, Elsevier B.V. http://dx.doi.org/10.1016/B978-0-444-59561-4.00001-2
Mojović L., Nikolić S., Pejin D., Pejin J, Djukić-Vuković A, Kocić-Tanackov S., Semenčenko V. (2013). The potential for sustainable bioethanol production in Serbia: available biomass and new production approaches, Materials and processes for energy: communicating current research and technological developments (A. Méndez-Vilas, Ed.), Formatex, 380-392. Available at: http://www.formatex.info/energymaterialsbook/book/380-392.pdf.
OECD/IEA (2010). Sustainable Production of Second-Generation Biofuels, Available at: http://www.progressivefuelslimited.com/PDF/second_generation_biofuels.pdf.
Pejin D., Mojović L., Pejin J., Grujić O., Markov S., Nikolić S., Marković M. (2012). Increase in bioethanol production yield from triticale by simultaneous saccharification and fermentation with application of ultrasound. Journal of Chemical Technology and Biotechnology. 87, 170–176.
Pejin D., Mojović L., Vučurović V., Pejin J., Denčić S., Rakin M. (2009). Fermentation of wheat and triticale hydrolysates: a comparative study. Fuel. 88, 1625-1628.
Pimentel D. (2003). Ethanol fuels: Energy balance, economics and environmental impacts are negative. Nat Resour Res 12, 127–134.
Radosavljević M., Milašinović, M. (2008). ZP maize hybrids as a raw material in the starch production. Journal on Processing and Energy in Agriculture (former PTEP), 12(4), 191-195.
Radosavljevi M., Mojović L., Rakin, M., Milašinović, M. (2009). ZP maize hybrids as a raw material for the bioethanol production. Journal on Processing and Energy in Agriculture (former PTEP), 13(1), 45-49.
Renewable Energy Magazine, Available at: http://www.renewableenergymagazine.com/article/global-ethanol-output-to-top-85-billion
Renewable Fuels Association – RFA (2013). Global Ethanol Production of 85 Billion Litres to Reduce GHGs by 100 Million Tonnes in 2013: GRFA, September 26, 2013 http:// http://www.ethanolrfa.org/news/entry/global-ethanol-production-of-85-billion-litres-to-reduce-ghgs-by-100-millio/
Semenčenko D., Radosavljević M., Semenčenko V. (2009) The role and place of biofuel research and application in renewable energy sources development strategies Sym-op-is, XXXVI Simpozijum o operacionim istraživanjima, Ivanjica, September 2009, Proceedings pp. 239-242.
Semenčenko D. (2009). Faktori u oblikovanju nacionalnog inovacionog Sistema. Institut "Mihajlo Pupin", Centar za istraživanje razvoja nauke i tehnologije, Beograd, 2009.
Semenčenko V., Mojović L., Petrović S., Ocić O. (2011). Recent trends in bioethanol production. Chem Ind 65, 103–114.
Semenčenko V., Mojović L., Radosavljević M., Terzić D., Milašinović-Šeremešić M., Janković M. (2013 a). Possibilities of utilization of co-products from corn grain ethanol and starch production, Chem Ind, 67(3), 385-397.
Semenčenko V. (2013, June). Investigation of various maize hybrids for bioethanol, starch and animal feed production, Doctoral dissertation, University of Belgrade, Faculty of Technology and Metallurgy.
Statistical Office of the Republic of Serbia, Available at: http://webrzs.stat.gov.rs/WebSite/
US Grains Council, *DDGS User Handbook*. (2012). Available at: http://www.grains.org/index.php/buying-selling/ddgs-userhandbook
Wuebbles, D.J., Jain, A.K. (2001). Concerns about climate change and the role of fossil fuel use. Fuel Process. Technol. 71, 99-119.

SMART METER AND CONSUMERS

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Abstract: This work is focused on a specific segment of devices that facilitate a smart use of energy and relations with consumers. Throughout this document a Cost-Benefit analysis will be showcased. The aim of this work is to combine and explain key information about the technology being implemented; Cost-Benefit analysis for consumers, benefit from the smart meter implementation in households and four utility prototypes that influence the overall business case for smart meters.

Keywords: smart meter, advanced metering infrastructure, energy efficiency, consumer, energy management

1. INTRODUCTION

Energy and its sustainable use has become the top priority for both developing and developed countries. With the upcoming growth of both population and energy consumption, being able to be more efficient and effective with the allocation of this resource is a challenge that the world and its leaders are embracing. In spite of efforts, the impacts of an unbalanced use of natural resources have led the world to a critical situation where the environment and society are under an unhealthy and dangerous burden. The development of technologies and the engagement of energy users towards a more conscious use of the energy they consume is critical, as well as, the development of the market to allow these innovative solutions to be both reliable and affordable, to ensure that their potential is achieved and their expected benefits delivered.

2. THE CONCEPT OF SMART METER

The concept of smart meter can be defined in general terms as (Obenchain, Thurber, Quenn, et al. 2011) electronic measurements devices, installed by the utilities at the consumer facilities to allow communication of the consumption of energy (gas, electricity, water). These devices have been used by utilities to deliver accurate billing information, for a part of their customers. At first the devices were mainly used by industrial consumers given the higher consumption and the need of specific consumption data, to allow the right and best quality service to be delivered, and also to provide specific and detailed billing data. The evolution of the market and consumer needs facilitated a decreased price of the technology, and increased need of information by all consumers, leading to the migration of these systems from the industrial sector to all customer classes. From the consumer side smart meters can be defined as (SEDC, 2012), communication and control systems, which have the ability to directly empower the consumers to understand, control, produce and earn from energy. Through this definition the consumer becomes an equal partner in the energy value chain.

A broad view of smart metering, published by the European Commission (EC, 2010) states that an intelligent metering system or “smart meter” consists of an electronic device used to measure the consumption of energy, delivering more information than a conventional meter, and that can transmit data through a communication network. In this perspective, the key feature of a smart meter is the possibility of bidirectional communication between the consumer and the supplier/operator; the system should also promote the dissemination of services that improve energy efficiency within the home. On a market perspective, shifting from old and static meters to smart active devices is a matter of increased importance for competition in energy markets.

A considerable array of definitions for what smart meter and smart metering is, are available in the literature and in industry reports. From the definitions stated above (Obenchain, et al. 2011; SEDC, 2012; EC, 2010) it is possible to build a comparison table to highlight different focus of different authors (*table 1*).

Table 1 Smart meter definition comparison (Obenchain, et al. 2011; SEDC, 2012; Martin, 2011)

Smart meter definition comparison			
Author	Obenchain *et al*, 2011	SEDC, 2012	Martin, 2011
Key concept	Electronic devices, providing billing information to allow better management by the companies and utilities.	Electronic devices, that allows consumers to manage and benefit from a better control of their energy expenditure.	Intelligent meters, that provide more and better information, allowing energy efficiency to be improved, while increasing competitiveness of the energy market.
Focus on	Utility benefits from smart meters, and management of resources	Consumer benefits from smart meter, as well as, utilities.	Consumer, utilities and the market benefit from the roll-out of smart meter technologies.

The general structure of the smart meter (*figure 1*) consists on a hardware combination of the meter and the platforms needed to gather the information, and the necessary software and communication layer that transmits and processes data, and enables the system to communicate consumption data for accurate billing, controlling and monitoring purposes.

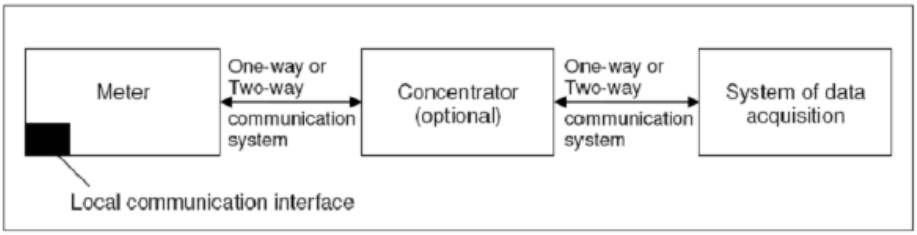

Figure 1 The general structure of a smart meter (source: Martin, 2011)

The general system architecture as demonstrated in *figure 1* represents the possibility of "one-way" or "two-way" communications between the different layers of the structure.
The evolution of the systems technology from "one-way" communications to "two-way" communications is linked with the shifting from the Advanced Meter Reading (AMR) systems (one-way communication) to the Advanced Metering Infrastructure (AMI) (two-way communication). The main differences between these two systems, AMI and AMR, are (Obenchain, et al. 2011):

AMI: Consists on the combination of the electronic meters with two way communication technology, for information, monitoring and controlling energy use;

AMR: Utilized one-way communications to collect meter data only.

The evolution of the communication system and its impacts on the smart meters capabilities are represented on the diagram below (*figure 2*), including the evolution of functionalities and the stakeholder benefits as a result of these evolutions.

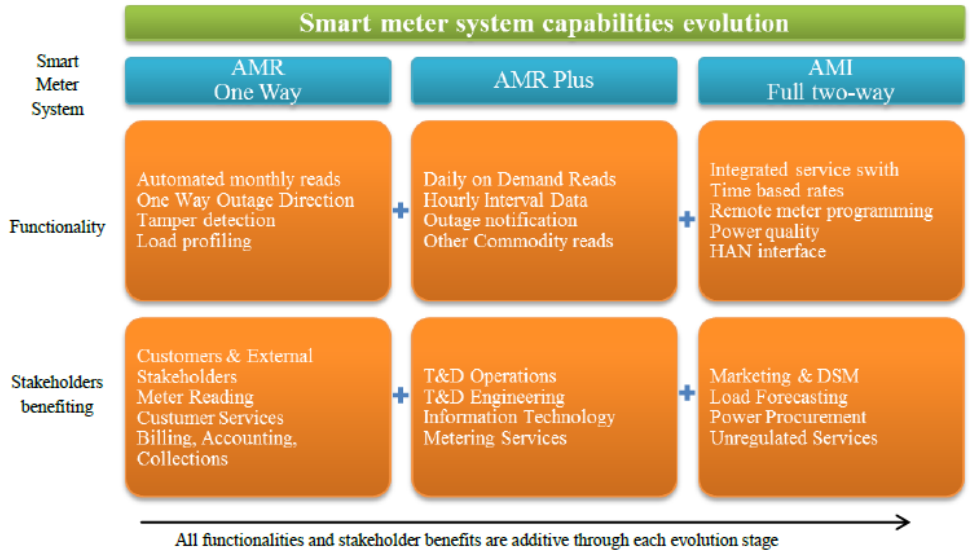

Figure 2 Smart meter system capabilities evolution (adapted from: Obenchain, et al. 2011).

Smart meters represent the new generation of meters, with the ability to replace existing electro-mechanical meters while offering a range of benefits for both the individual consumer and the energy system in general.

3. SMART METER AND CONSUMERS

Imagine a typical modern day Southern European family of four, husband and wife and a couple of grown up college kids living together. They go about their daily lives to work and university sharing their two cars and when necessary visiting the gas station to refill. In this world the system is such that they don't actually pay for gas at the gas station but simply fill the tank as necessary and receive a bill every month or two, once they have already forgotten who and with which car visited the gas station and how many times they have poured how much fuel into their vehicles. Let's also assume that their cars don't have a speedometer or a gas gauge, therefore they have absolutely no feedback in order to manage their fuel expenses. This is how we spend electricity and account for its usage in the world of today.

The widespread installation and utilization of AMI, and Smart Meters as its essential part, by homes and businesses will transform the way we purchase, spend, account for and manage our electricity consumption and needs. In preparations for widespread distribution of smart meters utility companies in Europe, North America, Australia and parts of Asia have during the past decade carried out numerous feedback and pricing pilot trails with their customers to assess the potential impact of smart meters and other AMI components on improving energy savings, increased energy efficiency, changes to customer behavior, their potential monetary savings in bills and reduction of greenhouse gas emissions. This section will provide an overview of cost benefit analysis of smart meter application, followed by a summary of selected feedback pilots carried out and their results[1].

3.1. Cost-Benefit analysis for the customer

Despite the rapid growth in the home energy management, and the significant energy management opportunity that is possible with the combination of smart meters and smart home energy management devices, concerns whether the costs outweigh the benefits of smart meters are a persistent concern among all stakeholders in the smart meter roll-out initiatives.

Smart meters provide an opportunity for two-way digital communications between the utility and the customer and establish a platform for customer energy management and demand response via both information feedback and rate programs. They are a tool for improving utility operational functions such as outage detection and management, remote meter reading, and remote customer (dis)connections. Furthermore, smart meters allow smart charging of plug-in electric vehicles as well as integration of distributed generation resources (Ehrhardt-Martinez, Donnelly, & Laitner, 2010).

Benefits from smart meters can be driven by changes in consumers' expected consumption behavior. Two potential sources of change in average consumption behavior may arise (DECC, 2010):

- a reduction in overall energy consumption/demand as a result of better information on costs and use of energy which drives behavioral change, and
- a shift of energy demand from peak times to off-peak times.

Smart meters provide benefits for utilities, customers and society as a whole (Faruqui, Mitarotonda, Wood, et al. 2011):

Operational – Allow the utility to deliver more reliable service, remote connection, better outage detection and recovery to its customer base at lower overall cost.

Customer – Arise from engagement in energy management driven by information and/or price signals, which leads to electricity usage reduction or load shifting and the opportunity to lower bills and mitigate cost increases.

Societal - Arise from demand response and direct load control, enabling reduction of peak purchases, thereby applying downward pressure on energy prices in spot markets, offsetting the need for new generation and transmission and distribution capacity, and potentially lowering carbon emission.

[1] (Ehrhardt-Martinez, et al. 2010; DECC, 2010; Faruqui, et al. 2011; Griffiths, 2012; Johnson, 2010; EComm, 2011)

A very elaborate cost benefit analysis of smart meters was carried out by The Edison Foundation, Institute for Electric Efficiency in their 2011 publication, *"The Costs and Benefits of Smart Meters for Residential Customers"* (Faruqui, et al. 2011).

Firstly the analysis defines profiles for four utility prototypes that influence the overall business case for smart meters, including the electricity generation mix, the renewable energy portfolio, the regulatory environment, emphasis on efficiency and conservation, and other factors.

- Pioneer: A utility that previously invested in automated metering with very high energy prices and that purchases power from a variety of generation sources;
- Committed: A utility with relatively high energy prices, primarily natural gas-fired generation, and a mandate to aggressively pursue renewable generation;
- Exploratory: A utility with relatively low-cost generation available, high population density, and highest demand in winter months;
- Cautious: A utility with low population density, high annual demand growth, and coal, nuclear, and natural gas dominant in its generation portfolio.

To continue, the authors define consumer adoption patterns and assume they will align with their energy worldviews. We developed energy management participation plans to correspond with four dominant customer segments, described below.

- Basic: For consumers who do not wish to engage at all;
- Comfort: For those with large load homes with air conditioning, pool pumps, smart appliances, minimal interest in energy engagement, and limited concern about their bills;
- Saver: For those primarily motivated by the opportunity to save money on their bills or mitigate potential bill increases;
- Green: For those motivated by environmental concerns and willing to be more engaged.

Out of the four consumer types, the authors of the study assume that each can have five different engagement pathways in terms of their usage patterns of smart meters:

- Passive: Unengaged households that benefit indirectly from operational improvements due to smart meters and incrementally if they coincidentally defer usage on demand response event days;
- Active: Engaged households that make conscious and manual adjustments to their electricity use based on energy information and price signals from peak rate plans (either no risk peak-time rebate (PTR) or heat wave critical peak pricing (CPP)) obtained via a web portal, a display, or other communications methods (e.g., email, text, or phone);
- Set and forget: Engaged households that use automation to adjust their electricity use via technologies such as programmable communicating thermostats (PCT) or home energy management systems (HEMS) based on energy information and price signals from peak rate plans (either no risk PTR or heat wave CPP);
- Utility automation: Households that allow the utility or a third party to directly control their central air conditioning via a signal sent to their smart thermostat or to a switch on their air conditioner. Customers retain the ability to override;
- Energy partners: Highly interested and engaged households that have electric vehicles and home energy management systems to automatically control electricity usage. The time of use rate applies to the entire household on a daily basis, not just on event days.

The model assumes that customers will choose an engagement path in line with their preferences in terms of price and in accordance with the appliances they use at home but also their sustainability sensibilities and willingness to take action.

Costs and benefits, as presented in *table 2 below,* are calculated based on investments in technology and the benefits arising as of their utilization.

Table 2 Costs and benefits (adapted from Faruqui, et al. 2011)

Costs and Benefits		
Costs	**Operational Benefits**	**Customer Benefits**
AMI	Avoided metering	Avoided generation and capacity
Enabling technology	Avoided outage	Avoided transmission and distribution
	Remote connection and disconnection of service	Avoided energy
		Avoided GHG emissions
		Avoided Gasoline

Even with conservative assumptions regarding consumer engagement in technology, programs, and rate plans, the results of the analysis show positive net benefits are possible for all four utility types. The model assumes a service territory of one million households. According to the study findings, the total costs of investing in AMI and associated technologies for home energy management varies across the four utility prototypes based on the utility and customer characteristics from a low of $198 million for the Pioneer utility to a high of $272 million for the Committed utility. The benefits also vary across the four utility prototypes based on both utility and customer characteristics.

- The operational savings vary from a low of $77 million for the Pioneer utility (who has already deployed AMR) to a high of $208 million for the Cautious utility;
- The consumer-driven savings vary from a low of $100 million for the Cautious utility to a high of $150 million for the Pioneer utility;
- The net benefits vary from a low of $21 million for the *Committed* utility to a high of $64 million for the Exploratory utility.

Although the net benefits are positive for each utility in this analysis, signifying that investments in smart meters make economic sense, customer-driven benefits could be much greater with more investment in and focus on customer education and engagement.

Furthermore if we consider an analogy to recycling, which took some time to get a substantial amount of people on board with the effort, we can assume that customers will migrate from passive engagement in energy management to much more active strategies. A potential area for further study is how to accelerate this process so that a broad array of customers are ready, willing, and able to engage in energy management soon after smart meters are deployed. Given the high satisfaction ratings of feedback pilot participants where education is a key component, the combination of program choice based on personal preferences (with comprehensive consumer education) could yield financial and societal benefits.

4. CONCLUSION

Smart metering is a way to reduce energy consumption, which is otherwise projected to keep growing across the Europe over the next two decades. Smart meters have the proven ability to enable significant changes to the current scenario regarding energy consumption (Johnson, 2007). Their purpose is to improve efficiency, not just at the household level, but utility-wide. For energy providers, smart meters promise to slash uncertainties in electricity consumption data and billing, eliminate the cost of manual meter readings and alert utilities to problems and outages more quickly and effectively.

The development of smart metering and the evolution on has the potential to change the energy industry and the interactions between consumers and distributors of electricity. Providing more and better quality information, these devices set the basis for realistic demand side programs and initiatives, focused on reducing unnecessary consumption, and shifting flexible load outside of peak hours. Reducing the peaks on demand will be possible through dynamic pricing, feedback and strong consumer engagement.

Smart energy systems deployment will positively impact safety and the overall service quality achieved, whilst providing distributors and network operator with essential information to enable demand side initiatives and programs to be implemented with success. Realizing the potential benefits linked to smart meter systems and their dissemination will depend on the success of consumer engagement initiatives and how the available information is organized and used to create more value for the energy market, for the society and for the environment.

REFERENCES

Department of Energy and Climate Change, DECC, (2010). *Smart Metering Implementation Programme: Prospectus*, United Kingdom.

Ehrhardt-Martinez K., Donnelly, K. A., Laitner, J. A., (2010). *Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities*, American Council for an Energy Efficient Economy (ACEEE), Washington D. C., United States.

Energy Community (2011). Energy Community Regulatory Board, *A Review of Smart Meters Rollout for Electricity in the Energy Community*. Vienna, Austria.

European Commission (2010). Commission staff working paper - *interpretative note on directive 2009/72/EC concerning common rules for the internal market in electricity and directive 2009/73/EC concerning common rules for the internal market in natural gas - retail markets*. Brussels, 22 January 2010.

Faruqui, A., Mitarotonda, D., Wood, L., Cooper, A., Schwartz, J. (2011). *The costs and benefits of smart meters for residential customers*, Institute for electric efficiency; IEE White paper.

Griffiths, C., (2012). Making energy use visible, Smart meter in-home display – usability research with consumers", Research Institute for Consumer Affairs, United Kingdom.

Johnson, P., (2007), *Smart Metering – Enabling Greater Energy Efficiency*. Strategic White Paper, Alcatel-Lucent.

Johnson, R., (2010). *A review of Smart Metering and Survey options for Energy*, University of East Anglia, School of Environmental Sciences (LCIC), United Kingdom.

Martin, G., (2011). *Smart Metering information Paper 4: Results of Electricity Cost-Benefit Analysis, Costumer Behaviour Trials and Technology Trials*", Commission for Energy Regulation, Tallaght, Dublin.

Obenchain, G. T., Thurber, J., Quenn, E. E., Gilleland, H., Holland. L., Hawkins, A., Bender, K., Morgan, T., Barto, L., (2011). *Smart meters and smart meter systems: A metering industry perspective*, Edison Electric Institute (EEI), United States of America.

Smart Energy Demand Coalition, SEDC, (2012). *Smart Metering and Information, Smart Meters and their central role in consumer empowerment*, Position Paper, European Union Parliament, Brussels, Belgium.

SUSTAINABLE DEVELOPMENT INDICATORS OF THE REPUBLIC OF SERBIA

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Abstract: *This study is based on a survey of possible ways and adopted methods and techniques for achieving adequate model of sustainable development in Republic of Serbia. For that reason, sustainable development is seen first at the global level, giving an example of good practice of European Union. Then, it provides an overview of state strategies and legal framework for sustainable development of the Republic of Serbia. The aim of this study is the assessment of the state of sustainable development of the Republic of Serbia.*

Keywords*: Sustainable Development, Strategy, Indicators of Sustainable Development, Goals, European Integration, Climate Changes, Global Pollution*

1. INTRODUCTION: ABOUT SUSTAINABLE DEVELEOPMENT

The rapid technological advancements and industrialization have resulted in an increased level of negligence and insensitive behavior, leading to the destruction of environmental balance (Cetin & Nisanci, 2010). Human civilization has never been closer to ecological collapse: one third of humanity lives in poverty, and another 2 billion people are projected to join the human race over the next 40 years (Worldwatch Institute, 2012). The implication of this ecological situation is obvious: to be sustainable, human beings must live within nature's carrying capacity; and they must measure where they are now and how far they can go. In 1992, governments at the Rio Earth Summit made a historic commitment to sustainable development - an economic system that promotes the health of both people and ecosystems. Otherwise, “sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987). In addition, it is important to notice that since sustainability is a multidimensional concept, economic, social and environmental aspects must be considered and integrated, too (e.g. WCED, 1987; Piątek, 2007; Sanchez, 2008; Pawlowski, 2009; Pawlowski, 2010; Tuziak, 2010).

2. EU SUSTAINABLE DEVELOPMENT STRATEGY

Sustainable Development Strategy has its origins back in Agenda 21, which is a key document for achieving Sustainable Development. Agenda 21 was adopted at the Earth Summit in Rio de Janeiro in 1992. Agenda 21 called all countries to develop a strategy for Sustainable Development, with the involvement of all stakeholders (Eurostat, 1998).

As originally stated in Chapter 40 of Agenda 21, the role and importance of statistical indicators for monitoring progress towards Sustainable Development have been identified as key items for the management strategy of the European Union.

Sustainable Development Strategy of the European Union, launched by the European Council in Gothenburg in 2001, and renewed in June 2006 contains goals for continuous improving the quality for present and future generations. Eurostat, the statistical office of the European Union, every two years publishes the monitoring report that supports the European Commission's report on the progress of implementation strategies. Objectively, the report provides a statistical picture of progress on the EU set of Sustainable Development Indicators. Through indicators, the quantitative rules are consistently applied; as well as the time direction, through certain symbols. In order to provide approximate assessment whether Europe is moving in the right direction, given the goals and objectives set out in the Strategy.

Sustainable Development Strategy is based on four distinct pillars: economic, environmental, social and international, which should mutually reinforce one another. Economic, social and environmental effects of all policies should be examined in a coordinated manner and should be taken into consideration when these policies are drafted and adopted. The EU also needs to assume international obligations in terms of Sustainable Development, and its various aspects, including peace, security and freedom, should promote outside the EU (Eurostat, 1998).

The strategy is based on the following guiding principles: the promotion and protection of fundamental rights; solidarity within and between generations; guarantee of an open society, the participation of citizens, businesses and the involvement of social partners; policy coherence and policy management integration; use of the best available knowledge, the precautionary principle and the "polluter pays" principle.

3. EUROPEAN UNION'S GOALS OF SUISTAINABLE DEVELOPMENT STRATEGY

The first, long-term goal of the strategy is limitation of the climate change and its effects to perform the obligations under the Kyoto Protocol, and taking the action to prevent the increase of global medium temperature above 2 degrees Celsius, above the level that was before the industrial era. The EU should pressure major industrialized countries to meet their obligations under the Kyoto Protocol and it should seek to provide an appropriate international framework for the period "after the Kyoto". It must implement measures and adaptations and testing ways of expanding greenhouse gas emissions; trading system to other sectors and other greenhouse gases (The Renewed EU Sustainable Development Strategy, 2006).

Limiting the negative traffic effects and reduction of regional disparities, is another long-term goal, for which is necessary to break the link between economic growth and development of transport So that the development of transport could be more environmentally friendly and suitable for health. Among other measures, the strategy envisages charging infrastructure, promotion of road transport and vehicles that produce less pollution and use less energy.

To promote more sustainable modes of production and consumption, the relationship between economic growth and environmental degradation should be terminated and also the attention should be on the tolerance of the ecosystems. With this goal, the EU, among others, should also promote Green Public Procurement; it should define the goals of environmental protection and social performance of products in collaboration with stakeholders; it should expand the distribution of eco-innovation and environmental technologies and produce relevant information on the labeling of products and services.

Also, the EU goals include the greater responsibility in natural resources management. Therefore, over-exploitation of resources should be avoided; the efficiency of use of natural resources should be improved; the value of services provided by the ecosystem should be recognized and further loss of biodiversity should be ceased.

In particular, the EU must make an effort in the fields of agriculture, fisheries, forestry; it should define and implement the priority actions for the protection of biodiversity.

Another Strategy goal is limiting the major threat to the public health. Food safety and quality must be ensured through the food chain. Threat to public health and the environment from chemicals should be removed by 2020 year, and research of the connection between health and pollutants must be developed.
In order to fight against the social exclusion and poverty and to mitigate the effects of the aging society, the EU needs to support the so-called "active ageing", which implies the inclusion of older people in different kinds of activities, whether it is voluntarily or not. Also, the effort should be made for assuring the sustainability of the pension system and social protection; integration of legal migrants and improvement of family situations (especially when it comes to children), and to promote the equality of sexes.

4. NATIONAL SUSTAINABLE DEVELOPMENT STRATEGY OF THE REPUBLIC OF SERBIA

National Sustainable Development Strategy of the Republic of Serbia defines Sustainable Development as long-term, continuous, comprehensive and synergetic process that affects all aspects of life (economic, social, environmental and institutional) on all levels (National Strategy for Sustainable Development of Serbia, 2008).

The goal is to achieve balance between three key factors, i.e. three Sustainable Development pillars: Sustainable Economic Development, Economy and Technology; Sustainable Development of Society based

on social equality and Environmental Protection with the rational use of natural resources. At the same time, the Strategy aims to bring together these three pillars as one whole, which will be supported by suitable institutions.

Strategy settlements are in line with European integration: EU Sustainable Development Strategy (adopted in 2001, and restored 2006) and the Lisbon Strategy (adopted by the Council of Europe in March 2000). The strategy is aligned with the Millennium Development Goals (UN) and the Millennium Development Goals in the Republic of Serbia, the Government of the Republic of Serbia adopted in 2006. The strategy is based on the reform goals identified in the strategic documents adopted by the Government. The strategy is fully in line with the principles and goals set out in the National Strategy of Serbia for Serbia and Montenegro's approaching to the European Union (adopted by the Government in June 2005) and Poverty Reduction Strategy (adopted by the Government in 2003), as well as strategies to regulate the economic development and environmental protection programs of the Republic of Serbia. It should also be noted that the Strategy is aligned with the entire set of strategies in almost all areas of economy, development, education, energy, in order to facilitate its application in various segments.

Indicators are very important for the successful evaluation of measures and activities for implementation of the Strategy. The choice of indicators reflects the connection with key instruments. In order to be internationally comparable, the selected indicators are aligned with new revised UN List of Sustainable Development Indicators, which also includes the indicators for the Millennium Development Goals. The indicators compliance is primarily reflected at the highest level, while some regional differences are recognized in the Indicators of the second, and especially of the third level. All indicators are gender-supported and they cover all aspects of Sustainable Development: economic, social and environmental (environmental indicators). Classification of indicators of Sustainable Development in Serbia is shown in the following tables (Milanovic, 2010).

Table 1: Poverty

I Level	II Level	III Level
1. Poverty	2. Lack of Income	3. Percentage of population below the national poverty line.
		4. Ratio of the average earnings of women and men.
	5. Inequality	6. GINI Coefficient
		7. HDI - Human Development Index
		8. Index of regional disparities in human development
	9. Help for the Poor	10. Population covered by State Help and Support programs
	11. Living Conditions	12. Percentage of constructed social housings regarding the total number of constructed dwellings

Table 2: Managing

I Level	II Level	III Level
1. Managing	2. Corruption	3. CPI - Corruption Perception Index
		4. Level of Citizen's General Trust
	5. Crime	6. Number of recorded violent crimes per 100,000 population
	7.Efficiency of the State Administration	8. Degree of computer automation in the state administration

Table 3: Public Health

I Level	II Level	III Level
1. Health	2. Mortality	3. Mortality rate of children under 5 years
		4. Life expectancy in good health
		5. Years of living with a disability / incapacity
	6. Provision of Health Care	7. Percentage of population with access to primary health care
		8. Percentage of women using some of the type of contraception.
	9. Health Status and Risks	10. Prevalence of smoking among children from 13 to 15 years
		11. Prevalence of smoking among adults aged 20 years
		12. Number of suicides

Table 4: Education

I Level	II Level	III Level
1. Education	2. Second Level Education	3. Percentage of population with a university degree
	4. Literacy	5. Adult literacy rate
	6. Level of population education	7. Rate of enrollment in primary and secondary education

Table 5: Population - Demographic Indicators

I Level	II Level	III Level
1.Population	2. Population	3. Percentage of population with a university degree
		4. Fertility rate
		5. Dependency ratio of elderly population
		6. Indicators of internal migration
	7. Tourism	8. Density in major tourist regions and destinations

Table 6: Economic Indicators

I Level	II Level	III Level
1. Economics development	2. Macroeconomic performance	3. GDP *per capita*
		4. Percentage share of investment in GDP
		5. Internal and External debt
		6. Trends in the retail price index
	7. Employment	8. Unemployment
		9. Employment rate
		10. Employment rate for women
		11. Unemployment rate for young people under 28 years
		12. Unemployment by region
	13. Information and Communication Technology	14. Number of active Internet users per 1000 population
		15. Number of Mobile phone subscribers per 100 inhabitants
	16. Research and Development	17. Expenditures for Research and Development as a percentage of GDP

Table 7: Global Economic Partnership

I Level	II Level	III Level
1. Global Partnership	2. Trade	3. Trade Deficit
	4. External Funding	5. ODA as a percentage of GDP

Table 8: Production and Consumption

I Level	II Level	III Level
1. Production and	2. Balancing Current Production and Consumption	3. Ratio of Current Production and Consumption
	4. Energy Use	5. Energy Consumption *per capita*
		6. Energy Intensity (energy per unit of GDP)

Consumption		7. Share of Renewable energy in total energy consumption
	8. Waste generation and management	9. Generation of waste
		10. Generation of hazardous waste
		11. Amount of waste that is subjected to the treatment
	12. Transport	13. Energy Intensity of Transport

Table 9: Natural Disaster

I Level	II Level	III Level
1. Natural Disaster	2. Sensitivity to Natural Disaster	3. Number of victims of Natural and Technological disasters
		4. Percentage of population living in natural risky areas

Table 10: Climate Change

I Level	II Level	III Level
1. Atmosphere	2. Climate Change	3. Emission of CO2 *per capita*
		4. Emission of Greenhouse gases
	5. Ozone Layer	6. Consumption of substances damageable for Ozone Layer
	7. Air Quality	8. Ambient concentration of pollutant urban areas

Table 11: Natural Resources

I Level	II Level	III Level
1. Natural resources	2. Land Use and Status	3. Change of the land use
		4. Land Degradation
	5. Desertification	6. Land degraded by drought
	7. Agriculture	8. Share of permanent crops in the structure of arable land
		9. Use of mineral fertilizers
		10. Use of pesticides
	11. Forest	12. Share of forest land total land
	13. Fishing	14. Annual catch five most common species of fish
	15. Water Amount	16. Annual amount exhausted quantity of grounded water and surface water, as part of an absolute and total of renewable water
		17. Water consumption by sectors
	18. Water Quality	19. Presence of fecal bacteria in drinking water
		20. Biochemical Oxygen demand in streams
		21. Percentage of waste water being treated
	22. Ecosystems	23. Share of protected areas regarding the total area of land
		24. Areas under the selected key ecosystems
		25. Index endangered species
	26. Types	27. Change in status of threatened species
		28. Share of endangered species in the total number of species.

5. CONCLUSION

Advanced climate changes, global population growth, changing market disinclination lifestyle, a global growth industry, and almost the lack of natural resources (water, food, oil) are just some of many problems that exist or will occur in the near future due to non-compliance with the laws of nature and its process (Strategy for Sustainable Development of Serbia, 2008). With that, human society is increasingly moving away from the environment, which provides the basis for life and survival.

In order to enable future generations to live in prosperity we have to turn to Sustainable Development. Sustainable Development is a multidimensional phenomenon that integrates several aspects of every individual's life (economic, social, and environmental), with emphasis on their mutual influence. Sustainable Development Indicators are qualitative indicators that evaluate the situation and change those aspects.

The introduction of the concepts of Sustainable Development over the past two decades became a turning point in our societies. Current policy should not mainly focus on their short-term impact, but they have to look for the long term one, and be more in tune with each other. Considering the complexity of the concept of Sustainable Development: taking into consideration of what counts for the benefit of both present and future generations; well-appointed official statistics that lead to impartiality and diversity available to provide expert statistical tools for both generations; and especially, statistical indicators necessary for adequate assessment and implementation of current policies are some of the basic and the key matters that need to be directed so that the concept of Sustainable Development could give positive effects, both today and tomorrow.

Since the concept of Sustainable Development has become increasingly present in our country, through the National Strategy for Sustainable Development, its indicators were first identified and currently are developing measurement models for those indicators that are not in the statistical system of the Republic of Serbia. The analysis of sustainability indicators, both the EU and the Republic of Serbia, will enable not only understanding the differences, but also the steps and actions necessary to take, in order to overcome those dissimilarities and according to the Republic of Serbia's strategy of joining the European Union. Comparing the indicators the Republic of Serbia and the European Union, it could be said that they are substantially oriented in the same topics and the same structure. However, it is noticeable that the EU, being much larger entity than the Republic of Serbia and whose institutions and laws are more developed, has certain indicators globally oriented, which in Serbia, a developing country, are not possible and measurable.

In Serbia, the indicators of sustainability are positioned on a lower level (in comparison to the level of the EU) because the awareness of Sustainable Development is not very high, and therefore it is necessary to begin from collecting the less complex indicators data, which doesn't require a certain institutional level and the ability to access data and financial resources, since in Serbia it is still not possible obtain. This is precisely the path that Serbia should take and it lies in strengthening the economic stability of the country, increasing the awareness of Sustainable Development, the adoption of laws that enable the framework for progress and application of indicators and general activities towards sustainability in the future time (National Strategy for Sustainable Development of Serbia, 2008). Indicators of sustainability can be useful for different types of communities and in different ways. Above all, they may indicate negative trends of certain aspects of human life, in order to preventively access to these areas before they should turn into a problem, in the future time.

For those communities that already have certain economic, social and environmental problems, indicators can show the way to a better progress. At the global level, indicators can initiate a joint discussion of people with different attitudes and coming from different surroundings, and during that process it can help to create a common vision towards Sustainable Development.

REFERENCES

Cetin G., Nisanci S.H., 2010, Enhancing students' environmental awareness, in: *Procedia Social and Behavioral Sciences 2*, pp. 1830–1834.

Eurostat, 1998. Sustainable Development in European Union. Brussels.

National Strategy for Sustainable Development of Serbia (2008). Retrieved from http://www.merz.gov.rs/sites/pdf.

Milanovic, T., *Analysis of indicators of sustainable development in the process of The Republic of Serbia to the European Union*, Master Thesis, 2010, FOS, Belgrade.

Pawlowski A., 2009, The sustainable development revolution, *Problemy Ekorozwoju/Problems of Sustainable Development,* vol. 4, no 1, pp. 65-76.

Pawlowski A., 2010, The role of environmental engineering in introducing sustainable development, *Ecological Chemistry and Engineering* S, vol. 17, no. 3, pp. 263-278.

Piątek Z., 2007, Balancing the order of the human world: natural and sociohistorical confitions, *Problemy Ekorozwoju/Problems of Sustainable Development*, vol. 2, no 2, pp. 5-18.
Sanchez A., 2008, Perspectives and problems in sustainable development, *Problemy Ekorozwoju/Problems of Sustainable Development*, vol. 3, no 2, pp. 21-23.
Tuziak A., 2010, Socio-economic aspects of sustainable development on global and local level, *Problemy Ekorozwoju/Problems of Sustainable Development,* vol. 5, no 2, pp. 39-49.
The Renewed EU Sustainable Development Strategy, (2006). Retrieved from http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2010117%202006%20INIT.
World Commission on Environment and Development – WCED, *Our Common Future*, Oxford, Oxford University Press, 1987.
Worldwatch Institute, *State of the World 2012: Moving Toward Sustainable Prosperity*, The Worldwatch Institute, Island Press, Australia, 2012.

RESEARCH ON THE SUBJECT OF STUDENTS AWARENESS AND KNOWLEDGE ABOUT GREEN IT

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Abstract: *The aim of this work is to show whether and to what extent the young generation is familiar with the concept of Green IT based on the survey which has been conducted. Furthermore, the goal is to inform primarily the students, and then the others as well, on how ICT can reduce the harmful impact on the environment and contribute sustainable development through various forms of informing. The introductory part shows how the use of ICT, and all its equipment individually, creates a detrimental impact on our environment. In addition, the concept of Green IT is outlined in more detail as well as the reasons why it needs to be implemented. As this approach shows its advantages, the following concepts are introduced: cloud computing, grid computing, virtualization technologies, utility computing, client server and peer-to-peer networking. A research has been conducted, where data has been collected by means of a survey, on whether and to what extent the students are familiar with the concept of Green IT. The research encompasses 82 freshman students from the Vocational College of Technology in Arandjelovac who attended the lectures from 'The Essentials of Information and Communication Technologies'. Young generations are overwhelmingly uninformed and don't possess awareness of this issue, the consequential emissions of harmful gases and harmful effects of ICT in general.*

Keywords: *Green IT, cloud computing, sustainable development, environmental, ICT*

1. INTRODUCTION

Thomas Friedman, in his well-known book —Hot, Flat, and Crowded" came to the following conclusion: —The convergence of global warming, global flattening, and global crowding is driving those five big problems – energy supply and demand, petro dictatorship, climate change, energy poverty, and biodiversity loss – well past their tipping points into new realms we've never seen before." Considering just how widespread ICT is and the fact that people can't imagine day to day life without it, it shouldn't come as a surprise to learn that it contributes a great deal to those five problems. People, in general, are not very aware of these problems and what they can mean, not only to us, but also to future generations. It is for their benefit that we should think about environmental sustainability, that is, about —development that meets the needs and aspirations of the present without compromising the ability of future generations to meet their own needs" (Development., 1987).

2. DETRIMENTAL EFFECT OF ICT USE ON OUR ENVIRONMENT

Today we rely on the Internet to find whatever we need, for example, library catalogs and databases, digital libraries, institutional repositories, e-books, e-journals, and so on. Access to this information is provided by an IR system. Such an extensive use of IR systems, which uses ICT (Information and Communication Technologies) at every stage of its creation and management, has an adverse effect on environment. Whenever ICT equipment is created or destroyed, it creates harmful gases, called GHG (greenhouse gases, a term used to measure environmental impact of a product or service). In running the ICT we use energy, and that also generates a substantial amount of GHG. In other words, as we are, in our daily life, becoming more and more reliant on IR systems for accessing and using digital information in a variety of forms, we are creating more environmental damages because of the increased use of ICT and energy. Because of that, it can be argued that we need to find a way to develop IR systems and services that are environmentally sustainable. As environmental sustainability has become a major area of concern for various national and international bodies, many different measures are being proposed for reducing the impact of industries and businesses on environment. One of those measures is the appropriate use of ICT which can reduce the overall GHG emissions of businesses.

The environmental impact of ICT can be significantly reduced by employing Green IT and cloud computing (Chowdhury., 2012). It has become a competition between computer hardware and software manufacturing firms to use environmentally sustainable energy efficient technologies in their products and services. Also, many companies and organizations are trying to make their businesses environment friendly, sustainable and cost effective by implementing green sustainable technologies (Lamb., 2009). Environmental sustainability is becoming imperative in data centers. Data centers are used by business facilities which contain ICT infrastructure platform (ICTP), cooling and power delivery equipments, servers and storage devices to store and process digital data and information (Lefurgy et al., 2007). Financial services, media, high-tech, universities, government institutions, and many others use and operate them to aid business processes, information management and communication functions (Daim., 2009). Data centers form the base of a large number of different services offered via the Internet including e-commerce, Web-hosting, social networking, and a variety of more general services such as software as a service (SAAS), platform as a service (PAAS), Internet as a service (IAAS), grid and cloud computing (Loper & Parr, 2007).

Many world known organizations like Green Grid, Energy Star, Green Data Center Alliance and many others are trying to develop green IT frameworks which are meant to reduce the emission of green house gases through maximum usage of already installed resources and devices in data center industry (Uddin & Rahman, 2012). However, not only do individual users but also systems and services that make extensive use of ICT have to change so that the target of reducing the GHG emissions of the overall business, industry and government could be met. The increasing use of ICT in its current form is not environmentally sustainable, as is proved by the research. The same research estimates that ICT‘s own sector footprint currently stands at 2% of global emissions and it will almost double by 2020 (Chowdhury G., 2012). In the same report it is suggested that appropriate use of the Green IT is a solution and that it can reduce ‗annual manmade global emissions by 15% by 2020 and deliver energy efficiency savings to global businesses of over EUR 500 billion‘‘ (Group., 2008) (Chowdhury G., 2012). ‗Gartner emphasizes that ICT industry is responsible for about 2% of global CO2 emissions which is almost equivalent to the aviation industry. An EPA report to U.S congress in 2007 emphasizes that current energy consumption in data centers is leading to an annual increase in the emission of CO2 (green house gases) from 42.8 million metric tons (MMTCO2) in 2007 to 67.9 MMTCO2 in 2011‘‘ (Uddin & Rahman., 2012).

From the mid-2000s onward, the amount of energy that is used by the applications available on the Internet has become a concern because of the rise of greenhouse gas (GHG) emissions; due to those concerns power-saving architectures and protocols have been seriously considered (Gupta & Singh., 2003). Since 2009, ICTs take amazing 4% of the world wide electricity consumption, and this number is expected to double within the next few years (Leisching & Pickavet., 2009). Zhang et al. have submitted a complete review on energy-efficiency plans in different parts of the telecommunication networks (Zhang at el., 2010). Energy-management is for the most part established on turning off, or putting in low power (sleep) mode, the components that are not in use such as line cards, network interfaces, router, and switch ports. There are also plans and projects for energy-efficient ICTs which require special power-saving hardware and architectures (Mouftah & Kantarci., 2012).

In the report from 2009 it is said that IT equipment contributes to global GHG emissions in the following percents: PCs and monitors contribute 40%, servers and their cooling equipment 23%, fixed line telecommunication equipments 15%, mobile telecommunications equipment 9%, local area and office network devices 7%, and printers 6% (Leisching & Pickavet., 2009). Keeping these numbers in mind, we can conclude that significant amount of energy could be saved in PCs and monitors by moving the IT services to distant servers. In this area, cloud computing could reasonably provide a solution for the green IT purposes. However, there is a negative side to the migration of services to distant servers in remote data centers. It will have two main impacts on global energy consumption and in direct correlation to the GHG emissions: (i) there will be an increase in the usage of data center servers, and (ii) moving the resources over the Internet will overload the Internet backbone traffic which will lead to an increase in power consumption of routing and switching equipments. Therefore, as Baliga et al. have stated,” energy-efficiency in cloud computing needs to maintain a balance between processing, storage, and transport energy” (Mouftah & Kantarci., 2013). As well, the Berkeley study concludes that laptops and desktop comprise approximately half of the Internet‘s total power consumption (Chowdhury G., 2012).

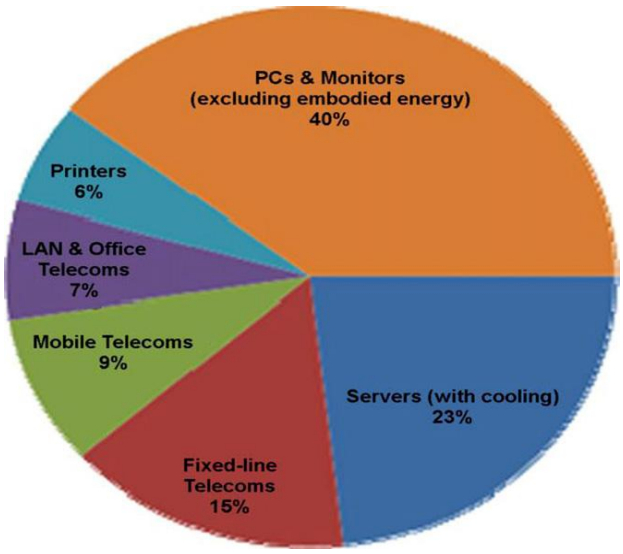

Figure 1: Estimated ICT CO2 emissions

In this picture we can see CO2 emissions for each ICT category. Based on this we can conclude that carbon emissions and energy consumption will only grow from year to year. The SMART 2020 study shows us that CO2 emissions from ICT are increasing at a rate of 6% per year and with such a growth rate they could represent 12% of worldwide emissions by 2020 (Kumar & Mieritz., 2007). It is becoming clear to the people all over the world that the humanity will have to pay dearly for the irresponsible behavior of the enterprises that have done the great damage to the environment. As we have already stated, information and communication systems account for 2–2.5% of the global carbon emissions, but it must be understood that if indirect energy use was to be included, then the number would rise to 14% of the total global carbon emissions (ITU-T, 2007). The problem becomes even greater if we take into consideration the e-waste made by massive usage of the IT equipment. About 500 million PCs were discarded between 1994 and 2003. That many PCs contain approximately 2872,000 t of plastics, 718,000 t of lead, 1363 t of cadmium and 287 t of mercury. The environmental problems that are connected to the IT are without doubt one of the most pressing concerns not only for the IT society, but for the general public as well. To date, the largest number of the environmental regulations and measures of control are being focused on the IT equipment manufactures. Every day environmental problems are more closely connected to the unsustainable trends in consummation than to the human population and technology. In particular, for the IT system, system‘s overall environmental impact largely depends on the system owner‘s decision concerning design. As Kohler and Erdmann concluded (Köhler & Erdmann, 2004), there are three levels of environmental impact: the environmental impact which is a result of the hardware‘s full lifecycle, the shifting of other connected non-IT processes, and the change in people‘s daily life and economy. A good system design results in lower environmental risks and impacts and improves corporate social responsibility (Zhang et al., 2011).

3. WHAT GREEN IT REPRESENTS AND WHY IT SHOULD BE IMPLEMENTED

Green IT refers to the initiatives and programs that directly or indirectly address environmental sustainability (Jenkin et al., 2011). Its objective is to lessen the overall environmental impact of ICT by applying various measures some of which are taking environment-friendly approaches to the production and use of ICT equipment and facilities and optimizing the use of those equipments and network infrastructure so that the energy consumption at every stage would be reduced (Chowdhury G., 2012). If we observe only the direct environmental impact of IT system, then we could define Green IT as ‗the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems— such as monitors, printers, storage devices, and networking and communications systems—efficiently and effectively with minimal or no impact on the environment.‘‘ (Murugesan., 2008)

Green IT or Green Computing helps us create more environment friendly and cost effective use of power and production technology. Green IT is a term that covers many different concepts like virtualization, cloud computing outsourcing, recycling, procurement and power management, etc. The main goal of Green IT is to achieve higher energy efficiency in the use of IT devices and to increase the utilization of already installed devices in data centers. On the other hand, organizations need to deliver new IT Services in short time while keeping in mind high reliability, performance and availability requirements as important issues in supporting

the business processes. IT must have a clearly defined Green IT strategy or framework which is in tune with business strategy and goals in order to realize and achieve both of these objectives at the same time. IT needs to translate IT Strategy to IT operational processes efficiently and clearly in order to assure effective business IT alignment in the most secure way (Uddin & Rahman., 2012).

4. TECHNOLOGIES WHICH ENABLE THE IMPLEMENTATION OF GREEN IT

Recent years, maybe even decades, have been marked by astonishing advances in information technology (IT). Their sole purpose is to achieve high performance data processing, data storage, and high speed wired/wireless communications on the Internet. Distributed systems, each aiming at a specific target, have become possible solutions, because of the limitations of local resources and power-efficiency concerns. For example," IBM's *autonomic computing* aims at building self-configuring, self-healing, self-optimizing, and self-protecting distributed computer systems for complex and unpredictable computing environments". As another example, *grid computing* comprises a" group of computers located at physically distant locations and sharing computing and storage resources to accomplish a specific task on an on-demand basis". There are also client–server and peer-to-peer networking. Client-server networking is a ~~-d~~istributed system consisting of a high performance server and lower performance clients", while peer-to-peer networking defines a" distributed system consisting of peers that share hardware resources such as storage, processing power, and network link capacity". Similar to the distributed computing services, *utility computing* is another business model that ~~-d~~elivers the computing resources among several computers based on an on-demand basis and bills the computing facilities such as in electricity and Internet billing" (Mouftah & Kantarci.,2013). The idea of distributed systems has in the end evolved to the *cloud computing* concept which offers almost infinite computing resources on-demand as well as the dynamic provisioning, release, and billing of computing facilities. On top of that, the expenses of service providers who use cloud computing are reduced (Armbrust, et al., 2009). As a matter of fact, as stated by Zhang et al., cloud computing is just a new business model that merges several distributed system concepts. (Zhang et al., 2010) According to the definition of the National Institute of Standards Technology (NIST), which is the one most often referred to in literature, cloud computing denotes ~~-a~~ shared pool of resources available to the users, which can dynamically be provisioned and released without interacting with the service provider" (Mouftah & Kantarci., 2013).

Grid computing comes closest to the cloud computing because it offers a distributed, powerful and cheap computing platform over the Internet. The difference is that cloud computing offers a homogeneous pool of resources to the users while the ones that grid computing offers are more heterogeneous. Also, cloud computing may be better than grid computing because of its high reliability assurance from the service providers (Kondo et al., 2009). For instance," Amazon-EC2 assures 99.995% reliability, which leads to 27 min or less downtime per year" (Mouftah & Kantarci., 2013).

IT infrastructure is growing almost daily, so we can consider cloud computing as a natural extension of virtualization technologies. These technologies enable scalable management of virtual machines over a number of physically connected systems. That is why cloud computing which is based on virtualization can offer practical and applicable approach to green IT/clouds. These are the clouds which emphasize the construction and development of scalable, energy efficient network software applications (NetApp) through improved utilization of the primary resources. The key precondition for upgraded security services as an integrated component of the infrastructure management strategy is emphasized by boosting the sharing of hardware and data in a multi tenant cloud architecture/environment and through this the former is achieved. Not only is the virtualization technology at the forefront in the sphere of industry but it's also grown into paramount technology in building a green IT infrastructure.

Since modern computing is prone to lead to high energy consumption it creates technical issues as well as environmental challenges. Due to the growth of the sizes of IT infrastructure, it has become an imperative to come up with efficient green IT solutions in order to minimize its effect on our environment. Cloud computing provides a natural extension of virtualization which enables scalable management of virtual machines dwelling on distributed hosts, thus permitting maximal usage of the concealed resources and supplanting the traditional ‗one server, one application'' model with a multi-tenant architecture/model of cloud services (Li, et al., 2011). The carbon footprint of ICT can be reduced in different ways, as is shown by Green IT/IS research. Some of those ways are the following: (1) by developing more sophisticated software and business systems that can help in the reduction of GHG emissions of businesses, (2) by developing new and improved technologies for manufacturing ICT equipments and infrastructure, and (3) by sharing computing

and ICT infrastructure and thereby optimizing the use of computing and network resources and also reducing energy consumption of ICT (Chowdhury G., 2012).

5. DISCUSSION AND RESULTS

With regard to the cognitions which have been reached on the basis of former research, and bearing in mind people's feeble awareness on the topic of environmental conservation and the facts which imply this, a research on Green IT has been conducted. In conformity with the already mentioned, this research also starts from the presumption that the majority of the respondents aren't acquainted with the term. On the basis of the results of the survey which has been conducted on the Vocational College of Technology in Arandjelovac, and where 82 freshmen students of vocational studies who attended the lectures on The Essentials of Information and Communications Technology', in autumn semester of the school year 2013/14 were surveyed, the following conclusions have been reached:

- Out of 31 surveyed students on the study program Information Technology, out of which 23 are members of the male and 8 of the female sex, 30 (96,7742 %) have never heard of the concept of Green IT, while only 1 (3,2258%) student is familiar with this term.

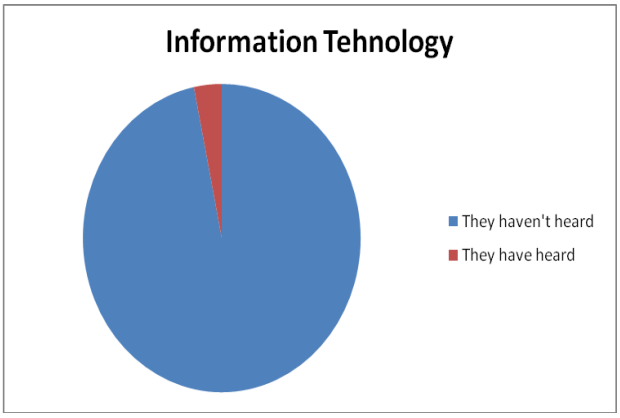

Figure 2: Percentage of students' familiarity with the concept of Green IT

- Out of 23 surveyed students on the study program Management in Tourism and Hospitality Industry, out of which 7 are members of the male and 16 of the female sex, 20 (86,9565%) have never heard of the concept of Green IT, while only 3 (13,0435 %) students are familiar with this term.

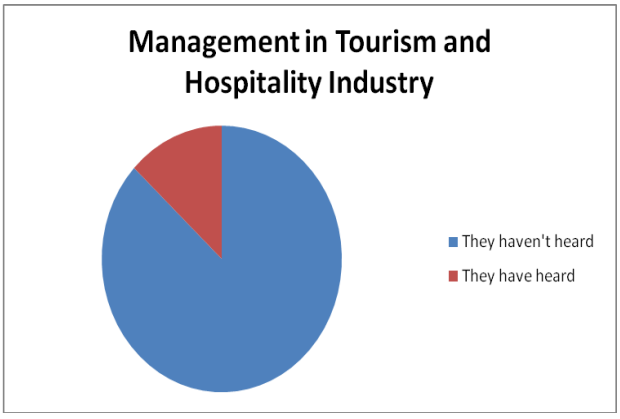

Figure 3: Percentage of students' familiarity with concept of Green IT

- Out of 6 surveyed students on the study program Technology and Engineering, out of which 3 are members of the male and 3 of the female sex, no one has heard of this term.

- Out of the 22 surveyed students on the study program Environment Conservation, out of which 8 members are of the male and 14 of the female sex, 20 (90,9091%) have never heard of the concept of Green IT, while only 2 (9,0909%) are familiar with this term.

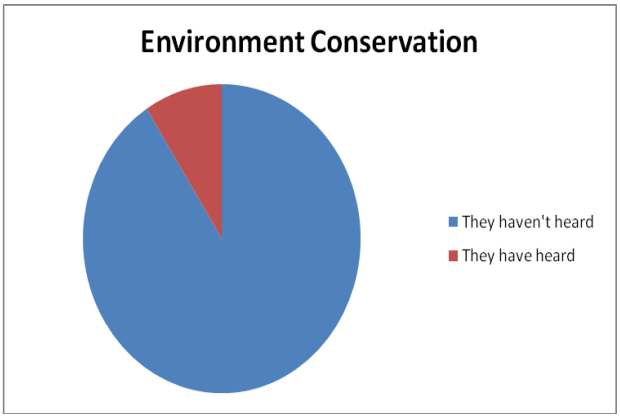

Figure 4: Percentage of students' familiarity with the concept of Green IT

6. CONCLUSION

Given its rapid development and progress, ICT has become part of our everyday life and is an integral part of many activities. Although ICT is very useful, emission of harmful gasses threatens to contaminate the environment. Green IT produces minimal greenhouse gas emission and can contribute significantly to the achievement of sustainable development, and play a key role in the aforementioned. The goal of Green IT is to directly or indirectly reduce the impact of ICT on the environment, that is, the ecological and economic costs by adopting a series of measures. Therefore, it is especially important that people are familiar with this concept. According to the results of this study we can notice that younger generation, which to a large extent uses ICT for various purposes, has a poor understanding of these relevant concepts. Consequently, it is necessary to inform and create awareness that through the use of ICT they should think and adhere to the measures that have been proposed in order to protect the environment and reach sustainable development.

REFERENCES

Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R., Konwinski, A., et al. (2009). Above the Clouds: A Berkeley View of Cloud Computing. *UC Berkeley Reliable Adaptive Distributed Systems Laboratory* .

Chowdhury, G. (2012). An agenda for green information retrieval research. *Information Processing and Management* , 3-5.

Chowdhury, G. (2011). Building environmentally sustainable information services: A green IS research agenda. *Journal of the American Society for Information Science and Technology* .

Daim, T., Justice, J., Krampits, M., Letts, M., Subramanian, G., & Thirumalai, M. (2009). Data center metrics: an energy efficiency model for information technology managers. *Management of Environmental Quality* .

Development, W. C. (1987). *Our Common Future.* Oxford: Oxford University Press.

Group, T. C. (2008). *Enabling the low carbon economy in the information age.*

Gupta, M., & Singh, S. (2003). Greening of the Internet. 19-26.

ITU-T. (2007). *ICTs and Climate Change.* ITU-T Technology Watch Report.

Jenkin, A. T., Webster, J., & McShane, L. (2011). An agenda for green information technology and systems research. *Information and Organization* , 1-24.

Köhler, A., & Erdmann, L. (2004). Expected environmental impacts of pervasive computing. *Human and Ecological Risk Assessment* .

Kondo, D., Javadi, B., Malecot, P., Cappello, F., & Anderson, D. P. (2009). Cost-benefit analysis of cloud computing versus desktop grids. 1-12.

Kumar, R., & Mieritz, L. (2007). Conceptualizing green IT and data centre power and cooling issues, Gartner research paper no.

Lamb, J. (2009). *The greening of IT: how companies can make a difference for the.* Upper Saddle River: IBM Press.

Lefurgy, C., Wang, X., & Ware, M. (2007). Power Capping: a Prelude to Power Shifting. *Cluster Computing* .

Leisching, P., & Pickavet, P. (2009). *Energy footprint of ICTs: forecasts and network solutions.*

Li, J., Li, B., Wo, T., Hu, C., Huai, J., Liu, L., et al. (2011). CyberGuarder: A virtualization security assurance architecture for green cloud computing. *Future Generation Computer Systems* , 1-5.

Loper, J., & Parr, S. (2007). Energy efficiency in data centers: a new policy frontier. *Environmental Quality Management* .

Mouftah, H. T., & Kantarci, B. (2012). Energy-Aware Systems and Networking for Sustainable Initiatives.

Mouftah, H. T., & Kantarci, B. (2013). Energy-Efficient Cloud Computing: A Green Migration of Traditional IT. 2.

Murugesan, S. (2008). *Harnessing Green IT: Principles and Practices.* IEEE Computer Society.

Uddin, M., & Rahman, A. A. (2012). Energy efficiency and low carbon enabler green IT framework for data centers considering green metrics. *Renewable and Sustainable Energy Reviews* , 1-5.

Zhang, H., Liu, L., & Li, T. (2011). Designing IT systems according to environmental settings: A strategic analysis framework. *Journal of Strategic Information Systems* , 1-6.

Zhang, Q., Cheng, L., & Boutaba, R. (2010). Cloud computing: state-of-the-art and research challenges. *Journal of Internet Services and Applications* , 7-18.

Zhang, Y., Chowdhury, P., Tornatore, M., & Mukherjee, B. (2010). Energy efficiency in telecom optical networks. *IEEE Communications Surveys and Tutorials* .

CLIMATE CHANGE TREATMENT IN NATIONAL SECURITY DOCUMENTS

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Abstract: *Climate change is a threat multiplier. It is hard even to list all concrete security threats generated from climate changes. Perception of this factor as a threat is relatively new. Natural disasters are one of logically expected implications of climate change. One of the missions of the defense forces in many countries is dedicated to supporting the civil authorities and population in a case of natural or man-made disasters. While traditional missions of defense forces are well presented in strategic documents and well evaluated towards implementation, the question arise how much defense forces are prepared, equipped and trained for conducting a mission of supporting society in a case of disasters. We started with investigating a placement of this mission in a strategic documents related to national security and defense. In dealing with climate change security implications, lessons learned from the similar cases in the past could be of help.*

Keywords*: Climate change, Disasters, Security, Military, Strategy*

1. INTRODUCTION

People around the globe become more and more aware of possible impacts of climate change on their life. There are many aspects of considering climate change impact on our civilization. Marshall (2012); and Pain (2013), offer some interesting analyses of a climate change possible impact on some common everyday issues. Alexander (2013), considered an real disaster event which occurred few years ago (Iceland volcano eruption in 2010), and noted some impressive facts about consequences on everyday life and particularly on air traffic.

Climate change issue arises, during last few decades, as a security threat worth of consideration and mentioning in a national security documents. It also earns growing attention. Tanner and others (2009), registered changes in priorities among security threats, and found that higher priority has been given to the climate change. In a long-term perspective for security, some nations see climate change as one of the most important factors, like in Finnish Prime Minister's Office Publications (2012).

In order to recognize climate change as a threat in a comprehensive way, there is a room for research in different scientific fields. First, what are causes and effects of climate change? Climate change may be a consequence of some natural phenomena, as well as the consequence of the mankind activities (global warming). Climate change made by the nature may be a consequence of orbital changes of the planet, Sun activities, a change of Earth's magnetic field, meteor impact, or gigantic volcano eruption, to mention some of the well known causes. Climate change affects almost all fields of human life and society, and negative aspects of that influence make that we perceive climate change as a threat.

Climate change is a threat multiplier in many aspects. Climate change may be a cause for generating problems in many other fields: agriculture, transportation, health, energy, technology, economy, social issues, migrations, and consequently, politics and security domain. Climate change may appear gradually (as it is considered for global warming), or in a short time with enormous changes. Climate has complex and global dynamics, and scientific climate models are still far from enough reliable tools for good, comprehensive and long-range forecasting.

Human civilization experienced various kinds of natural disasters. In last decade we had a series of severe mega-storms with devastating effects in the USA, volcano eruption in Iceland that heavily blocked air transportation in Europe (Budd and others, 2011), tsunami in Indian Ocean, earthquake with tsunami in Japan, wildfires in Australia, Mediterranean countries but in Russia as well, heavy earthquakes in Haiti and in Asia, long drought in Africa, devastating floods, and so on. One should not separate such disastrous events from climate change perceived narrowly just as global temperature grow. Common sense may suppose that body's volume enlarges proportionally with grow of temperature. In the case of our planet, that means that Earth's tectonic plates will make some motion which could be a trigger for earthquakes, tsunamis, volcano eruptions, etc.

2. DEFENSE FORCES MISSIONS AND CLIMATE CHANGE

In any nation state, defense forces are considered as highly organized, structured, robust, respective, trained and equipped social entity that are very appropriate for meeting different types of security challenges including natural or man-made disasters. In general, it is a kind of a last resort capacity of one society for dealing with various large-scale security challenges.

The purpose of the defense forces (tasks, duties, responsibilities) is usually given in strategic documents related to the national security and defense. Number and type of declared missions varies depending on country. However, there are three general types of missions for the military that could be found in strategic documents of different countries:

- Defend the country, nation and national interests (traditional tasks of armed forces).
- Contribute to the global peace (by participating in peace missions abroad).
- Support the civil authorities in a case of natural or man-made disasters.

The first mission is the most traditional task and every military organization is very familiar with that. Personnel strength, size of organizational structures, quality of equipment, military training and strategic and doctrinal documents, are mainly determined and oriented towards preparation for use of military forces for the purposes of the first mission: defending the country.

The second mission becomes very actually during the last few decades: many troop-contributing countries, many missions, many different places, increased mission duration, etc. Peace supporting is relatively new mission (comparing with the first mission) for the military. It is a lot different from the first mission. It demands new capabilities from military organization and particularly from the military man and woman as individuals. Fortunately, peace missions are in their essence of international character. Wide portfolio of specific training and operating procedures has been developed during decades in many countries. International military cooperation developed and sustained during the peace missions, evolve progressively on many other activities before (training, and preparation) and after mission (lessons learned, training improvement, etc).

For the first and the second mission, it could be said that modern military organizations are well prepared, trained, equipped and more or less familiar with. However, it couldn't be said for the third mission. The military organizations usually are not exclusively dedicated to the preparation of capabilities for natural or man-made disasters. However, the third mission is in a very close relation with negative consequences of climate change.

While traditional missions of defense forces are well presented in strategic documents and well evaluated towards implementation, the question arise how much defense forces are prepared, equipped and trained for conducting a mission of supporting society in a case of disasters (third mission). We start with investigating a placement of this mission ("third mission" in a further text) in a strategic documents related to national security and defense for a number of countries.

De France and Witney (2013), gave comparative qualitative analyses of security strategic documents for a European Union countries. This analysis generate ranking list of national security documents against criteria of comprehensiveness and currency. We used theirs results to pay more attention on those strategic documents that are estimated as very good, in order to recognize successful approaches and use them as a model in a future work.

In national strategic documents of various countries, the mission of defense forces related to challenges caused by (but not exclusively) climate change, appears in next forms:

- Support to civil authorities in countering security threats (Serbia).
- Defend the Homeland and Provide Support to Civil Authorities; and Conduct Humanitarian, Disaster Relief, and Other Operations (USA).
- Supporting civil emergency organizations in times of crises (UK).
- Protect nation and territory from major crises resulting from natural, health, technological, industrial or accidental risks (France).
- Supporting civilian bodies (Czech Republic).
- Contribute to countering natural and industrial disasters, mitigating their consequences, managing humanitarian crises and, if necessary, and participating in the support of civilian authorities (Hungary).

- Contribution to the National Security in Peacetime includes: protection and support to the population in case of natural disasters, industrial accidents and ecological crises; providing humanitarian relief; support to migration control; search and rescue activities; support when necessary to other government organizations and local authorities to prevent and overcome the consequences of natural disasters, industrial accidents, ecological crises and epidemics (Bulgaria).
- Assistance in the case of natural catastrophes and disasters of exceptional magnitude (Austria).
- Support other authorities on the basis of their requests for executive assistance, or in accordance with jointly implemented contingency plans (Finland).
- Assisting the civil authorities in response to major emergencies, natural disasters and in the maintenance of essential services (Ireland).

3. CLIMATE, WEATHER AND MILITRAY OPERATIONS

One of direct implications of climate change is change of weather conditions. Temperature, rain, snow, wind, in all theirs aspects and combinations, are factors that have tremendous impact on living and working conditions and all other activities of human society including international and internal conflicts and warfare. Weather conditions may have direct and indirect influence on national security and on engagement of national army. Potential influences of severe weather conditions on planning and conducting military operations could be numerous. To mention some of the most famous events from historical evidence where weather conditions made crucial impact:

- Debacle of the Spanish Armada at the end of 16.century. Spanish Navy, during expeditionary operations against Kingdom of England in 1588, had been faced with very strong North Atlantic storm that destroyed the Spanish fleet. It was introduction in the historical change of the strategic balance on the Atlantic between Spain and England.
- Influence of severe Russian winter on military operation in French-Russian war in 1812, and again on military operations during the World War II, particularly in 1941 and 1942.
- Weather conditions influenced a delay of the D-Day in operations Overlord in World War II (Allied invasion of Normandy, France). Landing operation was planned to start on the beginning of June, 1944, but it was threatened by strong wind, high seas and clouds. Initially planned D-Day was shifted to June 6, 1944. Weather forecast by military meteorologists suggested that day as it was expected to be slightly gentle weather and sea conditions. Otherwise, whole operation would have been delayed for at least one month.

Climate change makes impact on all sides in potential conflict, but also it changes the “theatre of operation”. Climate change may generate much worst weather conditions then mankind ever experienced in its history. That may place new challenges to the military organizations and on planning and executing of military operations. Some consequences of climate change could be indirect reasons for triggering situations for any of those three missions. In cases of first and second mission, climate change may:

- Induce tremendous increase of the need for some vital resources (energy, water, food, etc).
- Dramatically reduce availability of the currently available natural resources.
- Open new problems (new transportation routes across the Arctic Ocean; border issues on sea; under-sea resources exploitation; etc).
- Large-scale migration.

4. ALL MISSIONS SIMULTANEOUSLY – ONE HISTORICAL EXAMPLE

Looking back in history, it could be found some good examples of use of military forces for support civil population in some dramatic natural disasters. There are many examples where national armed forces are used to help civil population and authorities in fighting with floods, earthquakes, wildfires, high snowdrifts, etc. It is clear that respective logistical resources and well organized and disciplined military units are of great help in emergency situations caused by natural disasters.

However, natural disasters may arise in any time. They may appear in a peacetime, but also during some war. So, the military forces may be affected to perform two or even all three pointed missions at the same time. This may seem as logical exercise of scholar strategists, but it actually happened in not so far past. During the World War II, in March 1944, there was volcano eruption (Vesuvius, Naples region) in south Italy, just in period of famous Monte Casino battle.

Telling the story in a modern vocabulary, US and UK military forces performed the first mission (defending the country and national interests), which was somehow extended towards the second mission (wide international coalition that included: democratic states, common interest partners and resistance movements, conducted peace enforcement operations outside of national borders). Suddenly, in the middle of military operations, volcano eruption generated the need for performing the third mission. Comprehensive description of that situation with very good conclusions and recommendations was presented by Chester and others (2007). Frontline between Allied and German forces was few hundred kilometers on the north from Vesuvius, and final battle of Monte Casino started on 15 March 1944. Southern part of Italy, including Vesuvius region, was under Allied forces administration. The volcano eruption started in the middle of afternoon on 18 March 1944, and became a threat for around 600,000 people who leaved at that time in the Vesuvius area.

The responses of the USA and UK military forces were timely and comprehensive to that natural disaster. They took over complete responsibility for volcano emergency response: started with situational awareness; used military meteorology capacities to predict wind direction and intensity (because of volcano ash); call for cooperation local population and some local scientists for volcano behavior; engaged military engineering equipment (bulldozers, trucks) for sustaining transportation routes functional; helped in rescue and evacuation on hot spots; and prepare contingency plan for large-scale evacuation of civil population mostly by sea, for the case of worst-case scenario.

5. CONCLUSION

Long-term vision of the national and international security, incorporate the climate change issues and theirs complex implications as one of the most important factors. At the moment, climate change security consequences (mainly in the form of natural disasters) are recognized in many strategic documents related to national security and defense. Defense forces are seen normatively as a supporter of civilian authorities in coping with disasters, and not as a chief executive body.

Order of magnitude of needed resources, skills, information, etc, for comprehensive respond to possible disasters caused directly or indirectly by climate change, could be so huge that no single organization could cope with it, at least not so effectively and efficiently as it could be in coordination and cooperation with other organizations of the national states, but also with others at the international level. In that sense and in this context, future research could be related towards investigating concepts known in the field as: The whole of government approach; International military cooperation; Smart defence; Civil-military cooperation; etc.

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REFERENCES

Alexander, D. (2013). Volcanic Ash in the Atmosphere and Risk for Civil Aviation: A Study in European Crisis Management. International Journal of Disaster Risk Science. 4(1), 9-19.

Budd L., Griggs S., Howarth D., Ison S. (2011). A Fiasco of Volcanic Proportions? Eyjafjallokull and the Closure of European Airspace. Mobilities. 6(1), 31-40.

Chester, D.K., Duncan A.M., Wetton P., Wetton R. “Responses of the Anglo-American military authorities to the eruption of Vesuvius, March 1994”. *Journal of Historical Geography* 33, (2007): 168-196.

De France, O., Witney N. “Europe’s Strategic Cacophony”. European Council on Foreign Relations, 2013. Retrieved from http://ecfr.eu/page/-/ECFR77_SECURITY_BRIEF_AW.pdf

Defense Science Board. “Trends and Implications of Climate Change for National and International Security”. Office of the Under Secretary of Defense For Acquisition, Technology, and Logistics, USA, 2011. Retrieved from http://www.acq.osd.mil/dsb/reports/ADA552760.pdf

Department of Defense. “Sustaining U.S. Global Leadership: Priorities for 21st Century Defense”. Department of Defense, USA, 2012. Retrieved from http://www.defense.gov/news/ defense_strategic_guidance.pdf

Department of Defense. “Green Paper on Defence”. Ireland, 2013. Retrieved from http://www.defence.ie/ WebSite.nsf/grnPaperE

Federal Ministry of Defense and Sport. “Weiss buch” (White paper). Austria, 2012. Retrieved from http:/ www. bundesheer.at/pdf_pool/publikationen/weissbuch_2012.pdf

House of Commons Defense Committee. “The Strategic Defence and Security Review and the National Security Strategy”. UK, 2011. Retrieved from http://www.publications.parliament.uk/pa/ cm201012/cmselect/ cmdfence/761/761.pdf

Marshall M. (2012). Europe in 2050: A survivor’s guide to climate change. New Scientist. 216(2893), 8-9.

Ministry of Defense. “Defence strategy of the Republic of Serbia”. Ministry of Defense, Republic of Serbia, 2009. Retrieved from http://www.mod.gov.rs/multimedia/file/staticki_sadrzaj/dokumenta/strategije/ Strategija_ odbrane_RS_eng.pdf

Ministry of Defense. “French White Paper on Defence and National Security”. France, 2013. Retrieved from http://www. defense.gouv.fr/english/portail-defense

Ministry of Defense. “The White Paper of Defence”. Czech Republic, 2011. Retrieved from http://www.army.cz/ministry-of-defence/newsroom/news/the-white-paper-on-defence-2011--63155/

Ministry of Defense. “Hungary’s National Military Strategy”. Hungary, 2012. Retrieved from http://www. kormany.hu/download/b/ae/e0000/national_military_strategy.pdf#!DocumentBrowse

Ministry of Defense. “White paper on defence and the armed forces of the Republic of Bulgaria”. Bulgaria, 2010. Retrieved from http://www.md.government.bg/en/documents_others.html

Pain, S. (2012). Coffee to go: Is this the end of our favorite drink. New Scientist. 217(2898), 32-35.

Prime Minister’s Office Publications. (2012). Finnish Security and Defence Policy 2012 Government Report. Finland. Retrieved from http://vnk.fi/julkaisukansio/2012/j05-suomen-turvallisuus-j06-finlands-sakerhet/ PDF/VNKJ0113_LR_En.pdf

Tanner, F., Al-Rodhan N.R.F., Chandiramani S. (2009). Security Strategies Today: Trends and Perspectives. Geneva Centre for Security Policy. Retrieved from http://www.sustainablehistory.com/ articles/gcsp_gp_09.pdf

TECHNOLOGY AND INNOVATION MANAGEMENT

SUSTAINABLE TECHNOLOGY MANAGEMENT AND DEVELOPMENT - STATE, UNIVERSITY AND INDUSTRY PERFORMANCE MODEL

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Abstract: *In this paper a general model is created for measuring the performance of Technology and Innovation Management (TIM) related to the crucial dimensions/elements of the Triple Helix (TH) model. More precisely, the Triple Helix Model (high education – government - industry) is analysed in relation to its fulfilling the three main functions of TIM: planning, organizing and control (POC). The general model – TMD-TH (Technology Management and Development – Triple Helix) represents the framework for further more specific research into the relations of the observed dimensions. The general model is further divided into sub-models: TMD-G, TMD-U and TMD-I, where G stands for government, U stands for university and I denotes industry. The sub-models are to be investigated in more detail and the research results will be presented in separate papers. In the general model, the performance of each TH dimension is to be monitored by a set of indicators classified into categories according to the specific management function (POC) of TIM. The general model enables better systematisation of the indicators of TIM with links established with the main roles of the actors in the TH model. When applied in concrete situations in practice, at the level of national economy, the results obtained represent a base for developing policies and strategy that will be oriented at introducing change in the domains of highest priority in the aim of achieving more efficient and effective results in sustainable development.*

Keywords*: Triple-Helix (TH) concept, Sustainability, Technology and Innovation management (TIM), General model, Performance Indicators*

1. INTRODUCTION

In the dynamic global environment, with continuous and exponential technological growth and development, the relevance of the research conducted in managing technology, innovation and change is of high priority. The ultimate goal of achieving global competitiveness of firms and economies means that one of the crucial competitive factors today, technology and innovation, is to be managed by closely measuring, monitoring, controlling its performance. Why is managing technology so important? As stated in (White & Bruton, 2007), the necessity for technology management lies in: (a) the rapid pace of technological changes which require multidisciplinary approaches; (b) the rapid pace of technological development which shortened product life cycles; (c) the need to cut time for product development and create more flexible organizations; (d) the necessity to maximize competitiveness effectively by using new technologies; (e) the importance of changing management tools caused by rapid technology changes. Technology and innovation is placed at the centre of the policies and strategy developed for firms, industries, national economies, regions, sectors, etc. In this paper we develop the general model of sustainable technology and innovation management based on the assertion that it is the management of technology and innovation, not just the new technologies themselves, that represents the true competitive force leading to sustainable development.

Effective TIM is dependent on the capacities to measure and monitor performance which is not an easy task having in mind the interrelatedness of the activities, the time dimension and delays inherent to research and development inputs and effects, synergies, etc. Up to now, in both practice and theory, mostly used indicators of technology and innovation management (TIM) were related to research and development (R&D) activities, intensity of technology changes and degree of implementing innovations. The overview of literature in the field of TIM, as evidence of theoretical and empirical studies, shows that it is necessary to develop a complete, comprehensive approach. In this paper, an original attempt is made to classify and systematize TIM indicators according to basic management functions - planning, organizing and control (POC) linked to the performance of Triple Helix (TH) actors. The role of TIM as key factor in accomplishing sustainable development is clearly pointed out in theory and justified in practice, as sustainable new technologies and innovation lie at the core of economic, social and technological progress. The capacities and competencies in managing technologies are becoming at least as important, if not, even more significant than the capacities of the technologies, *per se*. TIM performance is measured and tracked by indicators at different levels: national economy, economy sectors, and companies. In this way, priorities are set for future actions in

order to improve management areas that are not developed enough, and to achieve the overall goals of efficiency and effectiveness of technology management at all levels.

The perspective of sustainable development requires an overall approach, encompassing indicators classified by using the Triple Helix concept (Etzkowitz & Leydesdorff, 1995). The TH comprises the hybridization of three dimensions/elements university, industry and government in order to generate new institutional and social formats for the production, transfer and application of knowledge (The Triple Helix Concept, 2013).

The basic hypothesis and assumptions elaborated in this paper are the following:

General hypothesis:

1. Technology management and entrepreneurship is as important as development of technology, *per se,* for sustainable development, and

Special hypothesis and assumptions:

1. TH model is a basic model for sustainability and TIM indicators are established according to the dimensions/elements of TH,
2. TIM functions, elaborated by POC, classified according to TH dimensions/elements, enable the establishing of the comprehensive, general model,
3. The general model with feedback relations is applicable for effective strategic management in the state, university and industry domains,
4. Application of the model with systematized indicators in practice is a valuable tool for more effective strategic analysis, establishing policies and strategy and their implementation, with specific tasks for TH-state, university and industry related to different functions of TIM.

In this paper, the authors have created a new general cross-functional model for measuring sustainable technology management and development, TMD-TH, based on two concepts: (1) TH concept with three dimensions: university, industry and government; (2) management concept based on three management functions – planning, organizing and control.

2. THE PRODUCTIVITY PARADOX AND THE TRIPLE HELIX CONCEPT

Building knowledge-based economy and society in the traditional sense is not sufficient enough for substantial economic and social progress and development. Theoretically and in practice it has been discovered that, despite the undoubtedly central role of investments in new knowledge in economic growth, there is still a neglected, missing link to economic growth, employment opportunities and international competitiveness. (Levi Jakšić et al., 2011a)

The productivity paradox detected in the 1950s discovered a new phenomenon: the investments in physical capital were increasing, but the productivity indicators decreasing (Bailey, M. N., Chakrabarti, A. K., 1988, pp.5). The fact that intangible components have been neglected showed that a new perspective and paradigm was necessary. The Japanese management approaches that emphasize the «soft» elements had proved effective and were pouring into Europe (especially Sweden, Germany) in the 1960s and by the mid-1970s in the United States emerged the shift of focus towards intangible assets. Knowledge, creativity, ideas and knowledge based capabilities and skills were found to have been neglected whereas resulting in productivity slowdown while the physical capital investments were still growing. This result pointed out to intangible technology components and knowledge as inevitable in economic growth models (Levi Jakšic, 2011).

The scholars were quick to point to the common denominator for success: a shift away from the factor of physical capital towards knowledge capital, which generally consists of: science, technology, creativity, ideas. (Acs, Z.J., Audretsch, D. B., Strom, R. J, 2009., p. 7) Different forms of knowledge capital alone were obviously not sufficient in creating competitive strength and firm growth. Technology as the integrative concept emerged, consisting of physical/tangible and intangible elements. This opened a new perspective in understanding the forces of competitiveness in the detailed analysis of the factors relevant to technological progress and growth.

The productivity paradox of the sixties has evolved as the Swedish paradox in the last decades of the past century – «as measured by the most common benchmarks of knowledge investments, such as R&D, university research, patents, human capital, education, creativity and culture, Sweden has ranked consistently among world leaders. However, following more than a decade a stagnant growth and rising unemployment, concerned policymakers in Sweden started to worry about what they termed as «the Swedish paradox».(Acs, Z.J., Audretsch, D. B., Strom, R. J, 2009., p. 7) Detecting of the persistent stagnant

economic growth despite high levels of knowledge investments...for the European context, had been termed the European Paradox. (Acs, Z.J., Audretsch, D. B., Strom, R. J, 2009., p. 7)

The new approaches show a clear turnaround focusing on soft elements not only in the form of intangible assets but involving also management principles and practices, entrepreneurship, leadership and emergence of technological rather than technical dimensions at the focus of competitiveness (Levi Jakšić, 2011).

Evidence from the case of Serbia clearly points to the very explicit roles of entrepreneurship that are missing in a country where resources are invested in scientific research but not effectuated in the economy and society. The indicators show that although intensive research in Serbia, when it comes to practical results and commercialization, the R&D phases of innovation lack entrepreneurship. In more detail it is shown that there is very low correspondence between fundamental and applied research. The links between the phases of Research, Development, Commercialization are in need of entrepreneurial cohesion. The entrepreneurship roles are viewed as necessary links to be introduced as follows: Research-Entrepreneurship-Development-Entrepreneurship-Commercialization (Levi Jakšić, 2011).

In the document presented in 2010 by the Ministry of science and technological development of the Republic of Serbia, «Strategy of Scientific and Technological Development of the Republic of Serbia», it is cited that one of the most serious problems of science in Serbia is the fact that a small amount of funds, from mainly one source invested in scientific research are distributed over more than 1 000 projects that were financed by the Ministry in 2009: 501 project of fundamental research for which 50.2% of the budget is allocated and 471 technology development and 129 innovation projects for which 39.2% of the Ministry funds are invested. According to their main definition and goal, the projects of technological development as result are expected to generate applied technological solutions, patents, pilot plants, new sort innovations, technological advancements and results with direct applicability. In the past period, 2003-2007, in the technological development field, over 3400 technical solutions have been realized. But, in spite of the high number of technical solutions, the number of patent applications from research and development institutions in the period of 2003-2009 has been extremely low, only 54. With these results Serbia has the lowest position in Europe.

Serbia is facing the same difficulties as detected for the situation in Europe. ,,The Europe 2020 strategy clearly signalled the importance of industrial competitiveness for growth and jobs as well as for Europe's ability to address grand societal challenges in the coming years. Mastering and deploying Key Enabling Technologies (KETs) in the European Union is central to strengthening Europe's capacity for industrial innovation and the development of new products and services needed to deliver smart, sustainable and inclusive European growth"(HLG on KET Final Report, 2011).

The High-level expert group (HLG) has identified the major difficulties Europe has in translating its ideas into marketable products – in crossing the internationally recognized "valley of death". This situation, namely the gap between basic knowledge generation and the subsequent commercialization of this knowledge in marketable products, has been commonly identified across the KETs and is known in broad terms as the "valley of death" issue. Its effects can include not only relocation of manufacturing and R&D, but also the disruption of entire value chains with their ultimate consequences on the sustainability of various strategic sectors in Europe. The "valley of death" is due to many factors including the absence of smart regulation, the unavailability of pre-commercial R&D support, insufficient access to large scale finance, and lack of political support and pro-active KET. To cross this valley, it recommends a strategy comprising three pillars: a pillar focused on technological research, a product demonstration pillar focused on product development, and a production pillar focused on world-class, advanced manufacturing.

Crossing the "valley of death" in the key enabling technologies in Europe requires the delivery of solutions to the three successive stages implicit in this crossing. The first stage, called "Technological research" consists of taking best advantage of European scientific excellence in transforming the ideas arising from fundamental research into technologies competitive at world level. The second stage, called "Product demonstration" allows the use and exploitation of these KETs to make innovative and performing European process and product prototypes competitive at world level. The third stage, called "Competitive manufacturing" should allow, starting from product prototypes duly validated during the demonstration phase to create and maintain in Europe attractive economic environments in EU regions based on strong eco-systems and globally competitive industries (HLG on KET Final Report, 2011).

Whilst European R&D is generally strong in new KET technologies, the HLG has observed that the transition from ideas arising from basic research to competitive KETs production is the weakest link in European KET

enabled value chains. This is demonstrable evidence of the impact to-date of the absence of a major focus on enabling innovation in the EU and an over-emphasis on basic research both within EU research programs and in some Member States. By focusing on these key stages of the innovation chain, the HLG proposals can trigger a virtuous cycle, from knowledge generation to market flow with feedback from the market to knowledge generation support, thereby strengthening economic development in Europe.

Innovation and opportunity at the base of entrepreneurship is viewed in the perspective of the critical role of institutions in the promotion of innovation defined by national innovation systems, and universities that are cited as critical institutional actors in national innovation systems (Mitra, 2011). The Triple Helix concept is used as the general framework emphasizing the network of institutions in the innovation and entrepreneurship system to be viewed and taken into account in relation to the new roles and responsibilities universities take in the modern world. (Levi Jakšić et al., 2012b) The Triple Helix model does not consider manufacturing as the driving force of economic development in the post-industrial stage. It assumes that the creation and dissemination of socially organized knowledge are playing the key role in creating competitive advantage of an economy. In this sense, institutions that generate knowledge increasingly play a role in the networks of relations among the key actors: University, Industry, and Government. In distinction to the knowledge-based system, which can be considered as an outcome of interaction among different social coordination mechanisms (markets, knowledge production, governance at interfaces), the Triple Helix model gives a heuristic for studying these complex dynamics in relation to developments in the institutional networks among the carriers (Leydesdorff & Meyer, 2006) and those components should generate new institutional and social formats for the production, transfer and application of knowledge. Also, the distinction between these entities and their activities are increasingly overlapping. In areas of intersection, the actors can partially substitute for one another (Ivanova & Leydesdorff, 2012).

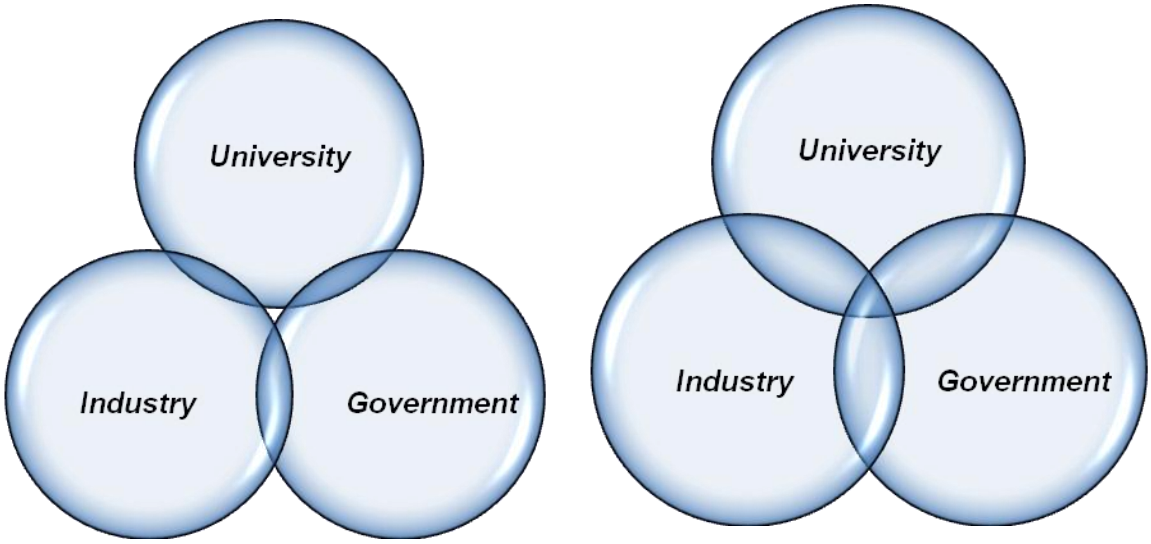


Figure 1: A Triple Helix configuration with negative and positive overlap among the three subsystems (Leydesdorff, 2012b)

The relationship between TH's elements is shown in Figure 1 as alternating between bilateral and trilateral coordination mechanisms or-in institutional terms-spheres. The systems remain in transition because each of the partner institutes also develops its own mission. Because of that, a trade-off can be generated between integration and differentiation, and new systems in terms of possible synergies can be explored and potentially shaped (Leydesdorff, 2012b). TH does not use only economic forces (*Industry*), regulations given by *Government* or research inventions performed by *Universities:* it can combine these categories and focus on examining the dynamics two or even all three components.

TH models can be elaborated in various directions. Networks of university-industry-government relations can be considered as arrangements which can be made the subject of social network analysis. This model can also be used for policy advice about network development, for example in the case of transfer of knowledge and the incubation of new industry. The new role of universities in knowledge-based configurations is the most explored topic among the three TH components, and it can be explored in terms of different sectors, regions, countries etc. (Godin & Gingras, 2000; Shinn, 2002). In some previous research studies (Levi Jakšić et al., 2012a), the thesis was confirmed that there is a constant need to research the universities' role in society, especially the one in practice and compatibility of the practical knowledge with current study programs at different educational levels.

In the TH system, universities have the leading role and this concept assumes that the knowledge universities produce is useful enough to be widely shared and applied, which should lead to national development. Industry operates in the Triple Helix as the place of production, government has the task to create contractual relations that will guarantee stable interactions and exchange, and in the end, the university is the source of new knowledge and technology, the generative principle of knowledge-based economies (The Triple Helix Concept - Theoretical Framework, 2011). The boundary between institutional spheres is blurred, because universities assume entrepreneurial roles by focusing on the production of useful knowledge and its exchange across a wider network of key players in socio-economic system. Also, industry should not only use practical appliance of knowledge, but also producing knowledge with a purpose of creating a wealth. And, finally, government has the task to facilitate interactions of industry and universities by creating policy frameworks for successful functioning of this cooperation. In developing countries, the challenge is to operationalise the TH system in order to provide sustainable basis for wealth creation and poverty reduction (Saad & Zawdie, 2011). Because of that, it is necessary to have some measures and indicators which will show the performance of a country within each TH area. In this paper, we develop a general model that examines all three components of the TH concept, and further research focuses on each component separately.

3. CROSS-FUNCTIONAL TIM MODEL

Technology and Innovation management implies: planning, organizing, leading, directing, organizing, coordinating and controlling all technology activities (operations) with the ultimate goal of providing continuous success (profitability, market share, environmental protection etc.). It includes all technological activities, strategic ones, related to management of technology development, through management of innovation, technology transfer, R&D activities and operational ones including managing a specific technology system, processes and operations as the form of implemented technology. (Levi Jakšić et al., 2011b) TIM, as specific set of competencies in the competency based competitiveness approach, is recognized as the critical success factor for firms, sectors, economies and regions. The integral TIM concept is focused at managing technology as external force and internal factor of the firm meaning that both the innovative and technological infrastructure and the technology and innovative capacities of the firm are taken into account. Managing technological diversification is a significant dimension of the new paradigm leading to operations competitiveness of the firm closely related to its innovative capabilities. (Levi Jakšić et al., 2012a)

In the previous section, it was postulated that the original TH model considers three entities represented in Figure 1. However, in some previous research (Levi Jakšić et al., 2012b), the authors concluded that for the relevant analysis of universities' impact in the economy, society and economic development it is necessary to introduce an extended Triple Helix model with an additional, fourth component - knowledge and science development (**Figure 2**). Its necessity derives from the interrelation between the dynamic category of science and knowledge development results and industry/economy/society sustainable needs with the government special roles in creating policies and funding research and development as well as educational and entrepreneurial activities in the economy and society. This new component influences the development of study programs which have the task to quickly respond to the latest environmental requirements by introducing the latest scientific results and findings in the study programs. In this paper, we examine measuring performance of TIM indicators based on the original TH model, but further research should include the science component, as well, because of its influence and a special role it plays in each of the traditional components of the TH model.

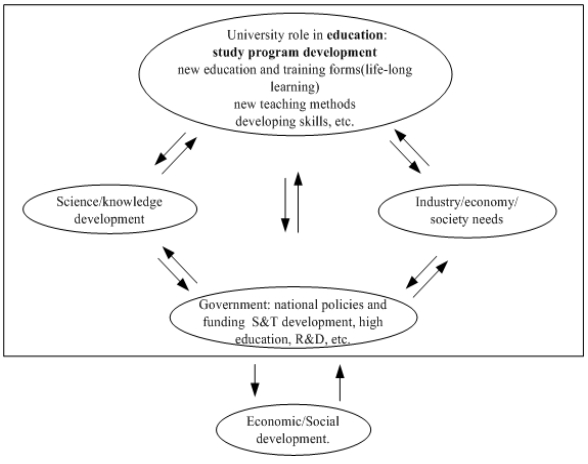
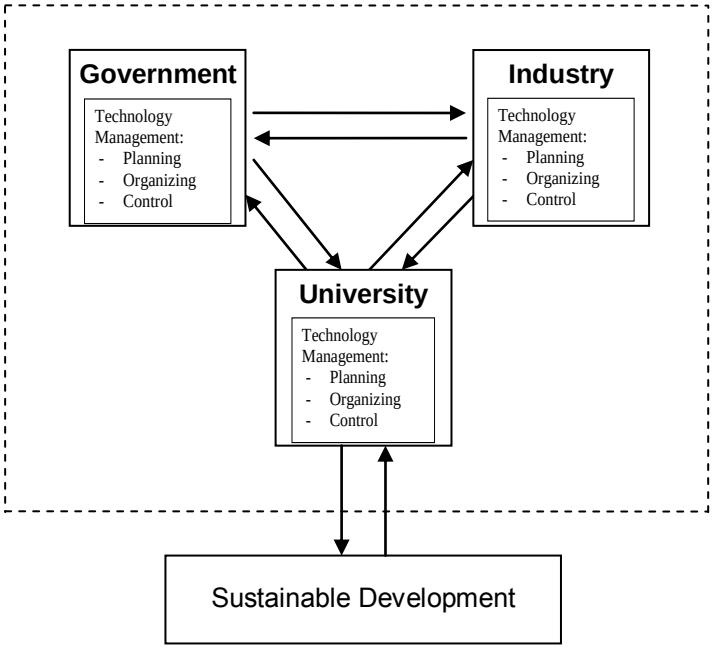


Figure 2: Study program development, Triple Helix and economic development. (Levi Jakšić et al., 2012)

Figure 3 shows the basic cross-functional TIM model, developed from the perspective of the Triple Helix (TH) concept and basic technology management functions. Firstly we have three separate TH entities: Government, Industry and University. Within each of the dimension we measure how successful the entity is in managing technology by evaluating its performance in each management function: planning, organizing and control. In this way, it is possible to view the current state, set the priorities within each category and to determine tasks that have to be performed in order to enhance sustainability based on prioritized actions in



certain areas. All these dimensions determine sustainable development, and by using the established model the relevant feedback is possible for effective decision making.

Figure 3: General cross-functional model

At a closer look at the model (**Figure 4**), we can examine in more detail the performance of technology management. Within each TH dimension, performance indicators are divided by basic management functions: planning, organizing and control. Planning activities and indicators are considered as inputs. These indicators measure infrastructure, investments and all other assets that are necessary to execute the main tasks and to achieve the results of the entity. Organizing performance is observed as a process that is transforming inputs (results of planning activities) into outputs..

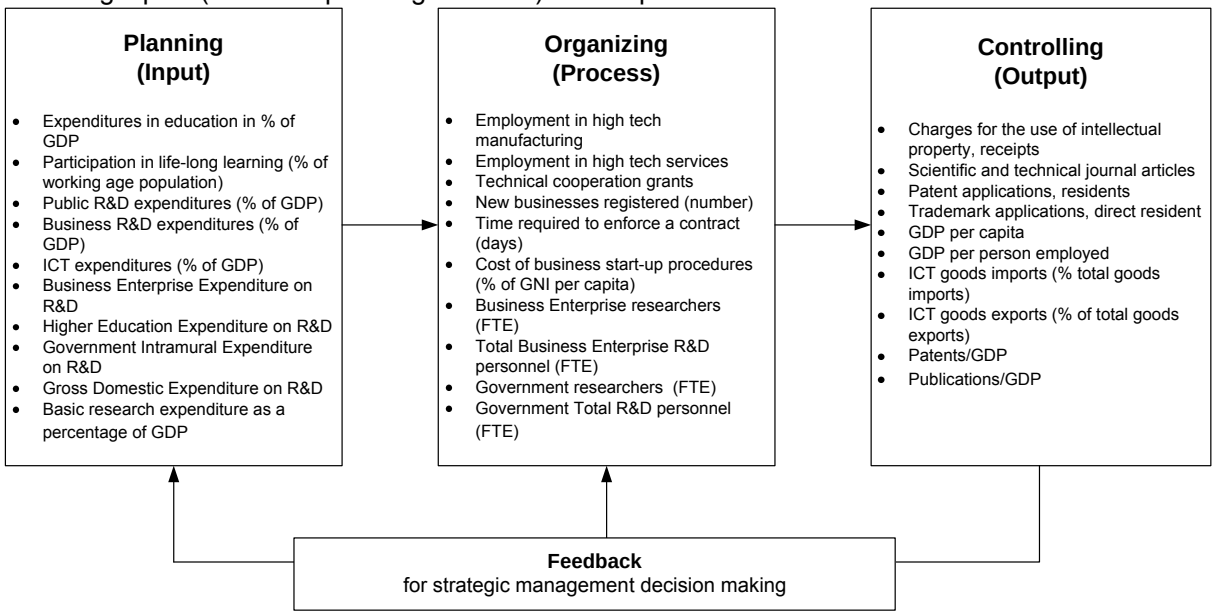


Figure 4: Technology Management Model[1]

[1] Indicators taken from (World Bank Indicators, 2014;EIS Indicators, 2009; Eurostat Indicators, 2014; OECD Indicators, 2014)

And, at the end, control is considered as the result of inputs (planning) and transformation in process of organizing. The control indicators are related to measuring the results of investing and managing (i.e. no. of patents, published papers etc.). These results are providing the feedback which is crucial for further decision making process related to achieving more in the level of sustainability. It should be noted that it is very difficult to separate indicators by these two dimensions (TH and TIM functions), and some overlapping and, the so-called "grey zones" are inevitable (as shown in **Figure 1**), especially in control activities, which are outcomes, the results that cannot be easily assigned to a category. In this case indicators would be repeated and classified in more than one category.

The model is decomposed for each TH component, and each component consists of its own indicators of TIM performance as shown in **Figure 5**.

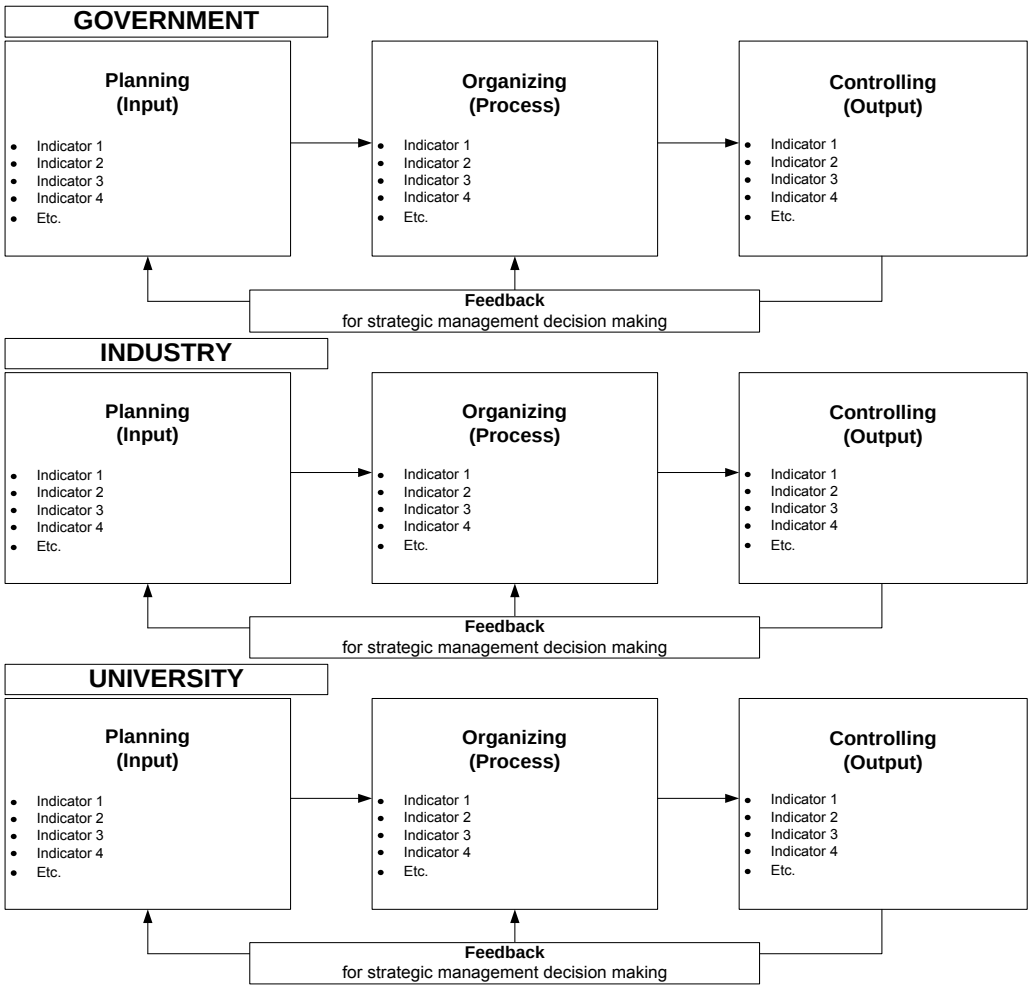


Figure 5: Developed sub-models of TIM model for each TH component

This model not only presents and classifies indicators, but it also highlights the connections that exist between these groups of indicators. At the end, the general model presents a framework for measuring performance of TH entities in TIM at the level of a national economy. It should be noted that the set of indicators may not be the same for each country, because of the specificity of each environment, but the majority will be applicable in most cases. In the general model presented in Fig. 5, the indicators are not specified and it should be noted that they need to be separated by TH components. Every component is to be examined separately and indicators for each management function should be defined. The indicators are developed according to the following criteria: easy measurable, accurate and the relevant data available. The model presented in Figure 4 consists of indicators measured by Eurostat, European Innovation Scoreboard (EIS) World Bank, OECD and similar organizations which provide relevant data and further research, considering identifying indicators for each TH component, and each management functions, would necessarily rely on these sources.

4. CONCLUSION

In the highly competitive global environment, with interminable and accelerating technological growth and development the necessity for technology management is not questionable (White & Bruton, 2007) Technology provides competitive advantage and is the crucial dimension in government, firm, industry, regional, and other, strategies. Levi Jakšić et al. 2011 state that, theoretically and in practice, it has been discovered that there is a missing component in acquiring economic growth with new employment opportunities and technological development. The missing link is the management of innovation and technology and technological entrepreneurship. It is crucial to enable scientific and technological developments oriented at creating new value in the economy and society. Efforts at achieving the efficient transition of science into new technologies and new technology into new value are the main task of effective TIM. In this effort, all the players within the TH model are significant as the TH notes the network of actors in the innovation and entrepreneurship system to be viewed and taken into account. The TH concept underlines the role of university in new, modern, knowledge-based economy. It also inspects the relations among the three components of a knowledge-based economy: (1) the knowledge-producing sector (University), (2) the market (Industry), and (3) Governments (Cooke & Leydesdorff, 2006).

In this paper we develop a general cross-functional model for measuring TIM performance of a national economy, from a TH perspective, creating separate sub-models for each TH component. This general model with the relevant indicators represents a base for measuring and monitoring how successful a national economy is in managing technology. All the basic management functions in TIM are evaluated (POC) enabling specific tracking of their performance coupled with the analysis of the contribution of each TH dimension in the specific performance of TIM. The complete analysis performed after the model is applied in concrete, real world situation, is the necessary tool for setting priorities and achieving better results in fulfilling the relevant goals of sustainable development: economic, social, environmental. In this paper, a list of the indicators is proposed based on the material provided by the World Bank and OECD, but the list is not closed and still needs to be extended and classified for each component of the TH model. It is planned that the general model as well as the sub-models be tested in a concrete situation, starting from the concrete results for Serbia and further to compare the situation with the countries in the region, as well as with the developed countries. This would enable a complete picture to be established with the cause and effect relationships more clear and leading to more precise and targeted policies and strategy with effective and sustainable TIM achieving sustainable development.

REFERENCES

Acs, Z.J., Audretsch, D. B., Strom, R. J.(2009). *Entrepreneurship, Growth, and Public Policy*, Cambridge University Press.

Bailey, M. N., Chakrabarti, A. K. (1988). *Innovation and the Productivity Crisis,* Brookings Institution, Washington

Cooke, P., & Leydesdorff, L. (2006). Regional Development in the Knowledge-Based Economy: The Construction of Advantage. *The Journal of Technology Transfer, 31*(1), 5-15.

EIS Indicators. (2009). Retrieved April 10, 2014, from European Innovation Scoreboard - EIS: http://ec.europa.eu/enterprise/policies/innovation/files/proinno/eis-2009_en.pdf

Etzkowitz, H. (2007). University-Industry-Government: The Triple Helix Model of Innovation. *EOQ Congresses Proceedings. 51st EOQ Congress, 22-23 May 2007.* Prague.

Etzkowitz, H., & Leydesdorff, L. (1995). The Triple Helix---University-Industry-Government: A Laboratory for Knowledge-Based Economic Development. *EASST Review 14*, 14-19.

Eurostat Indicators. (2014). Retrieved April 10, 2014, from Eurostat: http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/indicators/all_indicators

Godin, B., & Gingras, Y. (2000, February). The place of universities in the system of knowledge production. *Research Policy, 29*(2), 273-278.

High Level Group (HLG) on Key Enabling Technologies (KET) Final Report (2011). European Commission,

Ivanova, I., & Leydesdorff, L. (2012). Rotational Symmetry and the Transformation of Innovation Systems in a Triple Helix of University-Industry-Government Relations. *Technological Forecasting and Social Change*.

Levi Jakšić (2011). Sustainable Technology and Innovation management, in Y. Tsekouras, A. Damyanov, et al, ed, *Recent Economic crisis and Future Development Tendencies*, Rostov on Don, Russia

Levi Jakšić, M., Marinković, S., & Kojić, J. (2012a). Technology and Innovation Management in Serbia. *Proceedings of the XIII International Symposium SymOrg 2012: Innovative Management and Business Performance*, (pp. 1852-1860). Zlatibor, Serbia.

Levi Jakšić, M., Marinković, S., & Petković, J. (2011a). From Knowledge Based to knowledge entrepreneurship economy and society - the Serbian paradox. *Proceedings of the 30th International*

Conference on Organizational Science Development, Future organization (p. 270). Portorož, Slovenia: Založba Moderna organizacija.

Levi Jakšić, M., Marinković, S., & Petković, J. (2011b). Razvoj oblasti i kurikuluma menadžmenta tehnologije. *SPIN '11 VIII Skup privrednika i naučnika: Operacioni menadžment u funkciji održivog ekonomskog rasta i razvoja Srbije 2011- 2020* (pp. 67-74). Beograd: Fakultet organizacionih nauka.

Levi Jakšić, M., Marinković, S., Petković, J., & Kojić, J. (2012b). Managing University Impacts on the Economy. *31st International Conference on Organizational Science Development QUALITY. INNOVATION. FUTURE.* Portorož, Slovenia.

Leydesdorff, L. (2012a). The Triple Helix, Quadruple Helix, …, and an N-Tuple of Helices: Explanatory Models for Analyzing the Knowledge-Based Economy? *Journal of the Knowledge Economy, 3*(1), 25-35.

Leydesdorff, L. (2012b, February). The Triple Helix of University-Industry-Government Relations. *Encyclopedia of Creativity, Innovation, and Entrepreneurship, New York*.

Leydesdorff, L., & Meyer, M. (2006). Triple Helix indicators of knowledge-based innovation systems: Introduction to the special issue. *Research Policy, 35*(10), 1441-1449.

Mitra, J. (2011). *Entrepreneurship, Innovation and Regional Development.* New York: Routledge.

Mowery, D.C., Nelson, R.R., Sampat, B.N.,Ziedonis,A.A. (2004). *Ivory Tower and Industrial Innovation: University-IndustryTechnology Transfer Before and After the Bayh-Dole Act*, Stanford Business Books, Stanford.

OECD Indicators. (2014). Retrieved April 10, 2014, from Main Economic Indicators - complete database: http://www.oecd-ilibrary.org/economics/data/main-economic-indicators_mei-data-en

Saad, M., & Zawdie, G. (2011). *Theory and Practice of the Triple Helix Model in Developing Countries: Issues and Challenges.* New York: Taylor & Francis.

Shinn, T. (2002, August). The Triple Helix and New Production of Knowledge: Prepackaged Thinking on Science and Technology. *Social Studies of Science, 22*(4), 599-614.

The Triple Helix Concept - Theoretical Framework. (2011). Retrieved April 15, 2014, from Triple Helix Conference: www.triplehelixconference.org/th/9/the-triple-helix-concept.html

The Triple Helix Concept. (2013). Retrieved March 21, 2014, from Stanford University - Human Sciences and Technologies Advanced Research Institute: http://hstar.stanford.edu/3helix_concept

White, M. A., & Bruton, G. D. (2007). *The management of technology and innovation: a strategic approach.* Mason, OH: Thomson/South-Western.

World Bank Indicators. (2014). Retrieved April 10, 2014, from World Bank: http://data.worldbank.org/indicator/

GOVERNMENT PERFORMANCE IN TECHNOLOGY AND INNOVATION MANAGEMENT – THE CASE OF SERBIA

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Abstract: *This paper analyses the role of the state/government as one element of the Triple Helix model, and its role in Technology and Innovation Management (TIM). In order to observe the results of the measures and actions taken by the government, specifically related to the management of technology and innovation, a model was created based on selected quantitative indicators and indices. The model is developed for measuring and monitoring the performance in TIM, where we: first, classified the indicators according to the three basic management functions – planning organizing and control, observed as input, process and output, respectively; and second, show the relations that exist between these three categories of indicators. Planning indicators are observed as the investments in technological and innovative activities; Organizing indicators include the infrastructure, public administration efficiency and cooperation support, while control indicators refer to the national economy R&D and technology transfer effects and entrepreneurship outcomes. The model is tested based on the indicators for the Republic of Serbia. It is shown that the model is applicable in real world situations as, a useful tool to: 1) analyse the dynamics and changes that occur, 2) notice the interactions between functions of TIM, and 3) use the feedback as support in strategic TIM decision making of a national economy.*

Keywords*: Triple Helix, Technology and Innovation Management, State/Government, Performance, Serbia.*

1. INTRODUCTION

Contemporary management literature and practice recognize technology and innovation management (TIM) as critical success factor for firms, sectors, economies and regions. There is high evidence of steep rise in the development of the scientific field of technology management (Cunningham, 2011) corresponding to the practical needs of managing technology as the fundamental source of competitive advantage of firms and economies (Eskandari et al., 2007). Technological innovations in areas such as materials, electronics, aerospace, computers, telecommunications and biotechnology have influenced the rising dominant forces in the world economy. Yet, there are serious concerns about "our effectiveness in generating and exploiting technology" (Mallick & Chaudhury, 2000). The integral technology management concept is focused on managing technology as external force and internal factor of the firm, meaning that both the innovative and technological infrastructure and the technology and innovative capacities of the firm are taken into account (Levi Jaksic et al., 2012). The main institutions and actors in technology and innovation management process (at macro and micro level) can be identified as university, industry and government - the same elements that are recognized in the Triple Helix concept.

The concept of the Triple Helix (TH) was proposed by Etzkowitz and Leydesdorff in 1990s and today it is still developing through theoretical and empirical research. "The Triple Helix thesis is that the potential for innovation and economic development in a Knowledge Society lies in a more prominent role for the university and in the hybridization of elements from university, industry and government to generate new institutional and social formats for the production, transfer and application of knowledge" (Ranga & Etzkowitz, 2013). University-industry-government relations develop in terms of institutional arrangements that recombine three functions of the socio-economic system: (1) wealth generation and retention, (2) novelty production, and (3) control at the interfaces of these sub-dynamics (Leydesdorff, 2006). Overlap among governments, enterprises and universities, is the core of an innovation system. Interaction among these three players is important determinant of knowledge production and dissemination. During this process, active interaction among these three players promotes the rising spiral of innovation (Rao et al., 2012).

In recent decades, federal, state and local governments have created a variety of mechanisms to encourage knowledge-based economic development (Etzkowitz, 2002). The structure of national R&D system can be examined through the use of a Triple Helix framework that studies the relations among academia, business, and government (Etzkowitz, 2008). Development of a knowledge base is dependent on the condition that knowledge production be socially organized. The interfaces between institutions and functions can be

expected to resonate into co-evolutions in some configurations more than in others (Leydesdorff, 2006). This confirms the relevance of studying country specific university-industry-government configurations (see for example Rao, 2012; Park & Leydesdorff, 2010). Also, each element of Triple Helix could be examined, putting in the context of technology and innovation management and country competitive position.

In this paper, we analyse one aspect of the Triple Helix model – the government sector, and develop a model for measuring and monitoring government performance in technology and innovation management (TIM). We classify TIM performance indicators (of the government sector) into three basic management functions: planning, organizing and control (POC). Since we observe these management functions as input, process and output (respectively), and present indicators for their measurement, we are able to: (1) analyse if there is a correlation between these three functions of TIM and (2) see which function is "ahead" of the others and which one "lags behind", which enables us to determine the weaknesses of government sector performance in TIM. The model is tested and applied in a real world situation, with indicators taken for Serbia.

This paper is organized as follows: Section 2 explains the government role in the Triple Helix model, and observes ways of measuring government performance; in Section 3, a model for measuring and monitoring government performance in TIM is presented; in Section 4 the model is applied in the real situation of Serbia, and Section 5 concludes the paper.

2. GOVERNMENT IN THE TRIPLE HELIX MODEL

The neo (institutional) perspective distinguishes three main configurations in the positioning of Triple Helix (TH) elements. (Ranga & Etzkowitz, 2013) In **statists' configuration**, government plays the leading role, driving academia and industry, but also limiting their capacity to initiate and develop innovative transformations. These examples could be found in Russia, China, Some Latin American and Eastern European countries. **Laissez-faire configuration** us characterized by a limited government intervention in the economy (US, some Western Europe countries), with industry as the driving force and university with limited role in innovation, acting mainly as a provider. Government in laissez-faire configuration is also limited, acting as a regulator of social and economic mechanisms. The Knowledge Society is characterized by **balanced configuration** where universities and other knowledge institutions act in partnership with industry and government and even take the lead in joint initiatives (Etzkowitz & Leydesdorff, 2000). There has been a shift from the model of the state encompassing industry and academia. Development strategies, whether based primarily on the industrial sector as in the US or the governmental sector as in Latin America, are being supplemented, if not replaced, by knowledge-based economic development strategies, drawing upon resources from the three spheres of Triple Helix (Etzkowitz, 2002).

2.1. Measuring government performance

Building knowledge based economy and society in the traditional sense and as defined by traditional indicators is not sufficient enough for substantial economic and social progress and development. Theoretically and in practice it has been discovered that, despite the undoubtedly central role of investments in new knowledge in economic growth, there is still a neglected, missing link to economic growth, employment opportunities and international competitiveness (Levi Jaksic et al., 2011).

Traditional performance measurement systems have concentrated on development of indicators largely relating to economy (inputs) and efficiency (costs) due to the limited ability to measure effectiveness or outcomes in government organizations (Kloot and Martin, 2000). Although government is not, neither the supply, nor in most cases, the demand side of new knowledge and new technologies, it can promote effective enterprise-university interaction in order to facilitate university technology transfer by institutional arrangements, policy making and so on (Rao et al, 2012).

According to Rao et al. (2012) there are two aspects of government R&D investments: one is government R&D funding which indirectly promotes university patent technology transfer activities by supporting teaching and research activities; the other is specialized government R&D programs (foundation) which directly support university patent technology transfer activities. Thus, based on triple helix theory, government R&D investments, including government R&D funding and government R&D programs, can influence university patent technology transfer activities (Rao et al., 2012). It was shown (Chang-Yang, 2011) that it is difficult to evaluate the aggregate effect of public R&D support. The author found out that there are different effects of public R&D support on firm R&D, depending on various firm- or industry-specific characteristics. Four potential channels are identified: the technological-competence-enhancing effect, the demand-creating effect, the R&D-cost-reducing effect and the (project) overlap (or duplication) effect.

The study (Caerteling et al. 2013) showed that government championship is an important positive factor for the performance of technology development projects. Government championing has more impact than

government financial/technical assistance on both project performance and benefits to customers. Implications for practice were identified as: from a policy perspective, government should extend its technology policies by taking on the role as a champion, while companies should invest in building professional relations with champions in government. Despite the general growth of government R&D funding, R&D is potentially an area of government spending that is perhaps the most vulnerable to a budgetary cut in economic downturns. There are cross-national differences in government R&D funding in times of economic hardship (Kim, 2013). Strategic performance management demands an approach that is oriented at financial measures, but also at community concern and long-term development. The framework that presents strategic and balanced local government performance management is presented in Table 1 (Kloot and Martin, 2000).

Table 1: Choice in Local Government Performance Management (Kloot & Martin, 2000, p. 248)

Traditional Approach	vs.	Performance-oriented Approach
Top-down State Government and council-imposed, control-oriented performance management.	vs.	Strategic, collaborative, development of a performance management system involving all stakeholders.
Imposition of universal, industry-wide measures with less validity for specific council.	vs.	In-house development of valid, council specific measures to be used for organizational improvement and benchmarking with like councils.
Periodic reporting for the purpose of meeting control requirements of senior management, councillors and State Government.	vs.	Real-time up-to-date performance information for all stakeholders to monitor progress, demonstrate accountability and manage outcomes.
Piecemeal, myopic approach with a focus on the measurement process.	vs.	Integrated performance management system across the organization focused on value-for-money service delivery and organizational improvement.
Focus on financial measures only.	vs.	Focus on financial and non-financial measures: a results and determinants approach.

Investments in science and technology (S&T) are not the privilege of developed countries. According to Kim (2013) there is much to discover and learn from the experiences of non-OECD countries; in the recent years R&D funding in the developing world, especially countries such as Brazil, Russia, India and China, have been soaring, defying the predictions based on their economic and social levels of development. Political leaders in these countries promote S&T heavily as a springboard to move their nation forward in the increasingly knowledge-intensive economy of the 21st century.

3. A MODEL FOR MEASURING AND MONITORING GOVERNMENT PERFORMANCE IN TECHNOLOGY AND INNOVATION MANAGMENT

There are multiple indicators focused on measuring outputs at the level of industry, academia and government, independent of each other and much less systematic approaches in monitoring influences of outputs of industry, university and government to outcomes (effectiveness) (Singer & Peterka, 2012). In this paper we analyse one aspect of the Triple Helix, the government performance in TIM, and develop a model for its measurement and monitoring. The created model, in which government TIM performance indicators are classified into three crucial management functions – POC, is presented in Figure 1. We observe these three management functions also as three categories of indicators as: input, process and output, respectively.

As planning (input) indicators of government performance in TIM, we identified nine indicators, which refer to the *Investments* in technological and innovative activities of a country. These indicators are: R&D expenditures (% of GDP), Gross Domestic Expenditure on R&D - GERD (% of GDP), Government Intramural Expenditure on R&D - GOVERD (% of GDP), ICT expenditures (% of GDP), Basic research expenditure (% of GDP), Applied research expenditure (% of GDP), Experimental development expenditure (% of GDP), Government expenditure for new ventures/subsidies for new ventures (% of GDP) and Total investments in equipment (% of GDP).

Organizing (process) indicators of government performance in TIM refer to: *Infrastructure*, *Public administration efficiency* and *Cooperation support*. We identified eighteen organizing indicators: (1) nine infrastructure indicators (Government total R&D personnel (FTE), R&D organizations – government sector (number), Internet users (per 100 people), Fixed-telephone subscriptions (per 100 people), Mobile-cellular subscriptions (per 100 people), Personal computers (per 100 people), Electric power consumption (kWh per capita), Science and engineering graduates (% 20-29 population) and Population with 3rd level education); (2) eight public administration efficiency indicators (Time required to enforce a contract (days), Procedures to enforce a contract (number), Time required to register property (days), Procedures to register property (number), Cost of business start-up procedures (% of GNI per capita), Time required to start a business (days), Start-up procedures to register a business (number) and Time to prepare and pay taxes (hours); and (3) one Cooperation support indicator (Technical cooperation grants (BoP, current US$)).

We also identified twelve control (output) indicators of government performance in TIM and classified them into three main groups: *R&D results*, *Technology transfer results* and *Entrepreneurship results*. R&D results indicators refer to the patent activity of a country (Patent applications - resident, EPO patent applications (per million population) and USPTO patent grants (per million population)) and publishing activity (Number of scientific and technical journal articles). Technology transfer results include following indicators: Charges for the use of intellectual property, payments (BoP, current US$), Charges for the use of intellectual property, receipts (BoP, current US$), ICT goods imports (% total goods imports), ICT goods exports (% of total goods exports) and ICT service exports (% of total service exports). Entrepreneurship results are measured through the following three indicators: Number of new ventures (SMEs) with government support, New business density (new registrations per 1,000 people ages 15-64) and New businesses registered (number).

The model consists of thirty-nine indicators of government performance in TIM, classified into three main categories: planning (input), organizing (process) and control (output). The idea of the model is not only to present and classify indicators, but also to highlight the connections that exist between these categories of indicators. Planning indicators are seen as an input in technological and innovative activities of a county, measured through different indicators of investments in R&D and an indicator of government support for new ventures. The idea is to see if these investments are correlated with the Control (output) indicators, which refer to the patent and publishing activity of a country, results of technology transfer and entrepreneurship outcome. As the middle part of this model, which enables transformation of the observed inputs into outputs, we see the organizing (process) indicators which refer to technological and innovative infrastructure, public administration efficiency and cooperation support. The fourth element of the model is the feedback (from control to organizing and control to planning) which helps in making strategic management decisions in the area of TIM at the level of national economy.

Therefore, it is evident that this model presents a framework for measuring government performance in TIM that can be tested in any country. When applying this model, it is possible to include only the indicators that rest upon available data at a country level, so the next step was to make a choice of only those indicators from this list that were available and accessible (through large internet databases such as World bank, OECD, UNDP, UNdata and through the country's Statistical Office) for Serbia.

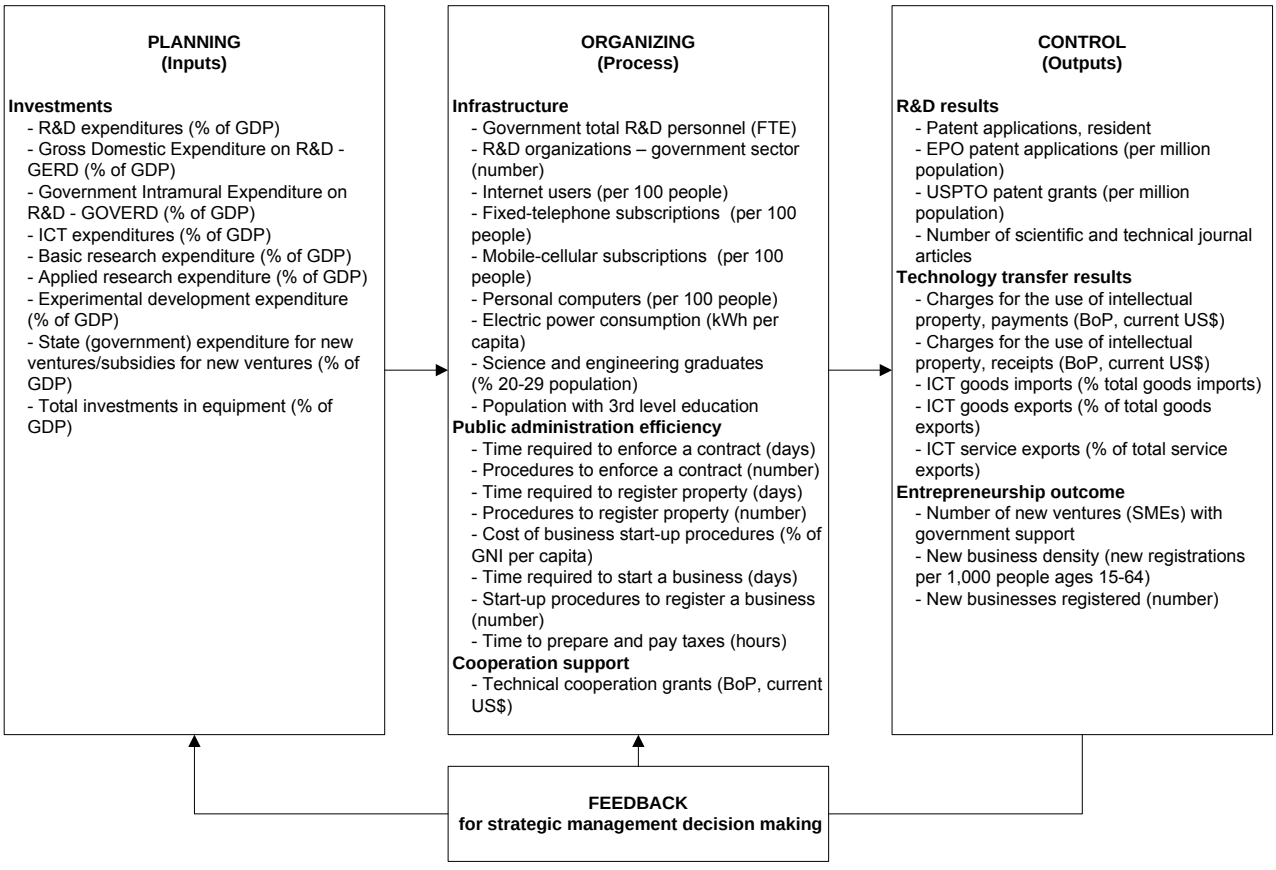

Figure 1: Model for measuring and monitoring government performance in TIM

4. APPLICATION OF THE MODEL WITH INDICATORS FOR SERBIA, RESULTS AND DISCUSSION

In this section we present an application of the created model in the case of Serbia. Thirty-one out of thirty-nine identified government performance indicators in TIM are measured at the country level. Data were collected from different sources: World Bank (2014), UNDP (2014), UNdata (2014), Statistical Office of the Republic of Serbia (2014) and European Commission – ERAWATCH country report – Serbia (2014). Lack of the available data for Serbia is the reason why eight indicators are excluded from this analysis.

In Table 2 we present the analysis of the government performance in TIM for the Republic of Serbia during the period 2008-2011. Column 2 presents the measured indicators of government performance in TIM. Column 3 presents the data source for indicators in Column 2. Columns 4-7 refer to the values of indicators for each year the observed period of time. Columns 8-10 present the indices of change (*IC*) over years, calculated as follows:

$$IC_{\frac{c}{p}} = \frac{Value_c - Value_p}{Value_p} \quad (1)$$

where *c* presents the current year and *p* the previous one. But, this equitation has to be applied with caution, because sometimes increase in value of an indicator over a two-year period has a negative influence on TIM (and vice versa – negative value has a positive influence), so we have to use the opposite value of IC in order to get valuable total result. For example, if we observe Table 2, $IC_{2011/10}$ for the indicator *Time required to register property (days)* is negative because value of this indicator decreased from 91 in 2010 to 11 in 2011 ((11-91/91) = - 0.87912), which is actually a positive phenomenon, so we have to use the opposite value for this IC. This is why this $IC_{2011/10}$ has a positive value of 0.87912. ICs with "opposite" values are marked with a sign * in the table.

Table 2: Indicators of government performance in TIM for the Republic of Serbia, period 2008-2011

Management function	Indicators of government performance in TIM	Data source	Year				Index of change over years (current/previous)		
			2008	2009	2010	2011	$IC_{2009/08}$	$IC_{2010/09}$	$IC_{2011/10}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Planning (input)	***Investments*** [a]						*0.7687*	*-0.0487*	*0.0259*
	R&D expenditures (% of GDP)	World Bank	0.385	0.919	0.764	0.735	1.3892	-0.1686	-0.0389
	Gross Domestic Expenditure on R&D - GERD (% of GDP)	Erawatch. European Commission	0.732	0.919	0.792	0.777	0.2555	-0.1382	-0.0189
	R&D performed by Government Sector (% of GERD)	Erawatch. European Commission	40.41	30.87	36.62	33.77	-0.2361	0.1863	-0.0778
	Basic research expenditure (thousand RSD)	Statistical yearbook of Serbia	4023613	10599663	10194423	10360031	1.6344	-0.0382	0.0162
	Applied research expenditure (thousand RSD)	Statistical yearbook of Serbia	3504120	9249510	6485507	8332825	1.6396	-0.2988	0.2848
	Experimental development expenditure (thousand RSD)	Statistical yearbook of Serbia	2713514	5095793	6147740	5991136	0.8779	0.2064	-0.0255
	Total investments in equipment (thousand RSD)	Statistical yearbook of Serbia	308863895	253368844	230547033	240129422	-0.1797	-0.0901	0.0416
						INPUT CHANGE	**0.7687**	**-0.0487**	**0.0259**
Organizing (process)	***Infrastructure***						*0.0203*	*0.0152*	*0.0092*
	R&D organizations - government sector (number)	Statistical yearbook of Serbia	67	68	59	58	0.014925	-0.13235	-0.01695
	Internet users (per 100 people)	World Bank	35.6	38.1	40.9	42.2	0.070225	0.073491	0.031785
	Fixed-telephone subscriptions (per 100 inhabitants)	UNdata	38.653	39.204	39.536	38.765	0.014267	0.008461	-0.0195
	Mobile-cellular subscriptions (per 100 people);	World Bank	120.521	125.126	126.036	130.248	0.038204	0.007272	0.033423
	Electric power consumption (kWh per capita)	World Bank	4291.844	4224.398	4358.812	4474.327	-0.01571	0.031819	0.026501

	Science and engineering graduates (% 20-29 population)	UNDP	21.5	21.5	23.7	23.7	0	0.102326	0
	Public administration efficiency						*0.10803*	*0.00844*	*0.11147*
	Time required to enforce a contract (days)	World Bank	635	635	635	635	0	0	0
	Procedures to enforce a contract (number)	World Bank	36	36	36	36	0	0	0
	Time required to register property (days)	World Bank	111	111	91	11	0	0.18018*	0.87912*
	Procedures to register property (number)	World Bank	6	6	6	6	0	0	0
	Cost of business start-up procedures (% of GNI per capita)	World Bank	7.6	7.1	7.9	7.8	0.06579*	-0.11268*	0.01266*
	Time required to start a business (days)	World Bank	23	13	13	13	0.43478*	0	0
	Start-up procedures to register a business (number)	World Bank	11	7	7	7	0.36364*	0	0
	Time to prepare and pay taxes (hours)	World Bank	279	279	279	279	0	0	0
	Cooperation support						*-0.65658*	*0.149693*	*-0.07822*
	Technical cooperation grants (BoP. current US$)	World Bank	322520000	110760000	127340000	117380000	-0.65658	0.149693	-0.07822
						PROCESS CHANGE	**-0.1761**	**0.0578**	**0.0142**
Control (output)	***R&D results***						*-0.02466*	*-0.04857*	*-0.14512*
	Patent applications. resident	World Bank	386	319	290	180	-0.17358	-0.09091	-0.37931
	Number of scientific and technical journal articles	World Bank	1043	1172.6	1165.3	1269.1	0.124257	-0.00623	0.089076
	Technology transfer results						*0.208775*	*-0.12006*	*0.095685*
	Charges for the use of intellectual property. payments (BoP. current US$)	World Bank	196380003.8	143291864.2	155910993.7	183330205.4	-0.27033	0.088066	0.175865
	Charges for the use of intellectual property. receipts (BoP. current US$)	World Bank	29039521.67	61611211.98	39040235.46	56902140.75	1.121633	-0.36635	0.457526
	ICT goods imports (% total goods imports)	World Bank	4.694	4.384	4.216	4.295	-0.06593	-0.03845	0.018821
	ICT goods exports (% of total goods exports)	World Bank	2.040	2.390	1.625	1.419	0.171428	-0.31984	-0.12702
	ICT service exports (% of total service exports)	World Bank	35.851	38.973	40.388	38.499	0.087079	0.036288	-0.04676
	Entrepreneurship outcome						*-0.09611*	*-0.04633*	*-0.10886*
	New business density (new registrations per 1.000 people ages 15-64)	World Bank	2.122	1.918	1.830	1.633	-0.09618	-0.04582	-0.10756
	New businesses registered (number)	World Bank	10746	9714	9259	8239	-0.09604	-0.04684	-0.11016
						OUTPUT CHANGE	**0.029335**	**-0.07165**	**-0.05276**
						TOTAL CHANGE	**0.2073**	**-0.0209**	**-0.0042**

Based on the calculated ICs for the observed indicators, we calculated ICs for input, process and output. These ICs represent the average values of ICs of the indicators included in each of these three groups. Then, the IC of total change over a two-year period is obtained as the average value of the ICs for input, process and output. In our research, we analyze the following changes: 2009/08, 2010/09 and 2011/10.

2009/08: Planning (input) indicators, which refer to the investments in technological and innovative activities, oscillate during the observed period of time. $IC_{2009/08}$ equals 0.7687 which indicates that great efforts are made at the country level, as far as investing is concerned. The reason why this happened is that, comparing with 2008, in 2009 R&D expenditures increased almost 3 times (reaching almost 1% of GDP – which is the highest value of the observed period). Basic research expenditure, applied research expenditure and experimental development expenditure also increased more than two times. This shows that a good basis for great results is formed, as far as we observe the input indicators. But, it is interesting to see what actually happens at the output side of the model represented by the Control indicators. Before that, if we observe the Organizing (process) indicators, $IC_{2009/08}$ equals -0.1761. Infrastructure is slightly improved ($IC_{2009/08 =}$ 0.0203) and Public administration efficiency also ($IC_{2009/08}$ = 0.10803), but Cooperation support decreased dramatically, resulting in $IC_{2009/08}$ = -0.65658, which caused Organizing change to be negative. But, it is

encouraging to note that for Control (output) indicators, $IC_{2009/08}$ has a positive value of 0.0293. However, this is not a very good result if we observe the IC for the input indicators. Nevertheless, we know that, regarding technological and innovative activities, input cannot be immediately translated into output, so we expect this positive change to be seen in the following years. Total $IC_{2009/08}$ equals 0.2073, which is a good total result that indicates positive movements in government performance in TIM in Serbia.

2010/09: Input indicators' $IC_{2010/09}$ equals -0.0487 which is a bad result, compared to the previous one ($IC_{2009/08}$ = 0.7687). Investments stayed almost at the same level in 2010 as in 2009, excluding R&D expenditures, GERD, Applied research expenditure and Total investments in equipment, which decreased over these 2 years. Organizing (process) indicators improved - $IC_{2010/09}$ = 0.0578. This is a slight improvement that occurred because of the positive changes in all three groups that it includes (Infrastructure: $IC_{2010/09}$ = 0.0152; Public administration efficiency: $IC_{2010/09}$ = 0.00844; Cooperation support: $IC_{2010/09}$ = 0.1497). At the output side we have a worrying result: Control $IC_{2010/09}$ = -0.07165. This is a result of the decrease in all categories of output: R&D results $IC_{2010/09}$ = -0.04857; Technological transfer results $IC_{2010/09}$ = -0.12006; Entrepreneurship outcome $IC_{2010/09}$ = -0.04633, which indicated that technological and innovative activities were not fertile: inputs are not being transformed into outputs at a satisfying rate. Total change, as it is expected to be, is negative: Total $IC_{2010/09}$ equals -0.0209, which is much worse than the previous 2-year period when total $IC_{2009/08}$ was 0.2073.

2011/10: On first glance it is clear when looking at Table 2, that the results are better than in 2010/09. Planning indicators $IC_{2011/10}$ equals 0.0259. This is only a slight improvement, which has not yet reached the great results from 2009/08. Anyhow, a positive tendency is good to be captured. These results are a consequence of: 1. increased investments in applied research and equipment, and 2.keeping values of all other indicators at the same level in 2011 as in 2010. Organizing indicators also improved: $IC_{2011/10}$ = 0.0142 (Infrastructure: $IC_{2011/10}$ = 0.0092; Public administration efficiency: $IC_{2011/10}$ = 0.11147; Cooperation support: $IC_{2011/10}$ = -0.07822). But, on the output side, we notice the decline again – Control $IC_{2011/10}$ = -0.05276. R&D results and Entrepreneurship outcome declined ($IC_{2011/10}$ equals -0.14512 and -0.10886, respectively), while only Technology transfer results were better: $IC_{2011/10}$ = 0.095685, mainly because the increase in Charges for the use of intellectual property (both payments and receipts). Total $IC_{2011/10}$ = -0.0042, which indicates to the negative trend in government performance in TIM.

Trends of changes of ICs for the Input, Process, Output and the Total ICs changes for the observed period are shown on Figure 2.

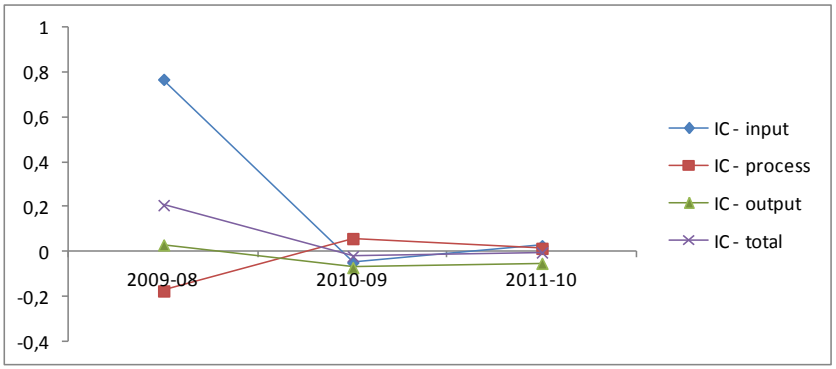

Figure 2: Trends of ICs of government performance in TIM (input, process, output, total) for the Republic of Serbia, period 2008-2011

5. CONCLUSION

Government as an important player and an element of the Triple Helix model, creates collaborative R&D projects and the necessary links among other elements, investing in development in different fields, regions and at different levels of a country. It is the key element in enhancing knowledge based economy that is largely based on efficient and effective technology and innovation management. Although government R&D investments could be vulnerable to a budgetary cut in times of economic difficulties, they are always present as incentives for the development of economy and society. Inputs, processes and outputs of government activity in Technology and innovation management are important to measure and analyse in order to determine correlations, achievements and weaknesses, as indicators relevant for the future activities and decisions. It is important to note that, by using the model developed in this paper, government impact in all three relevant spheres can be tracked, monitored and analysed for quick responding action with policies and strategy well adapted to the concrete TIM performance in practice.

In this paper, government performance in TIM is analysed and a model is created for its measurement and monitoring. One of the attributes of the model is its balanced structure enabling a systematic approach to the broad body of indicators already in use, oriented at better understanding the specific and most relevant role of the government in creating the innovative environment for supporting the basic technology and innovation management functions. In the model we classified the identified government TIM performance indicators into categories related to the three basic management functions - POC, also observed as the input, process and output, respectively, and show the relations that exist between these categories of indicators. Planning indicators refer to the investments in technological and innovative activities; organizing indicators refer to the technological and innovative Infrastructure, public administration efficiency and cooperation support, while control indicators refer to the country's R&D results, technology transfer results and entrepreneurship outcomes. Each of these categories and groups refer to the specific government TIM performance indicators, which are accessible in large internet databases such as the World Bank, OECD, UNdata, UNDP, and in the observed country's Statistical Office. In addition, we tested the created model in the case of the Republic of Serbia and have shown how the collected data can be analysed in order to measure changes, notice the interactions between the elements of the model and use the feedback as a support in making strategic management decisions in the area of TIM at the country level.

Nevertheless, this is not the final list of government performance indicators in TIM. This is the first attempt of the authors to create a systematic list of these indicators, which has to be re-examined, and potentially spread with more government performance indicators, which will be the subject of the authors' future research. The authors will also conduct further research of the other two components of the Triple Helix: University and Industry. This is necessary to complete the broader picture of the contribution and results of Triple Helix players in TIM at the national economy levels.

REFERENCES

Caerteling, J.S., Halman J.I.M., Song, M., Doree A.G. and Blj.J.D. van der (2013). How relevant is government championing behavior in technology development, *Journal of product innovation management*, 30(2): 349-363.

Chang-Yang, L. (2011). The differential effects of public RD support on firm RD: The theory and evidence from multi-country data, *Technovation*, 31 (5-6): 256-269.

Cunningham, S.W., Kwakkel, J. (2011). Innovation Forecasting: A case study of the management of engineering and technology literature, *Technological Forecasting & Social Change*, 78: 346-357.

Eskandari, H., Sala-Diakanda, S., Furterer, S., et al. (2007). Enhancing the undergraduate industrial engineering curriculum, Defining desired characteristics and emerging topics, *Education + Training*, 49 (1): 45-55.

Etzkowitz, H, Leydesdorff L. (2000). The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university-industry-government relations, *Research Policy*, 29: 109-123.

Etzkowitz, H. (2002). The Triple Helix of University-Industry-Government: Implications for Policy and Evaluation, Working Paper 2002-11, Institutet för studier av utbildning och forskning, Stockholm.

Etzkowitz, H. (2008). The Triple Helix: University-Industry-Government Innovation in Action, Rutledge, London.

European Commission (2014). ERAWATCH, Platform on Research and Innovation policies and systems – Country report – Serbia 2011-2013. Retrieved April 1, 2014, from: http://erawatch.jrc.ec.europa.eu/erawatch/opencms/search/advance-search.html?tab=reports&country=rs#listado

Kim, S. J. (2013). Government R&D funding in economic downturns: Testing the varieties of capitalism conjecture, *Science and Public Policy*, July, 1-12.

Kloot, L., Martin, J. (2000). Strategic performance management: A balanced approach to performance management issues in local government, *Management Accounting Research*, 11: 231-251.

Levi Jakšić, M., Marinković, S., Petković, J. (2011). From Knowledge Based to knowledge entrepreneurship economy and society – the Serbian paradox, Proceedings of the 30th International Conference on Organizational Science Development, Future organization, Portorož, Slovenia, Založba Moderna organizacija, p. 720

Levi Jakšić, M., Marinković, S., Kojić, J. (2012) Technology and innovation management education in Serbia, Proceedings of the XIII International symposium SymOrg 2012 – „Innovative management and business performance", Zlatibor, 1852-1860.

Leydesdorff, L. (2006.), The Knowledge-Based Economy and the Triple Helix Model, in Wilfred Dolfsma & Luc Soete (eds.), Understanding the Dynamics of a Knowledge Economy, Edward Elgar, Cheltenham, pp. 42-76.

Mallick D.N, Chaudhury A. (2000). Technology management education in MBA programs: A comparative study of knowledge and skill requirements, J. Eng. Technol. Manage. 17, 153-173.

Park, H., W., Leydesdorff. Longitudinal trends in networks of university-industry-government relations in South Korea: The role of programmatic incentives, Research Policy, Vol. 39, No 5, June 2010, pp. 640-649

Ranga, M. Etzkowitz, H. Triple Helix systems: an analytical framework for innovation policy and practice in the Knowledge Society, Industry & Higher Education, Vol 27, No 3,August, 2013, pp 237-262.

Rao, K., Meng, X, Piccaluga A. The impact of government R&D investments on patent technology transfer activities of Chinese universities: From the perspective of triple helix theory, Journal of knowledge-based innovation in China, Vol. 4, No. 1, 2012, pp 4-17

Singer, S. and Peterka, S. O. (2012). Triple Helix Evaluation: How to test a new concept with old indicators? *Ekonomski pregled*, 63 (11): 608-626

Statistical Office of the Republic of Serbia (2014). Statistical Yearbooks of Serbia 2010-2013. Retrieved April 5, 2014, from: http://webrzs.stat.gov.rs/WebSite/Public/PageView.aspx?pKey=452

UNdata (2014). UNdata: A world of Information – Data. Retrieved April 5, 2014, from: http://data.un.org/

UNDP (2014). Data by Country and Unit. Retrieved April 5, 2014, from: https://data.undp.org/page/projects

World Bank (2014). World Bank Indicators. Retrieved April 2, 2014, from http://data.worldbank.org/indicator

MECHANISMS FOR STIMULATING INNOVATION CAPABILITIES IN WESTERN BALKAN COUNTRIES

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Abstract: *Over the past few decades knowledge-based development and innovation are recognized as an engine of the economy development. This created revolution in R&D activities and economy. In this paper the authors highlighted the importance of innovation for restructuring economies of Western Balkan countries. The results indicate that drivers of innovation in Western Balkan countries are generally less powerful than those in EU countries. Authors also presented policy measures that can be successfully implemented in order to improve communication between various stakeholders in the innovation process.*

Keywords*: innovation, innovation process, Western Balkan countries (WBC), mechanism for fostering innovation, small and medium sized enterprise (SME)*

1. INTRODUCTION

The core of the continuous innovation process is the commercialization of Research and Development (R&D) results. This means transforming an invention into product or service that will be sold on the market and provide return for the investor. Generally speaking, innovation potential of a country is determined by R&D activities, human resources engaged in them, institutions and regulations and use of information and communication technologies.

Innovation is important on different levels and for different reasons. On a country level, innovation is important as an engine of economic growth. It increases human wellbeing and employment. For companies, innovation improves productivity, enables development and shareholder return.

The data presented in this paper provide evidence of existing huge differences in innovation capacity of developing and developed countries. Developing countries still lag behind developed countries when it comes to number of researchers, R&D expenditures, number of scientific articles and patents, etc. This is the fact that restricts the scope of innovations available for commercialization.

Developing countries also have limited efficiency in the process of commercialization of R&D results. Lack of interaction between science and industry is major limitation of innovation process. Encouraging technology transfer from faculties to private companies is a strategy used by many countries in order to mitigate constraints of innovation process. Policy measures presented in this paper are being implemented with that purpose.

2. INNOVATION AS A KEY FACTOR OF ECONOMIC DEVELOPMENT IN MODERN SOCIETY

In the last few decades innovations have been identified as crucial driver of economic and social development. Theory of innovation was developed by Joseph Schumpeter during the 1940s and after that many authors began to explore this phenomenon. Many studies have showed that innovation has main role in acquiring comparative advantage in the individual company, as well as in the macro economy.

In a general case, "*there are only two ways of increasing the output of the economy: (1) you can increase the number of inputs that go into the productive process, or (2) if you are clever, you can think of new ways in which you can get more output from the same number of inputs"* (Rosenberg, 2004). Increasing productivity of the economy is a key for raising living standard. This productivity growth can enable rising wages of workers and increasing national per capita income. Innovation is essential for increasing productivity. In the long term, no economy can be competitive by just increasing inputs. The best way to raise living standard is to find new methods for combining natural, human and capital resources and increase productivity.

Innovation consists of the purposeful search for changes and the opportunities that such changes might offer (Drucker,1985). Innovation includes making change, creating new ideas and new opportunities. It is important to note that innovation and entrepreneurship are closely connected, so innovation is one of the instruments of entrepreneurship.

Joseph Schumpeter argued that economic development is driven by innovation through a dynamic process in which new technologies replace the old, a process he labeled “creative destruction”. In Schumpeter’s view, “radical” innovations create major disruptive changes, whereas “incremental” innovations continuously advance the process of change. Schumpeter proposed a list of five types of innovations: introduction of new products, introduction of new methods of production, opening of new markets, development of new sources of supply for raw materials or other inputs, creation of new market structures in an industry (OECD 2005).

An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations (OECD, 2005).This understanding is quite broad and includes not only the development of new technologies, but also improvements in business practices, relationships and organizations.

There are many studies explaining relationship between innovation and economic development and growth. Neoclassical economists treat innovation as key factor contributing to economic progress and long-term convergence (Fagerberg, 1994). Supporters of endogenous growth theory argue that differences in innovation potential create variations in economic performance and wealth of the nations. They also devote attention to the place of international trade in the growth process, including the transmission of innovations from the industrial economies to the less developed countries (Grossman & Helpman, 1991). However, it is important to take into account social and institutional perspective of an economy. In a study by Rodriguez-Pose and Crescenzi (2008) is shown how regional innovation capacity is shaped in interaction between R&D sector, economic, social and institutional sector.

Innovation has become extremely important factor in productivity growth. According to Boston Consulting Group, relative importance of innovation to labour and capital has been growing over time. This rate is especially high from the 1990s (The Economist, 2007).

Today, innovation is facing new challenges on global, national and organizational level. Innovative capacity is created in interaction between research, education and innovation. Perhaps the most important obstacle to innovation and commercialization of R&D results in insufficient collaboration between scientific and corporate sector. Industry and science relations have to be stronger to ensure that R&D activities anticipate market needs. Measures of encouraging university entrepreneurship can also help in fostering innovation activities in the economy.

3. POTENTIAL FOR INNOVATION IN DEVELOPING COUNTRIES

During the 2000s indicators that foster innovation in Western Balkan Countries (WBC) were generally less advanced than those in developed market economies. Although many developing countries have well-educated labour forces and good tradition of scientific research, many of them cannot compete with developed countries. In the following tables WBC are compared with selected EU countries using various indicators of science and innovation activities.

Number of researchers per million inhabitants from 2005-2011 in WBC varied widely across countries (Table 1). While in Croatia number of researchers was 1584, in Albania was only 148. These numbers are much lower than in selected EU member states in which average number of researchers was 2329,29. Countries members of EU-15 have much higher number of researchers per million people which indicates that WBC as well as new EU member states have to include more people in R&D activities in order to catch-up with developed countries.

Number of scientific and technical journal articles includes articles published in the following fields: physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences. It is mainly in correlation with previous indicator in terms that countries with higher number of researchers have more scientific papers. Of course, this is not always a rule. For example, Slovenia and Bulgaria have more researchers than Serbia and Croatia, but have less scientific journal articles. However, these data should be considered with caution. The number of scientific and technical papers considers article counts from a set of journals covered by Science Citation Index (SCI) and Social Sciences Citation Index (SSCI). When interpreting these data for developing countries it is important to analyse if the improved number of scientific articles is result of including certain national journals in Science Citation Index or it is consequence of real increase in scientific productivity. Remarkable results in this area

have Germany and United Kingdom whose researchers published over 46000 scientific papers in 2011 (which is partially due to their large population).

Table 1: Science and technology indicators in selected countries

Country group/ country		Researchers FTE per million people (2005-2011)	Scientific and technical journal articles (2011)	Patent applications filed (residents + nonresidents) (2012)	Trademark applications filed (2012)
Western Balkan countries	Albania	148	27	11	2700
	Bosnia and Herzegovina	193	54	16	4517
	Croatia	1584	1289	251	7564
	FYR Macedonia	461	77	40	3275
	Montenegro	763	28	78	3896
	Serbia	1221	1269	224	6815
	AVERAGE	**728,33**	**457,33**	**103,33**	**4794,50**
New EU member states (selected countries)	Bulgaria	1623	650	259	6329
	Czech Republic	2891	4127	1017	11198
	Hungary	2303	2289	758	4939
	Poland	1679	7564	4657	17023
	Romania	737	1626	1077	10519
	Slovakia	2817	1099	203	4744
	Slovenia	4255	1239	453	1824
	AVERAGE	**2329,29**	**2656,29**	**1203,43**	**8082,29**
Selected EU-15 countries	Austria	4397	5103	2552	9519
	Germany	3950	46259	48092	64497
	Netherlands	3218	15508	2713	n.a.
	Sweden	5191	9473	2436	11290
	United Kingdom	4202	46035	23235	42848
	AVERAGE	**4191,6**	**24475,6**	**15805,6**	**32038,5**

Source: World Bank

Data on patents and trademarks show success of research, development and innovation activity in certain areas. It is actually a measure of innovation activity of a country that shows knowledge utilisation and transformation of knowledge into potential economic benefits.

Table 2: R&D expenditure in selected countries (% of GDP) from 2010-2012.

Country/ country group		2010	2011	2012
Western Balkan countries	Albania	n.a.	n.a.	n.a.
	Bosnia and Herzegovina	n.a.	n.a.	0,27
	Croatia	0,75	0,76	0,75
	FYR Macedonia	0,43	n.a.	n.a.
	Montenegro	n.a.	0,41	n.a.
	Serbia	0,79	0,77	0,96
New EU member states (selected countries)	Bulgaria	0,6	0,57	0,64
	Czech Republic	1,4	1,64	1,88
	Hungary	1,17	1,22	1,3
	Poland	0,74	0,76	0,9
	Romania	0,46	0,5	0,42
	Slovakia	0,63	0,68	0,82
	Slovenia	2,1	2,47	2,8
Selected EU-15 countries	Austria	2,8	2,77	2,84
	Germany	2,8	2,89	2,92
	Netherlands	1,86	2,03	2,16
	Sweden	3,39	3,39	3,41
	United Kingdom	1,77	1,78	1,72

Source: Eurostat
National Statistical Offices

Number of patents and trademark applications filed in 2012 is also modest in WBC compared to selected EU countries. Croatia and Serbia have highest number of patents (251 and 224), while in other countries in Western Balkan Region this number is very low.

R&D expenditures as a percentage of GDP in the Western Balkan Region from 2010-2012 were much lower than in EU countries (Table 2). Certain countries even have no statistical data that would allow calculating this indicator. This is a serious issue because absence of statistical monitoring means the inability to compare and improve this indicator. In 2012 in WBC higher R&D expenditure as % of GDP had Serbia (0,96) and Croatia (0,75). Most new EU member states have higher R&D expenditures, but still not as in EU-15 countries. Lack of investments in R&D (especially private ones) is partly a consequence of poor business environment, which reduces incentives for investing, especially when risk is high (which is characteristic of innovation investments).

4. DIFFERENT TYPES OF SUPPORT TO INNOVATION IN WB COUNTRIES

There are numerous examples of good practice in fostering innovation in European Union. Many of them are collected and described under the project WBC-inco.net – Coordination of Research Policies with the Western Balkan Countries (WBC-inco.net, 2011). In this paper will be presented policy measures that are suitable to apply in Western Balkan Countries. They are the following: Strategic Innovation, Innovation Officer, Innovation Voucher scheme, Soft Landing Platforms, Competition for Best Technology Innovation.

Strategic Innovation

Strategic Innovation has the aim to allow large number of small and medium-sized enterprises (SMEs) to improve their innovation capacities. Increasing number of innovative firms is crucial for developing countries which can be achieved by coaching and stimulating existing firms to develop strategic approach to innovation.

This methodology was developed by UNU-MERIT (The United Nations University – Maastricht Economic and Social Research Institute on Innovation and Technology) in the Netherlands while participating in an EU funded program (EdiSon) in which pilots had been performed in 15 Dutch SMEs. Because of the success in the 15 SMEs on the one hand and the policy choices that had been made in the Euregion Meuse Rhine on the other, UNU-MERIT developed a project proposal together with 3 other project partners in Flanders, Wallonia and Germany (WBC-inco.net, 2011).

The initiative enables management teams to re-develop their business strategy by putting priorities, making choices and implementing them. In that way, many SMEs are facilitated at micro level. It is conducted as 4 step intervention and final implementing phase in companies. These steps of intervention include interviews with top management, innovation scan and two strategic sessions with management team in a group. Implementing phase in companies facilitate trained consultants.

Strategic innovation implies that if one region wants to make improvements in innovation area, it is necessary to include large number of firms that will make changes on micro level. Crucial factor of success of this program is selection and training of consultants and interest of companies for the program. This approach is very effective and it usually gets high scores in the satisfaction surveys.

Innovation Officer

Innovation Officer is the approach that stimulates innovation in SMEs by enabling qualified staff. Innovation officers enhance innovation results and help in overcoming bottlenecks in SMEs operating. Philosophy of this scheme is that entrepreneurs should use knowledge to innovate, so they need new employee – innovation officer that will act as driver of innovation. This officer should detect opportunities for innovation and find ways for their effective implementation. To do this, he needs to have adequate knowledge about innovation processes and development. All plans he proposes should be reviewed by independent commission.

This method for enhancing innovation was developed in the Netherlands. It was part of larger programme – “Innovatie Zuid” which was financed by EU, the Dutch government and private businesses. The overall program was managed by Brabant Development Agency (BOM) and the implementer of this measure was Syntens, not-for-profit innovation intermediary.

Applying this method requires having good implementing agency. This agency should be independent, capable of problem definition and act as an intermediary between the entrepreneur and the innovation officer. First step of this approach is the initial conversation with SME and defining problem/opportunity. After that, intermediary agency writes innovation project and look for innovation officer. Innovation problem and innovation officer are being presented to independent committee which makes decision about the request. Innovation officer starts working, submits reports and gets salary from the SME. SME gets money back from the intermediary agency based on the innovation officer's report.

Innovation Officer Scheme is important because it can be applied in broad base of SMEs and not only in highly innovative ones. It stimulates creating innovative culture by enabling SMEs high-educated young professional.

Innovation Voucher Scheme

SMEs have generally very limited human and capital resources which do not allow them to develop their own know-how. This creates serious delays and missing important market opportunities. On the other hand, there is lot of available, already developed expertise in academic institutions and large companies that can be offered to SMEs. Since SMEs are not well informed about these external sources, they do not know enough to use this opportunity. Reducing this gap between knowledge institutions and SMEs is main goal of innovative vouchers.

Innovation vouchers are usually defined as small lines of credit provided by governments to small and medium-sized enterprises to purchase services from public knowledge providers with a view to introducing innovations (new products, processes or services) in their business operations (OECD, 2010). Such approach directly stimulates knowledge transfer, but also creates long-term relationships between industry and research institutions.

Research vouchers pilot project was developed in province Limburg in the Netherlands in 1996. It was implemented in cooperation with multinational company DSM dealing with chemicals and advanced materials. The goal was to allow SMEs to make use of knowledge accumulated in DSM's research sector. At first, there was limited number of vouchers given to companies for three days advice from DSM Research. After that, certain companies got vouchers to make use of DSM Research's expertise in certain areas. After this pilot many more voucher schemes were developed both in the Netherlands and the rest of the world.

The European Commission rewarded innovation vouchers as one of the best schemes for fostering innovation in Europe. This measure is widely applied because it is really flexible in terms that each region/ country can decide what type of knowledge will be offered under the voucher regime. This enables adaptation of the method to specific situation in certain region.

Soft Landing Platforms

Globalization and using new technologies have created new form of competition for countries and enterprises. In modern economy companies have to face with international competition and get into new markets. International operating increases growth, creates comparative advantages and long term sustainability. When changing business environment, companies are coping with various problems, especially when it comes to legal and tax systems, finding employees and clients, etc.

Conquering global markets will be more successful if companies have external support. Moreover, if that support comes from technology transfer intermediaries, there will be synergetic effect. Such services that help innovation led business to enter on foreign markets are often referred as Soft landing. Support services that Soft landing agencies offer should be flexible and focused on specific company's needs. Skills and contacts this agency has will enable companies faster and easier managing in foreign country. There are various types of services that soft landing offers: business planning, market analysis, finding partners, experts and personnel, access to funding, logistic, etc.

Soft Landing Platforms are created with primary goal to offer professional consulting services to companies starting operating on international level. However, this has proved to be a mechanism for improving innovative results of the company. The created collaborations with partners from different regions and countries contribute not only to the extension of their own networks, but also support the provision of conditions for international collaboration for economic growth. For businesses to innovate in this way, this has proven to be an effective mechanism for improving the innovative application of research results and for business development support to start-ups and existing SMEs (Kniejski, 2013).

Competition for Best Technology Innovation

Competition for Best Technology Innovation promotes entrepreneurial spirit in the domain of high-tech and gives support to people willing to commercialize their ideas and innovations. The competition is based on the philosophy that interaction of innovation and entrepreneurship are crucial for competitiveness of companies, universities and the economy as a whole. It mobilizes researchers, students, companies and innovative individuals to present results of their work.

Competition for Best Technology Innovation is successfully implementing in Serbia. It was initiated in 2005 by the Ministry of Science and Environmental Protection. The idea came from the Faculty of Technical Sciences in Novi Sad because they organized similar competition for their students in 2003. In 2007 this competition began to organize in the Republic Srpska, as a result of cooperation between Ministry of Science and Technological Development of Serbia and the Ministry of Science and Technology of Republic Srpska.

The competition has several phases. First, competitors have to register via internet and if they pass evaluation they get professional training on how to create innovative strategy for their product/service. Second phase includes creating business and marketing plan. Participants that show greatest potential and progress present their ideas publicly – at an exhibition, semi-finals and finals. Main criteria for choosing winner are: economic impact, novelty, growth potential and social impact. This competition has facilitated creation of more than 80 enterprises in Serbia and Bosnia and Herzegovina. It also helped in connecting and presenting to each other research and business sector.

5. CONCLUSION

Commercialization of R&D results and their conversion in profitable goods and services is important determinant of economic development and country competitiveness. Besides other factors, the scope of R&D activities depends on the number of researchers and academic institutions, level of investments in this sector, government policy measures, etc.

In a modern interconnected world, innovations are becoming international, so openness to foreign technologies and cross-border cooperation plays important role in fostering innovation. Innovation process includes various stakeholders and their relationships shape the effectiveness of the process. In order to ensure these linkages, there should exist organisations that support entrepreneurs in introducing products, finding financial resources and establishing new spin-offs.

Available data show that drivers of innovation in Western Balkan countries were generally less advanced than those in new EU members and developed EU economies. WBC still lag behind these countries in terms of number of researchers and scientific papers, number of patent and trademark applications, expenditures for R&D, etc. As a consequence, innovation process in WBC is facing with significant challenges.

In order to increase the effectiveness of converting R&D investments in commercial products, there are many policy mechanisms that can be implemented in WBC. Most of them are oriented on enhancing innovative culture and creating stronger links between research and business sector. Strategic innovation, Innovation Officer and Innovation Vouchers enable individual firms to re-develop their business strategy and orient towards innovation. On the other hand, Soft landing Platforms offer help in getting into new markets, but still the support is given by technology transfer intermediaries. Competition for Best Technology Innovation educates professional and general public about the importance of entrepreneurship and R&D.

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REFERENCES

Drucker, P. (1985). *Innovation and Entrepreneurship*, New York: Harper & Row.

Eurostat Statistic Database. Retrieved from http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

Fagerberg, J. (1994). Technology and International Differences in Growth Rates, *Journal of Economic Literature 32, 1147–75.*

Grossman, G. & Helpman, E. (1991). *Innovation and Growth in the Global Economy*, Cambridge: MIT Press.

Kniejski, W. (2013). Supporting Internationalisation of SMEs through "Soft-Landing Platform Services" - Good Practices and Experiences, *Incubator Magazine III.*

National Statistical Offices of Bosnia and Herzegovina, FYR Macedonia and Montenegro.

OECD (2012). Innovation Vouchers. Retrieved from http://www.oecd.org/innovation/policyplatform/48135973.pdf

OECD (2005). Oslo Manual - Guidelines for Collecting and Interpreting Innovation Data.

Rodriguez-Pose, A. & Crescenzi, R. (2008). Research and Development, Spillovers, Innovation Systems, and the Genesis of Regional Growth in Europe, *Regional Studies 42(1), 51–67*.

Rosenberg, N. (2004). Innovation and economic growth, OECD.

The Economist (2007). Something new under the sun. Retrieved from http://www.economist.com/node/9928154

WBC-inco.net (2011). Good practice examples of innovation policy approaches and instruments in the EU Member States and the Western Balkans.

World Bank Data. Retrieved from http://data.worldbank.org/

POSSIBILITIES OF OPENING UP THE STAGE-GATE MODEL

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Abstract: *The paper presents basic elements of the Stage-Gate and Open innovation models, and possible connection of these two, resulting in what is frequently called an "Open Stage-Gate" model. This connection is based on opening up the new product development process and integration of the open innovation principles with the Stage-Gate concept, facilitating the import and export of information and technologies. Having in mind that the Stage Gate has originally been classified as the third generation model of innovation, the paper is dealing with the capabilities for applying the sixth generation Open innovation principles in today's improved and much more flexible phases and gates of the Stage Gate. Lots of innovative companies are actually using both models in their NPD practice, looking for the most appropriate means of opening up the well-known closed innovation, especially in the domain of ideation through co-creation.*

1. INTRODUCTION

The need for lean, rapid and profitable new product/service development has never been more evident. In today"s business world, product life cycle is getting shorter, the competition is getting tougher, users are becoming more demanding, and therefore companies that do not innovate are losing pace with competition and slowly deteriorate.

A growing number of authors and leaders from different branches identified innovation as a key driver for achieving long-term success and profitability (http://www.prod-dev.com/stage-gate.php). Most of today's companies with great concern talk about improvement of their innovation performance in order to deliver sustainable growth and significant competitive differentiation (http://www.sopheon.com/industry-innovation/). However, it must be kept in mind that gaining competitive advantage by offering new product/service is not easy - in fact, it is estimated that about 46% of the funds, which company invests in the development and launch of new products/services is related to unsuccessful projects (http://www.prod-dev.com/stage-gate.php).

Having this in mind, the world's leading companies have revised their processes of product/service innovation, including critical success factors discovered through research of best practice, through introduction of the Stage-Gate new product/service development process. Based on various independent studies, which were conducted by leading consulting companies in the field of innovation management, it was concluded that 70-85% of the leading companies in the U.S. use model Stage-Gate for managing the entire process from idea generation to launching of new product/service to market (http://www.prod-dev.com/stage-gate.php).

Starting from this point, the paper is organized in tree main sections, first related to linear models of new product/service development, describing the development of innovation models through generations and the Stage-Gate model as a main representative of the third one; second related to open innovation model, its features and advantages; and third related to possible connection of previously mentioned models, discussing the ways of embedding the main principles of open innovation in the Stage-Gate model.

2. LINEAR MODELS AND STAGE-GATE

Innovation is identified as a key driver for strengthening of competitiveness, so that fostering innovation has become one of the key priorities in every company that strives to be the leader in the field. Globally, innovation appears to be the central element of today'sknowledge-driven economy, with domination of information-communactions technologies - ICT, as a key strategic dimension bringing completely new ways of communication and business. Even though the importance of innovation is recognized by most companies and they spend a lot of money on innovation, many of these initiatives do not generate reasonable profit or competitive advantage. Plenty of research in this topic reveals that the main problem does not lie in the invention part or the generation of innovative ideas, but more in the successful management of the innovation process from an idea to a successful product in the market (du Preez, Louw, 2008).Having that in mind, successful innovation demands a rigorous process for managing innovation, including a disciplined,

stage-by-stage approval process combined with regular measurement of every critical factor, ranging from time and money spent to the success of new products in the market.

When it comes to innovation processes from idea to commercialized product/service, literature proposes a lot of different models and frameworks. Basically, six generations of models can be found, from simple linear to increasingly complex interactive and network ones (Rothwell, 1992), up to new concept of open innovation (Table 1).

Table 1: Development of innovation models (adopted from (du Preez, 1992))

Model	Generation	Characteristics
Technology push	First	Simple linear sequential process, emphasis on R&D; market is the recipient of the R&D results
Market pull	Second	Simple linear sequential process, emphasis on marketing, the market is the source of new ideas for R&D; R&D has a reactive role
Coupling model	Third	Recognizing interaction between different elements and feedback loops between them, emphasis on integrating R&D and marketing – Stage-Gate process, – The Collaborative Innovation Process
Interactive model	Fourth	Combinations of push and pull models, integration within firm, emphasis on external linkages – Minnesota Innovation Research – Program (MIRP) model
Network model	Fifth	Emphasis on knowledge accumulation and external linkages, systems integration and extensive networking – The Creative Factory Systems Innovation Model
Open Innovation	Sixth	Internal and external ideas as well as internal and external paths to market can be combined to advance the development of new technologies

One of the most important elements of this classification is chronological review of models development, where shifting of models from conventional, unilateral, facing the own R&D solutions, via one-sided market orientation, to interactive combination of push and pull models, and contemporary, network models based on knowledge can be clearly noticed (Stošić, 2013).

The first and second generation models are linear models pulled either by market needs or pushed by technology and science. Coupling model as the third generation model recognizes the influence of technological capabilities and market needs within the company"s framework. Even though the coupling approach encompasses feedback loops it is essentially a sequential model. Cooper"s Stage-Gate model, which is in the focus of this research, can be looked at as the main representative of this generation. This model divides the product innovation process into series of stages – set of parallel activities, and gates - decision points between the stages. The fourth generation innovation process model, known as interactive model, observes the innovation process as parallel activities across organizational functions. The fifth generation or network models are the influenced by external environment and effective communication with external environment. The sixth generation of innovation models is open innovation models, which can also be seen as network models, but instead of being only focused on internal idea generation and development, internal and external ideas and paths to market can be combined to advance the innovation process (du Preez, Louw, 2008).

Having in mind the aim of this study, the following text will be describing the Stage-Gate model, Open innovation model and possibilities of their connecting i.e. the opening up of Stage Gate model.

Stage-Gate® is a trademark of R.G. Cooper & Associates Consultants Inc., a member company of the Product Development Institute. It stands for industry standard for excellence in new product/service development. This advanced, widely applied and recognized process, skillfully integrates a number of practices in an easy to understand recipe for success. It is characterized by a structure that engages users at all levels and functions, and consequently allows making good and effective decisions regarding further project extension, and impacts on quality and speed of innovation project execution.

The current Stage-Gate is a third-generation process, which incorporates six Fs (Cooper, 1994):

- Flexibility,
- Fuzzy,
- Fluidity,

- Focus,
- Facilitation,
- Forever green.
-

The first three Fs makes the process less rigid, enabling it to be scaled to various size projects and enabling stages to be overlapped and approved conditionally. “Focus” means that the process is connected to a strategy. “Facilitation” refers to specific role gate keeper, who ensures that the process is properly guided. As a final point, “forever green” suggests the continuous improvement of the process. Generally, these six Fs enables a more sophisticated process, but they also encourage more abuse of the process (Cooper, 1994).
Using the Stage-Gate model improves efficiency and reduces the risk of failure, regardless whether it is launching of new product or technology that could change the competitive image in the market, or introduction of new products that could generate additional income for the company, or defense of company"s market share by introduction of significantly improved product (http://www.stage-gate.com/resources_stage-gate_full.php).

Stage-Gate model is a business process for value creation that is designed for quick and profitable transformation of company"s best ideas into new products/services. Model as such generates an organizational culture that includes existence of the new product development process leader, strategic responsibilities definition, high-performance teams, focus on customers and markets, excellent solutions, compliance, discipline, speed and quality.

It follows that the Stage-Gate model provides a conceptual and operational roadmap for driving new product development, from idea to launch, i.e., blueprint for managing the process of product/service innovation, aimed at increasing efficiency and effectiveness. Stage-Gate approach decomposes innovation process in a set of phases that comprise a set of planned, multi-functional and parallel activities. At the entrance to each stage is a gate, which role is quality control and decision-making Go/Kill/Hold/Recycle to the process (Cooper, 2011).

Phases are activities undertaken by members of the team owning to gathering the information they need for project progress toward the gate. The phases are cross-functional and activities are undertaken in parallel to speed up the time to market. In order to provide risk management, parallel activities within a particular phase must be designed in a way to gather important information - technical, market, financial, operational (Stošić, 2013).

The model is structured in that way that in front of each stage is a gate, or decision point. The decision about whether an innovation project is going to pass certain gates perform, combined, both internal managers and external experts, so-called gatekeepers. Gates have a dual role. First, to check whether the project met all the criteria identified in previous gate and second, to check whether the project meets the criteria for the current phase.

Every gate includes following (Stošić, 2013):

- Elements that represents deliverables – results of actions from the previous phase;
- Criteria on which the decision on project are made;
- Outputs, representing the results of the decision (Go/Kill/Hold/Recycle).

There are many different predefined qualitative and quantitative criteria based on which the assessment of innovation project is made in every gate. Such criteria have to give answer on the following questions:

- Are the milestones connected to technology met?
- Does the project perform in accordance with time and budget?
- Could innovation concept reach potential benefits for end-users?
- Does the innovation concept coincide with pre-set goals and strategy?

Specific criteria are different from gate to gate and become more rigorous as the project approaches the development stage.

One of the innovation project characteristics is high risk level which to a large extent affects the innovation process stability and depends on the process stage. Consequently, it is useful to execute risk identification in a more precise and efficient way in order to respond in the right time and manner. This is the reason why it is important to choose the right gatekeepers and criteria within the gates to implement the project in line with planned. Different findings on SG benefits and weaknesses are summarized in Table 2.

Table 2: Advantages and disadvantages of Stage-Gate model

Benefits (http://www.stage-gate.com/resources_stage-gate_full.php)	**Common Errors and Fail-Points**(Cooper, 2008)
Accelerated speed-to-market	Gates with no teeth
Increased new product success rates	Hollow decisions at gates
Decreased new product failures	Who are the gatekeepers?
Increased organizational discipline and focus on the right projects	Gatekeepers behaving badly
Fewer errors, waste and re-work within projects	Too much bureaucracy in the idea-to-launch process
Improved alignment across business leaders	Too much reliance on software as a solution
Efficient and effective allocation of scarce resources	Expecting the impossible from a process
Improved visibility of all projects in the pipeline	
Improved cross-functional engagement and collaboration	
Improved communication and coordination with external stakeholders	

P&G is one of the companies which can be seen as a good example of applying the Stage-Gate model. It introduced the SIMPL™ model which consists of four main stages, where stages represent a set of current best practices in the form of key activities, and also clearly defined deliverables for project team (Figure 1). There are also four gates or decisions points in the model, which are comprised of a team recommendation and a management decision (Cooper & Mills, 2005).

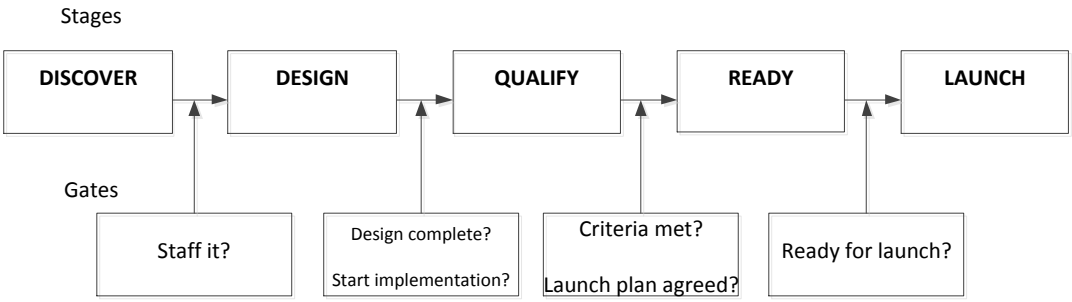

Figure 1: P&G"s SIMPL™ Process - An Idea-to-Launch Stage-Gate® Model (adopted from (Cooper & Mills, 2005))

3. OPEN INNOVATION AS A NEW PARADIGM

In today"s intensely competitive environment the main question is no longer why to innovate, but how to innovate. Bearing that in mind, innovation theory recognized that not all good ideas come from inside the firm, neither all good ideas emerged within the particular firm should be commercialized by that same firm (Gabel & Chesbrough, 2011).

Based on aforementioned, Henry Chesbrough coined the term “open innovation” to describe a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology (Chesbrough, Vanhaverbeke and West, 2006). While Chesbrough (2003, 2006) partly admits the rich source of antecedents to the „open innovation paradigm", there are some authors such as Trott and Hartmann (2009) who claim this paradigm to represent just an old wine in new bottles, meaning repackaging and representation of concepts and findings presented over the past forty years within the literature on innovation management.

The model of open innovation is based on the movement of ideas across organizational boundaries. Valuable ideas can be generated externally (outside the organization) and internally (within the organization), which also refers to the output of the innovation process, i.e. placement of innovations to the market.

On the other side, the conventional internal model of closed innovation is based on the principle of control for the success of innovation and innovation projects. The organization needs to generate and control their own ideas in the same way as the functions units - production, marketing, finance. The main features of both models are shown in the Table 3.

One of the factors that led to abandoning the concept of the closed innovation is the mobility and accessibility of knowledge due to ICT. Therefore, employees" fluctuation is encouraging knowledge transmission, resulting in a higher throughput of knowledge between the organizations. This has changed the logic of modern innovation processes and models, growing from closed to open ones, through well-known principles given in Table 3.

Table 3: Features of Open and Closed innovation model (Chesbrough, 2003)

Closed Innovation Principles	Open Innovation Principles
The smart people in the field work for us.	If we create the most and the best ideas in the industry, we will win.
To profit from R&D, we must discover it, develop it, and ship it ourselves.	External R&D can create significant value: internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to the market first.	We don"t have to originate the research to profit from it.
The company that gets an innovation to the market first will win.	Building a better business model is better than getting to the market first.
If we create the most and the best ideas in the industry, we will win.	If we make the best use of internal and external ideas, we will win.
If we create the most and the best ideas in the industry, we will win.	We should profit from others" use of our IP, and we should buy others" IP whenever it advances our business model.

For the successful implementation of this model, the organization should define the business in a way to use advantage of both internal and external ideas which can be improved through internal R&D, and to build an adequate business model which will provide greater value for the organization.

Key Factors to Implementing "Open Innovation" (Docherty, 2006):

- Broaden your view (where you look and your ability to see what"s there);
- Create alignment across the innovation ecosystem;
- Adapt an approach for your organization"s tolerance for risk;
- Put the focus on learning, not just results.

Many of the market leaders such as GE, Cisco, Adobe, Nokia, P&G, Spalding, Starbucks, successfully use the model of open innovation in order to improve their products/services, reduce the cost of R&D, solve technical problems and accelerate time to market (Stošić, 2013).

P&G has institutionalized its Connect and Develop program to ensure external ideas have access to the organization and that internal intellectual property is marketed to the outside. Aiming to speed and simplifying external innovation connections, P&G"s Connect and Develop program launched a new website, linking innovators directly to top company needs, and P&G business leaders directly to external innovation submissions. In the spirit of C+D, the web site was developed in collaboration with several external partners, which brought new innovative technology to the back-end of the site, enabling user submissions to directly feed into the business category leaders. This will allow P&G to review needs more quickly and more efficiently for strategic fit or scalability across the business.
(http://www.pgconnectdevelop.com/home/stories/cd-stories/20130207-pg-connectdevelop-launches-new-open-innovation-website.html)

4. POSSIBILITIES OF CONNECTING THE STAGE-GATE AND OPEN INNOVATION MODEL

Concerning the market needs and treat that internal R&D isn"t the engine of innovation anymore, left companies no options but to adapt their business if they want to stay competitive and not to miss opportunities any longer. Referring to that and the fact that a lot of external knowledge is now accessible, companies which have been using Stage-Gate model for their new product/service development make a great effort to improve their model, broadening it with open innovation features (Grolund, Ronneberg & Frishammar, 2010). It assumes accommodation of flowing the new ideas, intellectual property, technology or even fully developed products from external sources.

Companies which have moved to open innovation, also have to modify their Stage-Gate process, and consequently to modify their business model, making it more flexible in order to enable proper surrounding for networks of partners, alliances and outsourced-vendors. One of the best examples of Open innovation

Stage-Gate model usage is company P&G, which released SIMPL 3.0 version Stage-Gate system, designed to handle external ideas, technologies, and even fully developed products (Cooper & Edgett, 2008).

Using the open innovation in new product/service development implies its involvement in all three aspects of the innovation process, including ideation, development, and commercialization (Figure 2).

Ideation or Discovery stage: The first phase of the innovation process/project is always generating ideas - in the literature also known as ideation. The beginning of generating ideas process is always associated with the identification and understanding that somewhere there is a gap, i.e. new product characteristics, new elements of the business improvement process technology, a completely new business model (Cooper & Edgett, 2005; Cooper, 2011; Kahn, 2013; Stošić, 2013).This is the stage in which companies go across their borders looking for external information that could be helpful in satisfying customer"s needs, when it comes to ideas for new product/service development (http://www.stage-gate.com/resources_stage-gate_openinnovation.php). Many companies such as Starbucks, P&G, BMW, now use open ideation or co-creation, offering the possibility to customers to share their ideas by giving them problems the company is facing with or just giving them possibility to propose some new idea over the companies" sites.

Building the Business Case: Implies detailed market research, consumers" needs and desires, stakeholder analysis, concept testing, detailed financial and business analysis. As a result of the stage, a business case is obtained, i.e., defined the product/service, business justification and a detailed action plan for the next stage (Cooper & Edgett, 2005; Cooper, 2011; Kahn, 2013; Stošić, 2013). Concerning open Stage-Gate, this stage includes actions such as identification of missing internal capabilities, seeking for potential partners who will provide technological or marketing capabilities to develop and commercialize new product/service, developing an intellectual property strategy (http://www.stage-gate.com/resources_stage-gate_openinnovation.php).

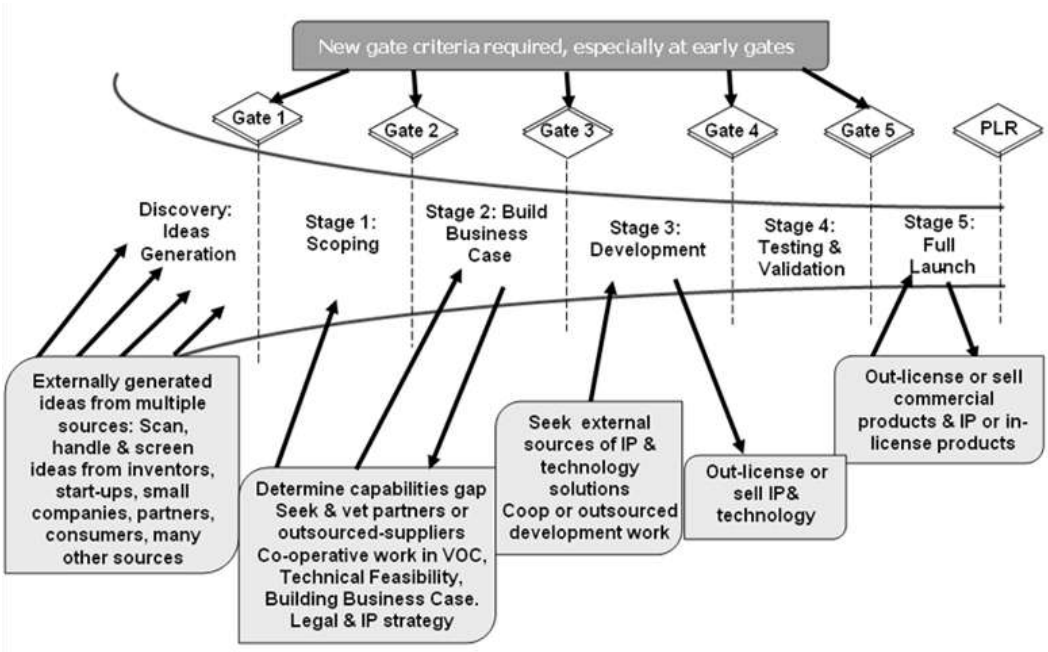

Figure 2: Open innovation Stage-Gate model
(http://www.stage-gate.com/resources_stage-gate_openinnovation.php)

Development stage: Within this stage comes to implementation of the action plan and development of new product or service. It is necessary to carry out various tests within the company"s laboratory in order to confirm that the product meets all the requirements (Cooper & Edgett, 2005; Cooper, 2011; Kahn, 2013; Stošić, 2013). Concerning the open Stage-Gate system, companies cooperate with suppliers or partners trying to solve technology and development problems and also try to get external innovations which have already been commercialized. Furthermore, companies can out-license or sell their internally developed technologies and intellectual property (http://www.stage-gate.com/resources_stage-gate_openinnovation.php).

Launch or commercialization stage: Start of full production and commercial launching of the product and its sales. Within this stage monitoring of the innovation project is carried out, as well as detecting and correcting mistakes (Cooper & Edgett, 2005; Cooper, 2011; Kahn, 2013; Stošić, 2013).On the other side, the open Stage-Gate system should enable the company to sell or out-license already commercialized products if

there is a possibility to gain more value elsewhere; or to in-license – purchase an already commercialized products for achieving new growth for the company (http://www.stage-gate.com/resources_stage-gate_openinnovation.php).

Speaking about gates and criteria they include, they must also be modified in the open Stage-Gate system. In this case, not having all the capabilities to develop or execute a project doesn't lead to a "Kill", but leads to seeking a partner to handle the missing elements. These modified criteria must be introduced, dealing with partner or supplier selection and their capabilities (http://www.stage-gate.com/resources_stage-gate_openinnovation.php).

Having been a leader in Open innovation model employment, P&G also made an effort to develop and introduce the *open Stage-Gate* model, frequently cited as SIMPL 3.0. This is the version of a Stage-Gate model and is a method used to drive products from idea to launch stages with clear go/kill criteria and timing requirements (Panduwawala, Venkatesh, Parraguez & Zhang, 2009). In addition, one of the examples that should be useful to mention is General Electric's open Stage-Gate named "Toll-Gate" (Stage-Gate system) for handling an open innovation, both out-bound and in-bound (http://www.stage-gate.com/resources_stage-gate_openinnovation.php).

5. CONCLUSION

In this paper we discussed the opportunities to make connection between the Stage-Gate and Open innovation model, to integrate the open innovation principles into a closed new product/service development model. As it is previously stated, open innovation principles infiltrate almost every stage of the Stage-Gate process, while recently the most popular engagement of open innovation is in the ideation phase. The companies through co-creation or crowdsourcing try to solve current problems or even try to somehow attract end users to propose their ideas through online or offline games or over the companies' sites.

Various papers confirm that opening up the new product development process, in this case Stage-Gate process can generate significant value. On the other side, its implementation can be very challenging. We presented both Stage-Gate and Open innovation model and emphasized the possible points of their association. When it comes to this connection, it should be pointed out that not only changes in the Stage-Gate process has to be made but also company's current business model and capabilities have to be put under examination. For this model, very important is dynamic view, where companies should continuously revaluate their business models and be aware of own capabilities in order to successfully leverage problems when engaging in external collaborations (Chesbrough & Schwartz, 2007).

The "Open Stage-Gate" model has many benefits, starting from the fact that this model systematically integrates the principles of open innovation with existing Stage-Gate processes; it increase companies' proficiency in outbound open innovation activities (selling intellectual property - licensing); it provides systematic application of open innovation principles; it helps managers to continuously evaluate and adjust companies' capabilities and business model, i.e. business model innovation; it allows systematic review and assessment of importing intellectual property from outside the boundaries. Involvement of external know-how and technology can contribute the company in many ways, such as to complete a product, add value to the product offering, speed up the innovation process and reduce development costs (Gabel & Chesbrough, 2011).

REFERENCES

Chesbrough, H. (2003). Open Innovation: The New Imperative for Creating and Profiting from Technology. Harvard Business School Press.

Chesbrough, H., & Schwartz, K. (2007).Innovating Business Models with Co-Development Partnerships. Research Technology Management, 50(1).pp 55-59

Chesbrough, H., Vanhaverbeke, W. and West, J. (2006). Open Innovation: Researching a New Paradigm. UK: Oxford University Press.

Cooper, R. G. (1994). Perspective third-generation new product processes. Journal of Product Innovation Management, 11(1), 3-14.

Cooper, R.G. (2008). The Stage-Gate Idea-to-Launch Process–Update, What's New and NexGen Systems. Journal of Product Innovation Management, Volume 25, Number 3, pp 213-232

Cooper, R.G. (2011). Winning at New Products: Accelerating the Process from Idea to Launch. Third Edition. Cambridge.

Cooper, R. G. & Edgett, S. J. (2008).Maximizing productivity in product innovation. Research Technology Management, 51(2).
Cooper, R. G., & Edgett, S. J. (2005). Lean, rapid, and profitable new product development. Product development institute.
Cooper, R. G. &Mills, M. S. (2005).Succeeding at New Product Development the P&G way: A key element is using the “Innovation Diamond”. Product Development Institute Inc.
Docherty, M. (2006). Primer on „open innovation": Principles and practice. Visions, XXX, 2.
Drucker, P (1985). Innovation and Entrepreneurship: practice and principles. London: Heinemann.
Du Preez, N. D. & Louw, L. (2008).A framework for managing the innovation process. Management of Engineering &Technology.PICMET 2008. Portland International Conference on (pp. 546-558). IEEE.
Gabel, D. and Chesbrough, H. (2011).A Guide to Developing a Portfolio of Ideas and Experiments. Filene Research Institute.
Grolund, J., Ronneberg, D. and Frishammar, J. (2010). Open Innovation and the Stage-Gate Process: A Revised Model for New Product Development. California Management Review 5, 3: 106-131.
Kahn K. (2013). The PDMA Handbook of New Product Development.3rd Edition. John Wiley & Sons. New Jersey.
Panduwawala, L., Venkatesh, S., Parraguez, P. & Zhang, X. (2009). Connect and Develop - P&G's big stake in open innovation. University of Bath.
Rothwell, R. (1992). Successful industrial innovation: critical factors for the 1990s. R&D Management.Vol 22:3. pp. 221 – 239.
Stošić, B. (2013). Innovation Management – Innovation projects, models and Methods, Faculty of Organizational Sciences, Belgrade.
Trott, P. (2005). Innovation Management and New Product Development. 3rd edition. Harlow, England: Pearson Education Limited.
Trott, P. & Hartmann, D. (2009). Why'open innovation' is old wine in new bottles. International Journal of Innovation Management, 13(04), 715-736.
http://www.prod-dev.com/stage-gate.php
http://www.sopheon.com/industry-innovation/
http://www.stage-gate.com/resources_stage-gate_full.php
http://www.stage-gate.com/resources_stage-gate_openinnovation.php

THE EVOLUTION OF MOBILE TECHNOLOGY IN RETAIL MARKETING CHANNELS IN THE REPUBLIC OF SERBIA

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Abstract: *The evolution of retail institutions in marketing channels goes towards the implementation of modern information technology. The use of mobile technology is influenced by changes in buying habits and improvement of the buying experience of consumers on a global scale. Mobile commerce application has an increasing tendency with significant involvement in the whole electronic commerce in the market of developed countries. Retailers implement mobile technology tin order to get closer to consumers, to present their offers and become competitive. Offer becomes available in the global market thanks to mobile technology, which allows comparison of different retailers' offers by consumers. Modern mobile technology in the Republic of Serbia is an opportunity for growth of the application of mobile retailing in the country.*

Keywords*: marketing channels, mobile technology, retailing, globalization, internationalization*

1. INTRODUCTION

The application of modern technologies in the retail marketing channel is changing the structure of the channel, as well as the relations between participants in marketing channels. Retailers adapt to changes in the global market in order to reach the individual consumer, which is much easier with the implementation of new mobile technology. Changes in the mobile technology have an increasing impact on end-users in the Republic of Serbia, which is a potential that needs to be utilized.

The development of mobile technology in marketing channels set the following goals: continual evolution and trends of mobile technology in marketing channels, development and implementation of mobile technology in the process of globalization and internationalization, the use of mobile technology in the Republic of Serbia.

The main goal of this paper is to show implementation of mobile technology in modern marketing channels, all influenced by rapid technological changes in the global market. It should be noted that the use of new mobile technologies in the retail channel marketing aims to increase the competitiveness and reaching the end consumer. The research goals will be achieved by applying analytical, descriptive and comparative methods in data processing.

2. EVOLUTIONARY DEVELOPMENT OF NEW MOBILE TECHNOLOGIES IN MARKETING CHANNELS

The use of technology in marketing channels led to a closer relationship between all participants in the marketing channels, including connection with the consumer. The technological revolution in telecommunications, as well as changes in lifestyle of potential customers has enabled the development of mobile technologies in marketing channels. New mobile technologies have found their implementation in marketing channels, especially in retailing, because it is an attractive way for purchasing for some groups of consumers.

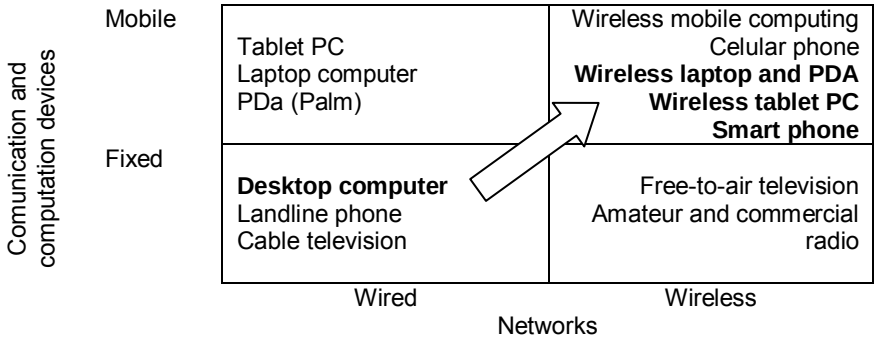

Figure 1: The development of the wireless mobile environments (Turban, King, et. al., 2010, p. 386)

Namely, the use of desktop computers and the necessity of connection of the computer to the Web, restricts those who want to obtain information about offers, or even do their shopping while on the way home, at work or in any other situation, when computer it is not available.

An additional factor which "pulls" the development of mobile application technologies are innovations in telecommunications and the emergence of new mobile devices with increasing performances, which exceeds the power of desktop computers. The evolution of new mobile technologies in marketing channels has led to the development of mobile environments. As it can be seen in Figure 1, the further development of the application of mobile technologies by consumers is influenced by the spread of use of mobile devices, especially smart phones with the characteristics of computers and tablet PCs, wireless laptops and PDAs that have a direct or wireless connection to the Web. Furthermore, mobile commerce includes any business activity conducted over the wireless network (Turban, King, et. al., 2012, p. 277).

In developed countries, the market share of mobile commerce in the overall e-commerce is rising from year to year, while in some countries show greater significance than the e-commerce. In the USA mobile commerce generated $41.68 billion of the total $262.3 billion of e-commerce sales in 2013, which was an increase of 68.2% from 2012 and account for 16% of total ecommerce sales (Forbes, http://www.forbes.com/, February 2013).

For the development of mobile commerce use by participants in marketing channels, it is necessary to access to adequate technical support for conducting transactions, the development of telecommunication network for rapid and secure exchange of information, adequate software support, applications that are customized and that are simply used by the user, and the willingness of all participants to accept the technology. Therefore, the infrastructure that supports mobile commerce requires the cooperation between multiple stakeholders such as mobile operators, service providers, manufacturers of mobile devices, Internet service providers, to the banking institutions and retailers and acceptance of technology by end-users, namely potential consumers.

In Figure 2 we can see the trend of exponential growth in sales via smart phones in the U.S. since 2012, with growth in the 2015th year, and an increase in the share of total e-commerce.

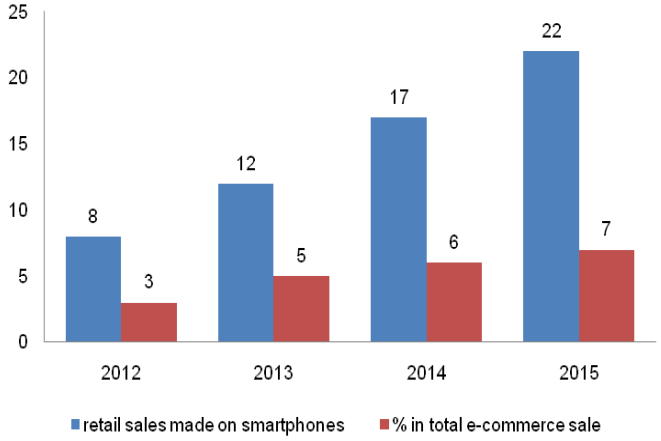

Figure 2: The U.S. Mobile commerce sale via smart phones in billions and share in total e-commerce sale with predictions in next years (Forrester Research, http://blogs.forrester.com/, January 2013)

In addition to high-performance smart phones, full use of smart phones means the existence of a developed telecommunication network. For the development of mobile commerce is crucial the evolution of mobile networks, and today we talk more about the implementation of 4G and 5G networks for mobile commerce. It is expected that transactions through mobile phones will rise to a thousand times until the 2020, influenced by the development of the new 5G network. The new technology should provide faster Internet at any time, video calls, instant access to on-line databases, creation of shopping lists, and buying via mobile devices will become more common (Končar, Leković, & Petrović-Katai, 2013, p. 122).

Smart phones with 5G technology have the possibility to choose the most secure data connections and ensure safe and fast transactions of mobile commerce. Data about the use of mobile devices, such as smart phones and tablet computers, shows their rise in share in turnover of retail marketing channel from year to year, and that tends to increase in the coming period, especially in developed market countries, such as the USA, Japan, Australia and so on. According to e-Marketer research in 2013 half the users of mobile

technology in the United States will have a connection to the Internet (Lovreta, Končar & Petković, 2013, p. 435).

Table 1: The U. S. Mobile commerce sale via smart phone and tablet (eMarketer, https://www.emarketer.com/, April 2013)

year / share	2012	2013	2014	2015
retail m-commerce sales	24.81	38.84	53.41	71.16
% change	82	56.5	37.5	33.2
% retail e-commerce	11	15	18	21

The use of smart phones in recent years is growing due to the multifunctionality, and the additional benefits are provided by tablet computers. Therefore, in the further development of new mobile technologies in marketing channels is important the usage of high-performance mobile devices. In the developed countries a large part of the mobile commerce transactions are conducted via smart phones and tablet computers, which affects the growth of the total e-commerce transactions.

3. BUILDING THE MOBILE RETAIL CONCEPT IN CONDITIONS OF GLOBALIZATION AND INTERNATIONALIZATION OF THE MARKET

Although the revenue from mobile retailing is relatively small, this concept begins to occupy an important place in the shopping experience in traditional retailing. Mobile retailing improves shopping experience and allows interaction between consumers and retailers on global market. Thanks to the mobile retailing, retailers have the opportunity to develop interactive relationships with consumers, to learn about consumers' individual needs in the best way, and appropriately and quickly respond to consumers' demands.

Gaining a significant role in the modern process of buying, mobile retailing is used in different business forms of retail sector. With mobile phones, smart phones, tablet computers and other mobile devices that have access to the Internet, buying process is easier because it is allowed to search products, locate store and products in the store, compare prices on the Web, and so on. By that, consumer has the opportunity not only to communicate with the retailer, but also transfer its experiences to other consumers globally, as all information is available on the Web.

The use of mobile technology in retail affects on the value of the sales, which is directly associated with factors related to end-users, ie. potential consumers. Factors that are relevant for the adoption of mobile technology are income per capita, the number of mobile phone users, the availability of technology, consumer buying habits, education and information literacy of users, and so on. There are different ways of application and use of mobile technology by end-users, ie. potential consumers. The application of modern mobile devices has an impact on changing habits and behavior of consumers. Consumers are using mobile devices to access the Web and come up with the necessary information about the offer, especially (Deloitte, October 2013, p. 20):

- 56% getting store locations,
- 54% check/comparing prices,
- 47% getting product information,
- 45% shop/browsing online,
- 40% checking product availability in a store or website,
- 36% get/using discounts, coupons, sales information,
- 32% scanning product barcodes to find more product information,
- 31% making a purchase online,
- 24% getting text messages or exclusive deals from retailers.

Based on the above, it can be concluded that the use of new mobile technologies in retailing has an impact on the achievement of competitive differentiation against the competition, in such a way that the information is available to potential consumers irrespective of the consumers' location. Location-based mobile commerce (the user is physically located at any place) is the key for offering relevant personalized services, which is the combination of personalization and location (Končar, 2008, p. 242).

Mobile retailing offers new possibilities to end consumers regardless of time and space. In combination with locating retail store or products, mobile retailing creates new value for consumers. The following years are considered crucial for the penetration of mobile retailing in the global market. In Table 2 is a growing trend in the mobile retailing in the United States, as well as a growth of the share in the total e-retail.

Table 2: Predictions of the US retail m-commerce sales 2011-2015, with the % sale and share in retail e-commerce sales (Forbes, http://www.forbes.com/, February 2013)

year / share	2011	2012	2013	2014	2015
retail m-commerce sales	13.57	24.78	41.68	56.72	75
% change	171.7	82.6	68.2	56.72	32.2
% of retail e-commerce sales	7	11	16	19	22

As it is presented in Table 2, as in the preceding parts, the United States leads the world in the application of mobile technology and mobile commerce. Retailers in the U.S. implement mobile commerce in their business. A large number of medium and large retailers in the United States recognize the importance of mobile commerce in achieving competitive advantage and positioning over the competition. However, it can be concluded that mobile retailing is a still a small percentage of the global e-commerce, or mobile commerce, and therefore have a little share in total retail trade. The only exception is Japan with advanced mobile retailing. Region with a high-paced growth of mobile retailing is East Asia, where growth is much higher than in Europe. A significant portion of electronic retail transactions in Japan are conducted through mobile devices, which is why this country is considered to be advanced in the application of mobile technology in retail.

4. THE CONCEPT OF MOBILE RETAILING IN FUNCTION OF THE DEVELOPMENT OF THE MODERN MARKETING CHANNELS IN THE REPUBLIC OF SERBIA

For the development of mobile commerce in the Republic of Serbia, a necessary factor is the implementation of the infrastructure of mobile commerce. Retailers in Serbia should take into consideration the advantages of mobile commerce for business development. The strategy of mobile commerce should be a support to existing businesses.

Using the latest generation of mobile telephony should improve and precedes the development of mobile commerce in Serbia. Mobile operators in Serbia conducted testing 4G mobile network in real conditions in April 2011. Bimonthly testing was performed in collaboration with manufacturers of mobile devices, companies Ericsson, Huawei and Nokia Siemens Networks, that have installed their equipment in multiple locations. Successful tests have shown that the mobile network in Serbia is fully prepared for the introduction of LTE technology and the launch of next-generation mobile telephony. Bearing in mind that only part of the frequencies intended for the use of 4G technology is in use at present, only after the completion of the digitization process, which will happen in 2014, use of a wider frequency range and 4G phones will be in use in our country (Končar, Leković & Petrović-Katai, 2013, p. 122). Croatia has started to operate a 4G network based on LTE technology that brings users up to ten times higher data rates than previously.

Table 3: Devices used for accessing the Internet in the Republic of Serbia from 2006 to 2013 (Republički zavod za statistiku, 2013)

year / device	2006	2007	2008	2009	2010	2011	2012	2013
PC	94.0	90.0	95.2	93.2	91.1	88.7	84.8	80.9
Cellular phone	-	26.6	24.8	25.4	21.8	15.7	37.2	46.1
Laptop	4.6	8.6	8.5	15.4	19.3	27.8	35.4	46.6
Game consoles	-	-	-	1.5	1.3	1.1	1.3	2.8
PDa palmtop	-	0.5	0.5	0.7	0.1	0.2	1.1	5.0
TV	-	0.2	0.1	0.2	0.1	0.4	0.8	3.5

As the main factor in the further development of mobile retail in Serbia is the number of users of mobile devices, as well as information literacy of users. Number of mobile phone users has increased to 86.9% (up from 83.9% a year earlier) in 2013 in the Republic of Serbia (Republički zavod za statistiku, 2013, p. 2). In Table 3 it can be seen that for access to Internet users mostly use PCs (80.9%, with a fall in the previous year), and for this purpose the mobile phone is used by 46.1%, an increase over the previous year from 37.2%. However, using a PC to access to the internet from year to year declines, while growth in the use of mobile phones, laptop and tablet computers recorded growth in the period 2006-2013. Based on the above it can be concluded that the growth of mobile phone use will continue in the future, as well as use of the Internet by users, as a necessary condition for the implementation of mobile commerce.

Additional prerequisite for the implementation of mobile retailing is the development of mobile payment systems. What is recognized is that mobile payment systems are developing in recent years in Serbia. Thus, in cooperation with mobile operators and banks is developed a system for mobile payments “PlatiMo”, through mobile phones. Also, very popular in the Republic of Serbia is voucher system “Qvoucher”, which acts as an electronic "supplement" for payment goods and services on the Internet. After only two years since the introduction of this system it has over 20,000 users and over 25,000 transactions per month.

Revenue from mobile retailing in Serbia is relatively small, but its aspect begins to occupy an important place in the shopping experience. Mobile retail is yet to show its full potential in generating growth across all retail channels, along with improving the buying experience by allowing greater interaction between consumers and retailers. Exploitation of mobile technologies will enable retailers to be oriented towards the user, potential customers, develop closer relationships and increasingly meet the needs of individual consumers.

5. CONCLUSION

Continual evolution of new technologies and trends in marketing channels, under the influence of global environmental factors, leading to innovation and the emergence of new mobile devices with increasing performance. Thanks to the mobile retailing, retailers have the opportunity to develop interactive relationships with consumers in the global market. The implementation of new mobile technologies in retailing has an impact on the achievement of competitive differentiation against competitors in marketing channels. The implementation of new mobile technology needs to improve and develop mobile commerce in Serbia. As the main factor for this development of mobile retailing in Serbia is a growing use of the Internet by consumers.

REFERENCES

Deloitte, (2013, October). *“Deloitte’s 2013 Annual Holiday Survey Naughty or nice? How will retail sales fare this holiday season?”*. Deloitte Development LLC

Končar, J., (2008). Elektronska trgovina. Subotica: Ekonomski fakultet Subotica

Končar, J., Leković, S., Petrović-Katai, Z. (2013, February). *“Primena koncepta mobilne trgovine u Republici Srbiji”*, Paper presented at XVII Naučno-stručni skup “IT13 - sadašnjost i budućnost”, R. Crna Gora, Žabljak, 25.02.-01.03.2013., Univerzitet Crne Gore

Lovreta, S., Končar, J., Petković, G. (2013). Kanali marketinga, trgovina i ostali kanali, Beograd: CID, Ekonoski fakultet Univerziteta u Beogradu, Subotica: Ekonomski fakultet, Univerzitet u Novom Sadu

Republički zavod za statistiku, (2013, 23rd September). Upotreba informaciono-komunikacionih tehnologija u Republici Srbiji, Beograd: Republički zavod za statistiku

Turban, E., King, D., Lee, J., Liang, T.-P., Turban, D. (2010). Electronic Commerce 2008. A Managerial Perspective. New Jersey: Prentice Hall, Pearson

Turban, E., King, D., Lee, J., Liang, T.-P., Turban, D. (2012). Electronic Commerce 2012. A Managerial and Social Network Perspective. New Jersey: Prentice Hall, Pearson

Forrester Research, (2013, January). *“US Mobile Retail Forecast, 2012 To 2017”*. Retrieved from http://blogs.forrester.com/sucharita_mulpuru/13_01_2013_us_mobile_retail_sales_to_top_12_billion_in_2013

eMarketer, (2013, April). Retrieved from https://www.emarketer.com/go/coverage/mobileMarketing.aspx

Forbes, (2013, 10th February). *“Ecommerce Is Growing Nicely While M-commerce Is On A Tear”*. Retrieved from http://www.forbes.com/sites/chuckjones/2013/10/02/ecommerce-is-growing-nicely-while-mcommerce-is-on-a-tear/

ADVANCED REAL ESTATE MANAGEMENT SYSTEM

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Abstract: *GIS and Internet services are one of the leading trends in the new developments of the information technology. Their impact could be seen in the different sectors of business and management. Very closely connected to the new paradigm of mobility, detecting the space/location is becoming one of the most important point for the different industries. Contrary to isolated use of technologies, Advance Real Estate Management System presents integration of GIS and Internet as one of new models in business management.*

Keywords*: GIS, Internet, Management, Real Estate, Model, Software*

1. INTRODUCTION

Information technology has shifted the paradigm of the global economy. In a macroeconomic sense, information technology affects the patterns of production, investment and employment. In a microeconomic sense, information technology changes business activities (Eui-hwan, 1999). The world is changing from the industrial age to the information age. The rise of information technology marks a more complex relations between space and time. The accent must be on the approach to treat the space and time as the key, integrated entities in the "new mobility".

Where people live? What they do? Where, when and how they go? And where, when, and how they spend their money are now key factors in the business success. From product development to distribution, marketing and sales, GIS technologies help companies identify, understand and serve their markets far more effectively than ever before (Winslow, 2002).

Space, place, location plays a key role in determining the type and nature of human activity. The space/location determinant is correlated with consumers' information needs, and product or service choices. Many previous papers from various fields have discussed the usage of space information in day-to-day business applications (Goodell & Syverson, 2007), (King, 2009), (Svantesson, 2007), (Briney, 2013).

However, as GIS technologies progress and spread across the globe, the more questions are arising. What can businesses do to stay ahead of the changes? Which technologies are the most efficient and flexible for different business models? What this type of the information could tell us about business processes and how do we use those insights to manage the same processes?

It is important to note, space/location as furthered by this renewed Internet industry has seemingly extended the influence of the 'social' as a driver of contemporary Internet innovations (Sap executive insight paper, 2011). Internet and surrounding communication technologies are becoming the key drivers in the innovations and new business models.

2. INTEGRATING GIS AND INTERNET TECHNOLOGIES FOR NEW BUSINESS MODELS

GIS's development has been more evolutionary, than revolutionary. It responds to contemporary needs as much as it responds to technical breakthroughs. Planning and management have always required information as the cornerstone. Early information systems relied on physical storage of data and manual processing. With the advent of the computer, most of these data and procedures have been automated. As a result, the focus of GIS has expanded from descriptive inventories to entirely new applications involving prescriptive analysis.

In the past, analytical models have focused on management options that are technically optimal. Yet in reality, there is another set of perspectives that must be considered, the business solution. It is this final sieve of management alternatives that most often confounds geographic-based decisions. These are not the usual quantitative measures amenable to computer algorithms and traditional decision-making models (Berry, 2000).

The step from technically feasible to business acceptable options is not so much increased scientific and econometric modelling, as it is communication. Basic to effective communication is involvement of interested parties throughout the decision process. This new participatory environment has two main elements—consensus building and conflict resolution. Consensus building involves technically-driven communication and occurs during the alternative formulation phase. It involves a specialist's translation of various considerations raised by a decision team into a spatial model. From this perspective, an individual map is not the objective. It is how maps change as the different scenarios are tried that becomes information. Often, seemingly divergent philosophical views result in only slightly different map views. This realization, coupled with active involvement in the decision process, can lead to group consensus (Berry, 2013).

However, if consensus is not obtained, mechanisms for resolving conflict come into play. The business-driven communication occurs during the decision formulation phase. It involves the creation of a "conflicts map" which compares the outcomes from two or more competing uses. Each map location is assigned a numeric code describing the actual conflict of various perspectives. For example, a parcel might be identified as ideal for a wildlife preserve, a campground and a timber harvest. As these alternatives are mutually exclusive, a single use must be assigned. The assignment, however, involves a holistic perspective which simultaneously considers the assignments of all other locations in a project area.

Traditional business approaches rarely are effective in addressing the holistic problem of conflict resolution. Even if a scientific solution is reached, it often is viewed with suspicion by less technically-versed decision-makers. Modern resource information systems provide an alternative approach involving human rationalization and tradeoffs. The dialogue is far from a mathematical optimization, but often comes closer to an acceptable decision. It uses the information system to focus discussion away from broad philosophical positions, to a specific project area and its unique distribution of conditions and potential uses (Berry, 2000). In this direction, GIS might have the unique ability to be the right solution.

GIS uses spatio-temporal (space-time) location as the key index variable for all other information. Just as a relational database containing text or numbers can relate many different tables using common key index variables, GIS can relate unrelated information by using location as the key index variable. The key is the location and/or extent in space-time.

Any variable that can be located spatially, and increasingly also temporally, can be referenced using a GIS. Locations or extents in Earth space–time may be recorded as dates/times of occurrence, and x, y, and z coordinates representing, longitude, latitude, and elevation, respectively. These GIS coordinates may represent other quantified systems of temporo-spatial reference (for example, film frame number, stream gage station, highway mile-marker, surveyor benchmark, building address, street intersection, entrance gate, water depth sounding, POS or CAD drawing origin/units). Units applied to recorded temporal-spatial data can vary widely (even when using exactly the same data, see map projections), but all Earth-based spatial–temporal location and extent references should, ideally, be relatable to one another and ultimately to a "real" physical location or extent in space–time.

Related by accurate spatial information, an incredible variety of real-world and projected past or future data can be analyzed, interpreted and represented to facilitate education and decision making (Rafi, 2011).

GIS technologies are not merely about space location, in this sense, and can be read as technologies of mobility. As Cresswell (2010) writes, mobility is ~~-t~~he entanglement of movement, representation, and practice". Physical movement, Cresswell continues, is the ~~-r~~aw material" of mobility. Beyond this notion, however, representations of mobility abound. Mobility is thus about the meanings of movement (or the absence of movement) (Cresswell, 2011). In this sense, mobilities demand the recognition of the spatiality of our worlded interactions, despite the ways in which space and time are ~~-t~~amed", to use Massey (2005), by some methods for measuring movement.

The rise of Internet technologies marks a further enabling of the turning of space into time, while also producing more complex relationships of mobility between the here and there. These geographies of information technology emphasize the ways in which technology imbricates in everyday life.

It therefore becomes apparent that new models cannot succeed in a business sense without integrated framework based on detailed knowledge of GIS and Internet technologies.

3. RESEARCH AND OBJECTIVES

This research aims to develop an effective response to the challenges currently faced by emerging GIS and Internet technologies and their influences in different new business models.

It is intended that the research findings will contribute to the development of a framework/model designed to support the creation of the software which could be effectively used to manage new business models.

These above aims raise the following core project objectives:

• To identify different location/positioning and communication technologies

• To propose ways in which these specific technologies may be combined

• To create software to manage new business model related with Real Estate and property market

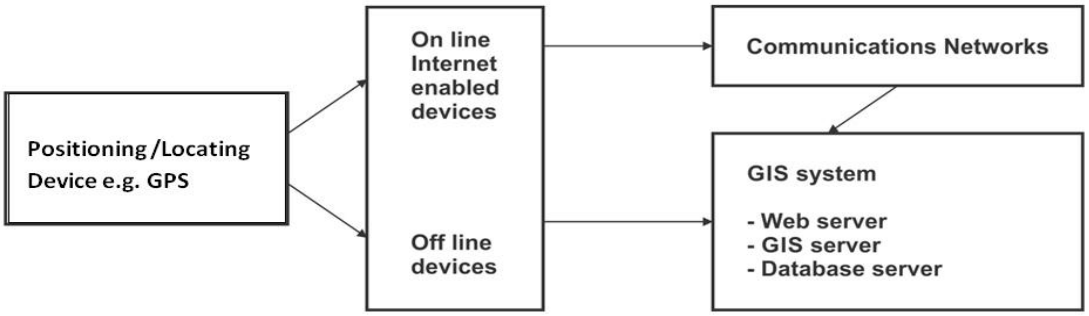

Figure 1. GIS and Internet technologies integrated with the communications networks

4. METHOD

HTML5 with Geolocation API was used and tested on the following the browsers and Geolocation service (including corresponding maps):

- Chrome - Google Location Services
- Firefox on Windows - Google Location Services.
- Firefox on Linux - GPSD
- Internet Explorer 9+ - Microsoft Location Service.
- Safari on iOS - Apple Location Services for iPhone OS 3.2+.
- Opera - Google Location Services.

The following code (JavaScript) was applied in the part of GIS in order to get the current location of the user:

```
// Current position
navigator.geolocation.getCurrentPosition(prcsGeolocation,geolocError,
{
timeout: 0,
enableHighAccuracy: true,
maximumAge: Infinity
}
);
//Tracking position
Id = navigator.geolocation.watchPosition(prcsGeolocation,geolocError,
{
timeout: 0,
enableHighAccuracy: true,
maximumAge: Infinity
}
);
```

Figure 2 Snippet of the code

The method of comparison was used with the following criteria:

- Accuracy of location
- Work in the different environments (in-door, bad weather conditions etc)
- The range of the different platforms and devices
- The level of adaption with open source software (like PHP, MySQL)

5. APPLIED GIS - ADVANCED REAL ESTATE MANAGEMENT SYSTEM

Malta is a southern European country in the Mediterranean Sea. With the area of 316 km2 and the population of 400000 people, Malta is one of the world's smallest and most densely populated countries. Malta's population density of 1,282 per square km is by far the highest in the EU, and one of the highest in the world [17- [Online]. Available: http://mt.wikipedia.org/wiki/Malt, 2014.]. Very limited space with population density and advance economy has a serious impact in many different sectors. One of this area is real estate or property market.

Malta with very good standard, historically always important geographic position, moderate climate, membership in Europe Union, is very attractive location for many people to buy or rent the property. The prices in last decade clearly indicates this trend. However, the micro location is increasingly becoming the key factor in the most of the business decisions related with the real estate system in Malta. It was clear the new information system needs to be in place, which represents not only the properties, but more the complete environment around the properties. The price is important factor, but the location is even more important.

The new system is based on GIS architecture with the following components:
- HTML5 with Geolocation API
- XML
- PHP
- MySQL

The main features of the system:
- Clear separation of the client and server side
- HTML5 and JavaScript enables all the platforms (Windows, PC, MAC) and devices (PC, SmartPhone, Tablet) to use the system
- Using XML as de-facto standard in exchange format
- PHP and MySQL as open source technologies

There are two parts of the application:
- Administrator part which is responsible for all input and updates of the data
- The part for Public user which could search for the property

Using HTML5 Geolocation API, which separates the implementation of Geolocation from the underlying devices, there are several benefits:

- There is a solution for the limitation of GPS (Chivers, 2013) which cannot work in bad weather conditions or in-door environment.

- Combining several methods of the positioning like GPS, A-GPS, Cell-ID, Wi-Fi (Reardon, 2005) etc, the accuracy of the coordinates is improved and it is available in all different environments.

- Web interface brings main advantage to avoid any limitation of using different devices with the different operating systems

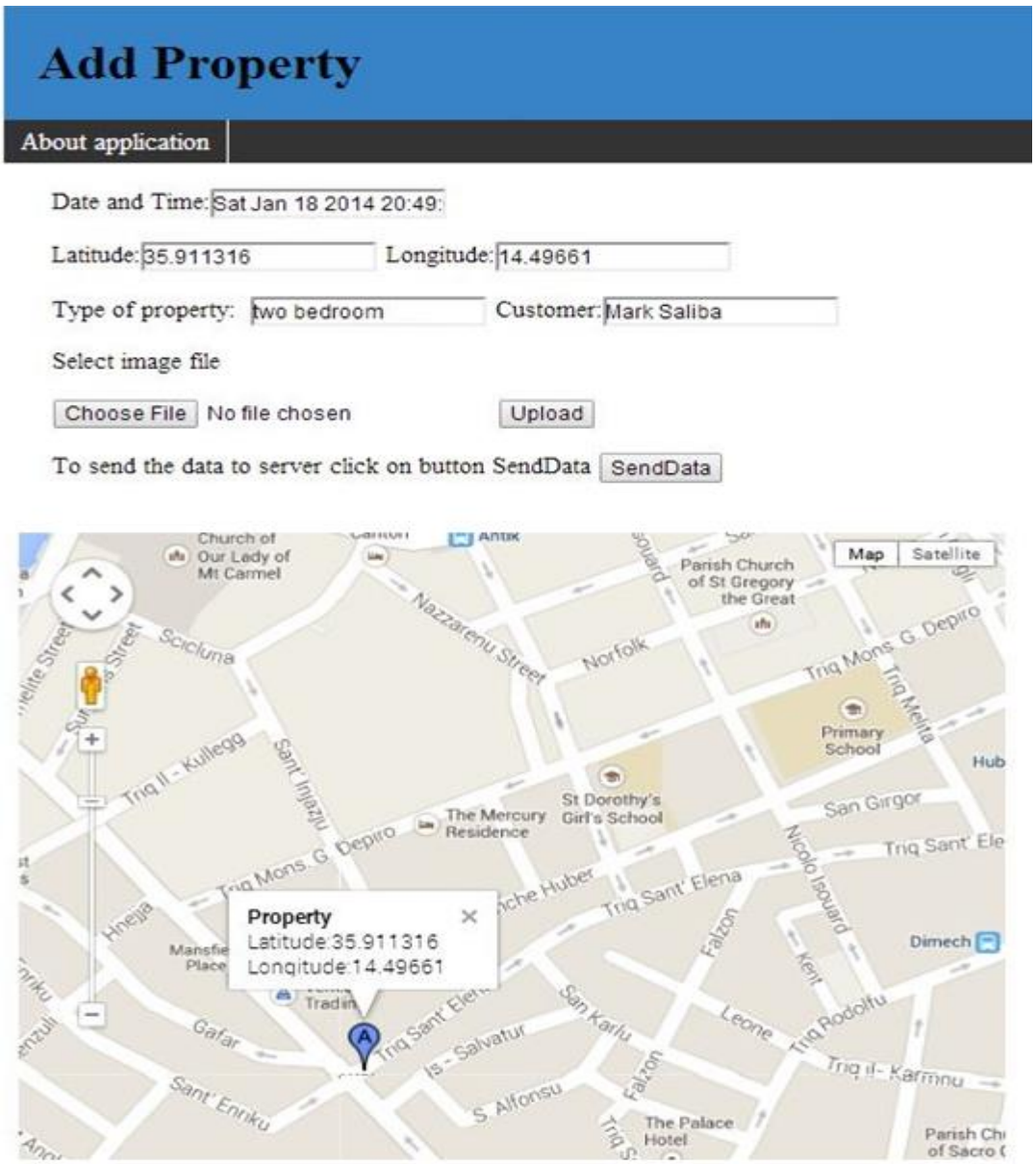

Figure 3. Add Property

Very important feature of the new system is the ability to add the objects which are located near the property. As it was mentioned, micro-location is becoming very important factor in any business decisions related with property.

How far is the post office? How far is the bank? But even more important the information about some small objects which usually is not available, like small supermarkets, green grocery shops, pharmacy etc.

Similar to the previous screen, adding the object located near the property is very simple process, getting the coordinates of the object, inputting the details of the object and send data to server.

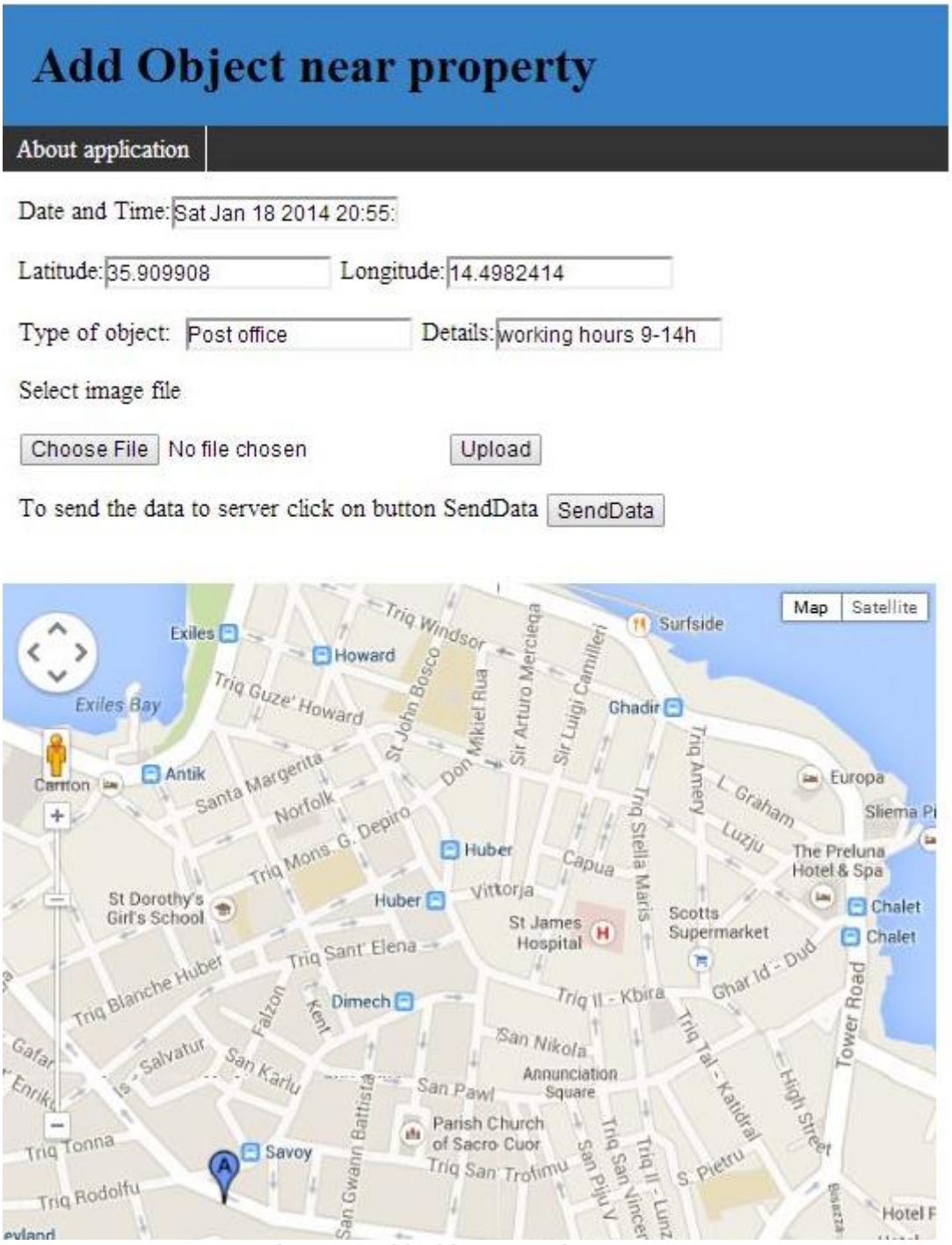

Figure 4. Add Object near the property

Public user of the application could use the search in two modes:

- Selecting the position of the map and inputting the search criteria like; find and show all the properties which are located in the distance of 500 m from this position and the value of these properties not to exceed 100 000 euro.

- Automatically getting the current position (show on the map) and inputting the search criteria like; find and show all the properties which are located in the distance of 500 m from this position and the value of these properties not to exceed 100 000 euro.

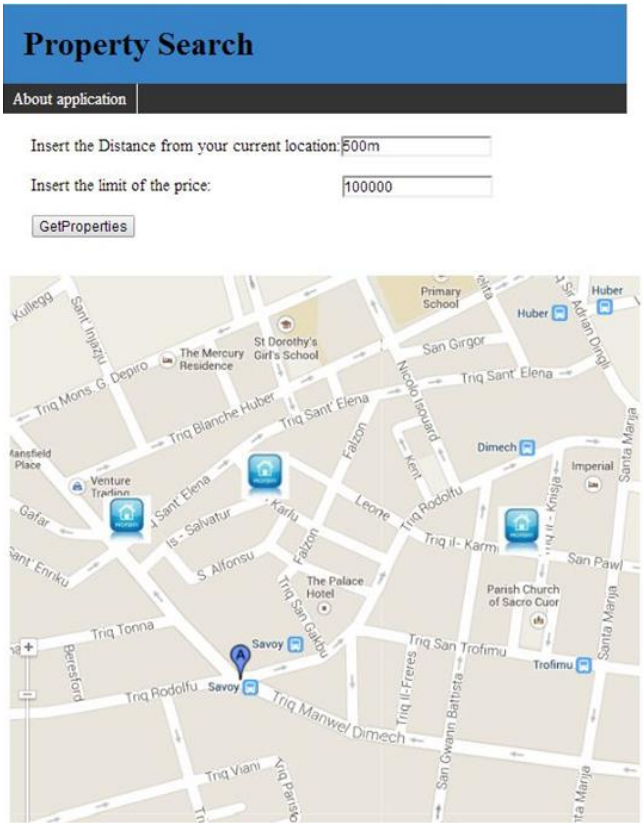

Figure 5. Property search

Figure 5. Shows three properties with above-mentioned conditions.

Figure 6. Property View

Clicking on one of these properties (exactly clicking on the icon which represents the property) from the Figure 5. the next screen (Figure 6.) will show the property.

The details of the property will be shown, like one or two images and the objects close to this property. The location of the objects and ability to see their position in a relation with the location of the property will give the new details about the property itself.

6. CONCLUSION

The new trends and developments of the information technology have very important or even the critical impact to all spheres of today's economy. Technological mobility, the characteristic of modern world, is changing the traditional meaning of the space/location. The new business models where the space/location

is critical will require integrated approach in combining different Internet technologies with the communications networks where GIS will be synergy integrator on the separate levels.

Advance real estate management system is one of the examples where this integrated approach is applied. Considering very specific conditions, the system is developed to be the tool to manage appropriate business model with over 3000 properties and over 7000 objects. The new research and recommendations will be to create the other prototypes of the software solutions based on the above-mentioned integrated approach, always considering business model as a critical factor.

REFERENCES

Berry, J. (2013). *GIS Evolution and Future Trends*, Beyond Mapping III. Compilation of Beyond Mapping columns appearing in GeoWorld magazine 1996 to 2013, Retrieved from: http://www.innovativegis.com/basis/MapAnalysis/Topic27/Topic27.htm#Top.

Berry, J. (2000). *A brief history and probable future of geotechnology*, University of Denver. Retrieved from: http://www.innovativegis.com/basis/Papers/Other/Geotechnology/Geotechnology_history_future.htm.

Briney, A. (2013). *How Businesses Use Geographic Information to Make Sound Business Decisions*. About.com. Retrieved from: http://geography.about.com/od/geographictechnology/a/businessgeog.htm.

Chivers, M. (2013). *Differential GPS Explained*. ArcUser Online. Retrieved from: http://www.esri.com/news/arcuser/0103/differential2of2.html.

Cresswell, T. (2010). Towards a politics of mobility. *Environment and Planning D: Society and Space* 28(1) 17 – 31.

Cresswell, T. (2011). Mobilities II: Still. *Progress in Human Geography*. p. 645-653.

Escolar. M. (2003). Exploration, Cartography and the Modernization of State Power in: Brenner, N., Jessop, B., Jones, M., MacLeod, G. (Eds.), *State/Space: A Reader*. Blackwell Malden MA, pp. 29-52.

Eui-hwan, H. (1999). Information technology and economic development. *Technology Standards Division*, Ministry of Information and Communication. (Republic of Korea).

Goodell, G. & Syverson, P. (2007). The right place at the right time. *Communications*. ACM 50(5):113–117.

King, K.F. (2009). Geolocation and federalism on the internet: Cutting internet gamblings gordian knot. *Columbia Science and Technology Law Review*.

Massey, D.B. (2005). *For Space*, Sage. London.

Reardon, M. (2005). *Wi-Fi used for location services*. CNET News. Retrieved from http://news.cnet.com/Wi-Fi-used-for-location-services/2100-7351_3-5754288.html.

Rafi, KM. (2011). *http://en.wikipedia.org/wiki/User:Rafi.km*. Retrieved from: http://en.wikipedia.org/wiki/User:Rafi.km.

Sap executive insight paper. (2011). *Mobility Series Mobility: Its Impact, Opportunities, and Challenges*. SAP.

Svantesson, D. (2007). E-commerce tax: How the taxman brought geography to the borderless internet. *Revenue Law Journal*, 17.1.

Winslow, J. (2002). *Analyzing CRM Data.* CRM magazine. Retrieved from: http://www.destinationcrm.com/Articles/Web-Exclusives/Viewpoints/Analyzing-CRM-Data-48034.aspx.

CLOUD COMPUTING INFRASTRUCTURE APPLICATIONS IN COMPUTER SIMULATION

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Abstract: *This paper presents possibilities for improving computer simulations using cloud computing infrastructure. Authors examine the types and good examples of cloud-based computer simulations, offering suggestions for the architecture, frameworks and runtime infrastructures which support running simulations in cloud environment. There are cases when Monte Carlo simulation can have more accurate outputs than analytical methods. In order to reach such accuracy and results precision, Monte Carlo simulation sometimes requires orders of magnitude more computing time. Such computationally intensive scientific problems can be solved by using the possibilities offered by cloud computing platforms as cloud computing has become the standard for providing hardware and software infrastructure. Authors present results of solution that uses public cloud infrastructure for executing simulation experiments and increased efficiency of simulation execution more than 300 times and still keeping costs at acceptable level.*

Keywords*: cloud computing, infrastructure, computer simulation, Monte Carlo simulation*

1. INTRODUCTION

In last couple of years, Cloud Computing has become a standard for delivering hardware and software infrastructure. It is based on a pay-per-use business model where resources are acquired only when really needed and customer pays only for resources actually used. Cloud computing represents the mechanism for dealing with the use of external services as part of the computational foundation (Tor-Morten, 2012). It provides scalable, distributed computer services as needed. The aim of cloud computing is to present a service layer for its users where all detailed logic is made transparent and drawn upon as needed. In general, cloud computing is recognized as an infrastructure where all underlying resources (storage, RAM, processors, load balancers etc.) are completely abstracted from the end user. This leads to the cloud provider/vendor to be in charge of performance, reliability and scalability. Gartner (2013) defines cloud computing as a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service using Internet technologies. The National Institute of Standards and Technology (NIST) defines cloud computing as “a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction” (Peter, M., & Grance, T, 2011). The same authors list three service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). Some authors extend this list with additional service models: Communication as a Service (CaaS), Database as a Service (DBaaS), Security as a service (SECaaS), Identity Management as a Service (IMaaS), Desktop as a Service (DaaS) (Schaffer, 2009) and Carroll et al. (2011) extend it further with: Monitoring as a Service (MaaS), Storage as a Service (STaaS), Compute Capacity as a Service (CCaaS), Hardware as a Service (HaaS), IT as a Service (ITaaS), Business Process as a Service (BPaaS).

Infrastructure as a Service (IaaS) service model brings possibility for outsourcing common elements of infrastructure like virtualization, storage, networking, load balancers etc. to a vendor of choice. The IaaS provider bills for the infrastructure services usage as per its service level agreement (SLA). One of the biggest benefits of IaaS is that it provides granular control, in which you can choose the core components for your infrastructure.

The starting hypothesis of this paper is that by using cloud computing technologies, researchers can increase efficiency of simulation experiment execution, decrease costs and improve computer simulation process in general. As in traditional computing environment, it is possible to execute all kinds of simulation experiments using cloud computing environment. This approach can make models accessible to a wider range of researchers, and data analysis of simulation experiments outputs can be performed in more improved ways.

2. LEASE OF HARDWARE INFRASTRUCTURE FOR SIMULATION LAUNCHING

Simulation is a process of creating abstract models of real systems and performing experiments based on these models. A computer simulation is a simulation performed by computer to reproduce behaviour of a system (Radenković et al. 2010).

IT infrastructure is the foundation for computer simulation, and has important impact on simulation execution efficiency, on process of simulation model development as well (Marinković et al. 2014). Recent development of virtual platforms and virtual platforms hardware infrastructure modified the way in which the applications, services and hardware are used on Internet. Cloud computing represents a new way for using infrastructure, hardware and software resources. We may differentiate between private, public and hybrid clouds (Figure 3). The well-known public ones are: Amazon, Google, Microsoft Azure and Salesforce. The private clouds are often developed within big companies, by using the virtual platforms (commercial: VMware, Citrix, or open source: Eucalyptus).

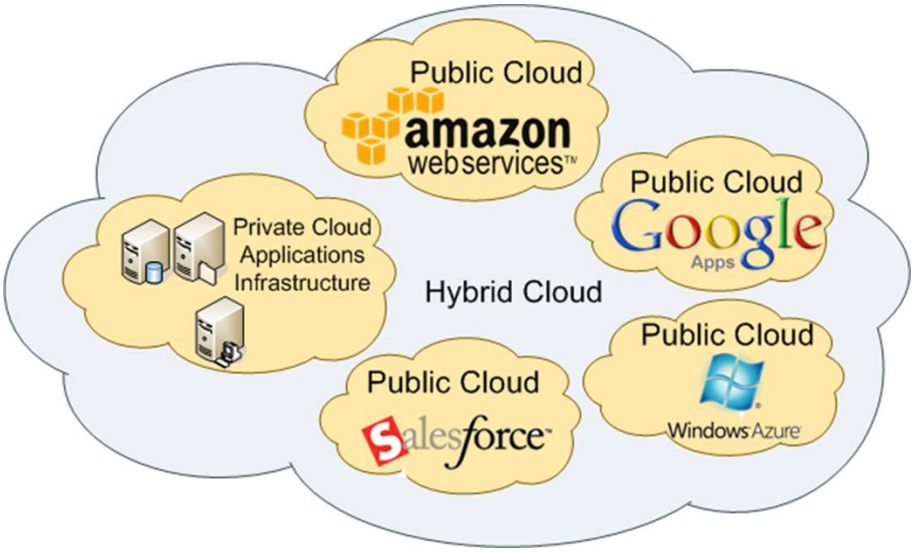

Figure 1: Types of clouds according to the development model (adopted from Slook, B, 2009)

In our paper we will present possibilities of using computing infrastructure offered by public cloud provider.

The use of cloud computing services has become inevitable in the majority of research institutions with the aim of fulfilling the need for increased IT resource and data storage capacities. The main three factors which influence the expansion of cloud computing use are the following:

1. Constant increase of IT resources and storage needs which lead to increased hardware and support costs;
2. Exponential growth of data used in research;
3. Greater use of Service computing which use Web 2.0 applications.

Along with IT infrastructure rented from cloud computing service providers, research institutions are starting to use applications accessible on the Internet, instead of traditional software installed on on local computers. This approach reduces IT system complexity, prices and maintenance costs.

Cloud Computing is most frequently related to lease of IT resources in public clouds (IaaS and PaaS service models). IaaS model includes leasing of virtual machines and data storage space, while PaaS model includes leasing of system software (operating systems, DBMS, application servers i and development tools).

The main components of any Cloud infrastructure are:

1. Hardware layer - including storage, IT and network infrastructure (EMC, IBM, CISCO, NetApp, HP, ...)
2. Virtualization layer - application of virtualization technologies: VMware, Citrix, Microsoft
3. Application layer – applications which are offered to users as a service.

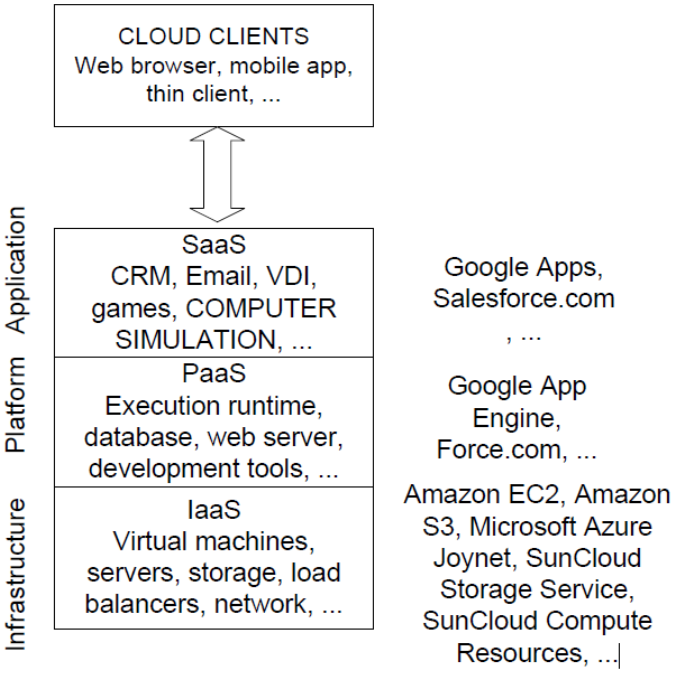

Figure 2: Service models of cloud computing (adopted from Peter Mell, Tim Grance, 2009)

Focusing on the lease of hardware and virtual hardware infrastructure, we can list three main aspects introduced as a novelty by Cloud Computing (Andrzejak et al. 2010):

1. User's impression that the resources are unlimited, which implies that there is no need for additional resources planning;
2. The ability to extend resources at any time and according to current needs;
3. The ability to lease IT resources for a short period of time (for example processors for an hour, data storage for one day) and their abandonment after the activity is finished.

Executing of simulation experiments of complex models has always been hardware demanding and time consuming. Also, necessary memory and storage space for storing results of such simulation experiments is extensive. By the rule, such experiments are demanding large databases which store numerous results of different experiments and their variations. Although they are usually structured, there is a great number of unstructured data output such as pictures, videos, etc. Additional challenge is put in front of researchers by using and processing the data resulting from simulation experiments.

We may conclude that computing infrastructure necessary for performing simulation experiments used to be one of most expensive components of simulation projects. Leasing of IT infrastructure from Cloud Computing service providers brings possibilities for performing multiple experiments which may be executed at the same time, in parallel, without the need of having own expensive IT infrastructure. Also in some cases, during the project implementation, researchers may need to change existing hardware performance by adding additional CPUs, memory and storage, and it is possible to be done during the very experiment. The virtual infrastructure provides business continuity plan, which means that the break-up of physical hardware does not influence the execution of the simulation experiment.

CLOUD INFRASTRUCTURE FOR EXECUTION OF MONTE CARLO SIMULATION

Poole, Cornelius, Trapp and Langton (2012) provide good examples for the implementation of the simulation experiment, by using the Monte Carlo simulation. This type of simulation is common in financial simulations field, and it can be implemented even in spreadsheet (Barjaktarović-Rakočević, et al., 2006, Marković, et al. 2005, Marković & Čavoški 2005). The users of Cloud infrastructure have the possibility to multiply calculations in a short time period within the Monte Carlo simulation experiments, which is the basis of the Monte Carlo simulation (Metropolis, N., & Ulam, S, 1949, Mahdevan, S, 1997). The classic infrastructure would require an expensive and specialized hardware. If it is not available it will be time consuming to

perform calculations. The new infrastructure model ensures the repetition of a great number (millions and even billions) of experiments within a very short period of time.

Poole et al. analysed the application of GEANT4 C++ tool for simulation of penetration of particles through geometrical shapes by using the Monte Carlo simulation. Flexible definition of geometry and adjustment of physical processes offer the user a high level of control and the ability to simulate a wide spectrum of radio therapy techniques with the aim of rapid and quality determination of therapy with cancer patients. In carrying out this study researchers used Amazon EC2 as the computing platform and Amazon S3 as storage. By using the Amazon public cloud the Monte Carlo simulation was significantly speeded up by increasing the number of instances of simulation experiment.

In our study, we have used Microsoft Azure cloud platform as infrastructure for performing simulation experiment. For the experiment task, we have chosen simple case of approximating the value of π using Monte Carlo simulation. Although, there are more complex and useful applications of Monte Carlo simulation, including financial, behavioural, mechanical ad nuclear physics problems, we wanted to focus on benefits provided by using Cloud Computing infrastructure, leaving model as simple as possible.

For approximating value of π using Monte Carlo simulation, we used the approach of approximating the circle with radius r=1 inscribed within a square, as presented in Figure 3. The area of the circle is $r^2\pi=1^2\pi=\pi$, and the area of the square is $(2r)^2=4$. A simple Monte Carlo simulation to approximate the value of π involves randomly selecting n points and finding the number of points that satisfy (red points, Figure 3). In the end, the value of π is approximated as π –
As the generation of points are independent events, we can split them on different nodes and represent them as generating pairs of random numbers in the range between 0 and 1 inclusively and perform validation if they fit inside the circle area by verifying

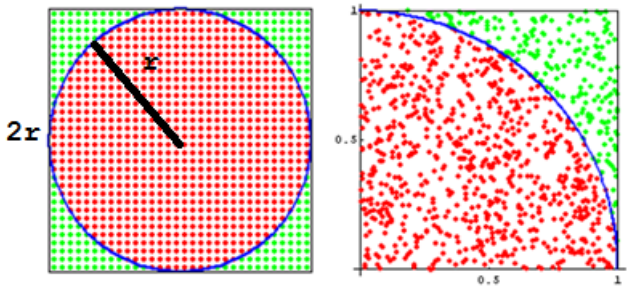

Figure 3: Circle inscribed inside of rectangle and points that fit inside, marked red

Implementation of the simulation software is done by using Java and JBoss application server including JBoss Messaging. The architecture consists of three different types of nodes: one manager node, JBoss cluster and multiple worker nodes and is presented at the Figure 4. Manager node starts and controls simulation experiment, splits simulation process into granular tasks, sends them in tasks queue and collects results from results queue, puts results together and produces final results of simulation experiment. JBoss cluster is in charge of delivery of tasks and results messages to and from worker nodes. Each worker node has the same piece of software installed and listens to tasks queue, performs incoming simulation task and posts back the result of task. The manager node split in tasks according to the necessary number of iterations per each task. Each task, before being sent to the tasks queue is assigned a unique identifier and is saved at the manager node. This way, if some worker node fails, that task is being resent to the task queue and gets delivered to other worker node for processing. In an asynchrony way, idle worker nodes take tasks from the tasks queue in order, one by one, executes necessary random numbers generation in iterations and posts results to results queue. After this, worker node is available for receiving new task from the queue and continues executing it. When all tasks are done, and manager node received all results, it can aggregate final result and calculate requested approximation.

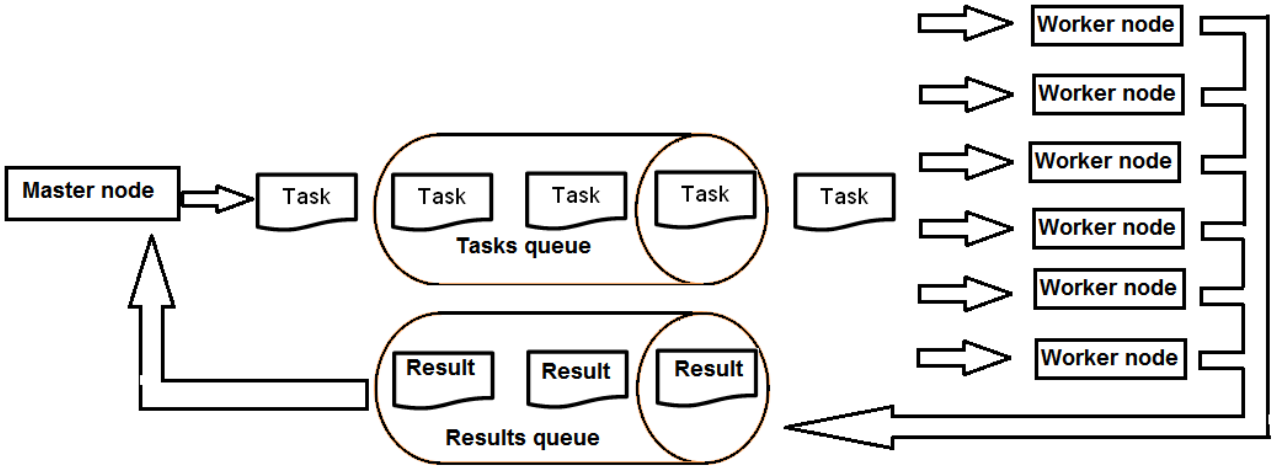

Figure 4: The architecture of simulation system

For comparison purposes, the experiment was conducted on single computer, HP ProBook 6440b, with i5 processor, having 2 cores at 2.4 GHz and 3GB RAM with sequential execution of random numbers generation and also in Microsoft Azure public cloud, on nodes with 2 virtual cores, and 3.5 GB memory. In order to get more accurate results, each simulation task is performed for 10 times and average results are presented in the Table 1:

Table 1: Performance and price comparison

Single computer			Cloud environment		
Number of points generated	Decimal Precision	Avg. Duration	Worker Nodes	Duration	Price (USD $)
100	1	**0,015 s**	2	2,24 s	0,27
1.000	1	**0,121 s**	2	3,45 s	0,27
10.000	2	**0,349 s**	2	4,82 s	0,27
100.000	3	**0,599 s**	2	5,01 s	0,27
1.000.000	3	**1,642 s**	2	7,96 s	0,27
10.000.000	3	**10,983 s**	5	21,72 s	2,74
100.000.000	3	105,354 s	5	**22,44 s**	2,74
1.000.000.000	4	19,944 m	10	**33,66 s**	5,48
10.000.000.000	5	2,648 h	10	**2,34 m**	5,48
100.000.000.000	5	1,042 d	20	**10,85 m**	10,95
1.000.000.000.000	5	11,003 d	100	**47,71 m**	54,75

These results are showing that working with small number of points generation makes more sense to be performed on a single computer rather than using multiple nodes cloud environment. This is most probably because of messaging overhead and time needed for synchronization between nodes. When number of random numbers generated for simulation goes over 100.000.000, 5 worker nodes perform this simulation task near 5 times faster than single computer. This speedup is more obvious when dealing with very large amount of random numbers generated (1.000.000.000.000) where 100 nodes finish this simulation task near 332 times faster, with quite acceptable costs (Figure 5).

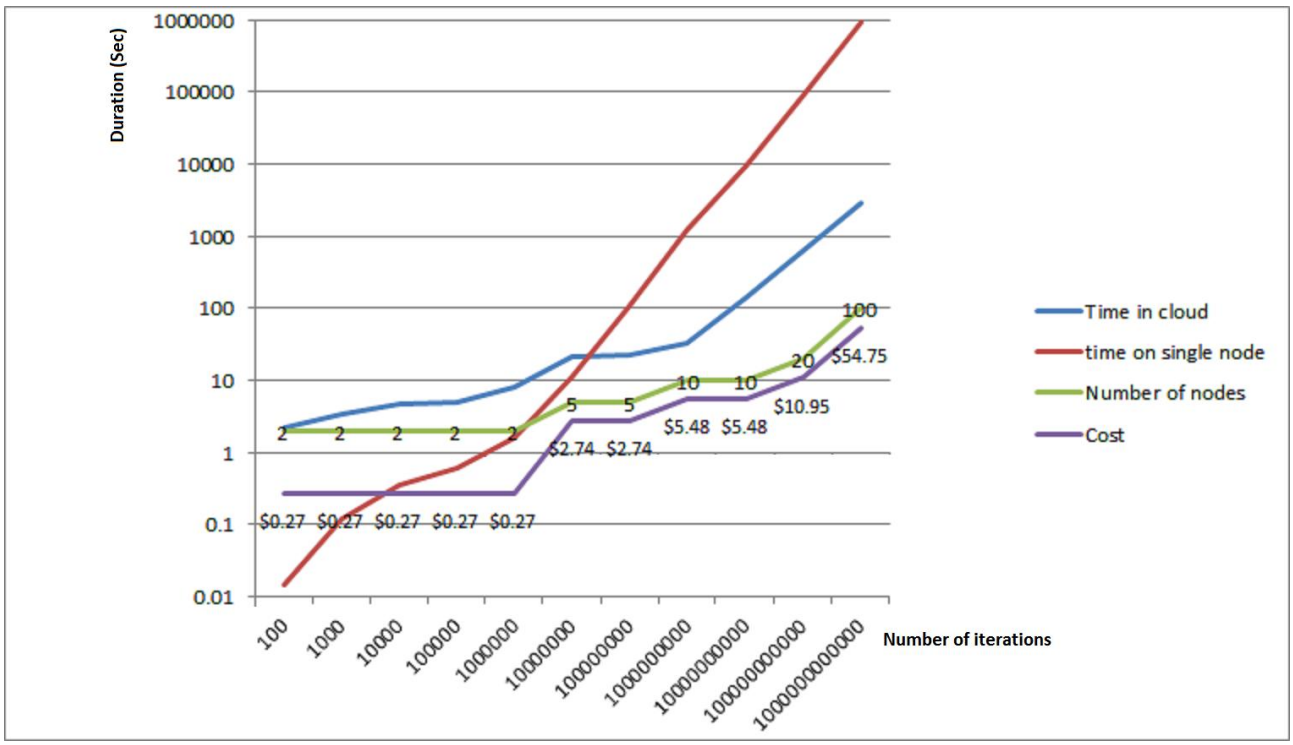

Figure 5: Experiment duration as function of number of nodes, cost and number of iterations

4. CONCLUSION

Earlier, most of the simulation software's paradigm was that each software user has his software copy installed on his computer. There was a strong relation between user, software and computing resources and this approach lacked scalability. By introducing virtualization and cloud environment, the way software is being developed and used has changed significantly. There is no more need for having own computing infrastructure. Distributed computing is now performed using multiple virtual machines rented from one or more cloud providers. As Fox et al. (2009), Harms & Yamartino (2010), De Assunção et al. (2009), Etro (2009), Kondo et al. (2009), Grossman (2009) and many other authors confirmed in their works, the use of cloud computing brings a significant reduction of IT cost. This is more obvious in cases where the system is used from time to time, executing tasks which require intensive computing resources usage, and then powered off. From results gathered during research, we can point out that, by using the public cloud infrastructure, the Monte Carlo simulation was significantly speeded up by increasing the number of instances of simulation experiment. As costs are linearly increasing as number of instances grows, in cases where time is a critical factor, by increasing the number of instances it is possible to speed up the simulation experiment execution with linear cost increase.

REFERENCES

Andrzejak, A., Kondo, D., & Anderson, D. P. (2010). Exploiting non-dedicated resources for cloud computing. In Network Operations and Management Symposium (NOMS), 2010 IEEE (pp. 341-348). IEEE.

Barjaktarović-Rakočević S, Marković, A., & Čavoški, S. (2006). Common stocks valuation using simulation models-case of Serbian capital market. International scientific days 2006 "Competitiveness in the EU - Challenge for the V4 Countries", 1110-1116.

Carroll, M., Van der Merwe, A., & Kotze, P. (2011, August). Secure cloud computing: Benefits, risks and controls. In Information Security South Africa (ISSA), 2011 (pp. 1-9). IEEE.

De Assunção, M. D., Di Costanzo, A., & Buyya, R. (2009). Evaluating the cost-benefit of using cloud computing to extend the capacity of clusters. In Proceedings of the 18th ACM international symposium on High performance distributed computing (pp. 141-150). ACM.

Etro, F. (2009). The economic impact of cloud computing on business creation, employment and output in Europe. Review of Business and Economics, 54(2), 179-208.

Fox, A., Griffith, R., Joseph, A., Katz, R., Konwinski, A., Lee, G., ... & Stoica, I. (2009). Above the clouds: A Berkeley view of cloud computing. Dept. Electrical Eng. and Comput. Sciences, University of California, Berkeley, Rep. UCB/EECS, 28, 13.

Gartner (2013). Gartner IT Glossary - Cloud Computing. Retrieved October 10, 2013, from http://www.gartner.com/it-glossary/cloud-computing/

Grossman, R. L. (2009). The case for cloud computing. IT professional, 11(2), 23-27.

Harms, R., & Yamartino, M. (2010). The economics of the cloud. Microsoft whitepaper, Microsoft Corporation.
Kondo, D., Javadi, B., Malecot, P., Cappello, F., & Anderson, D. P. (2009, May). Cost-benefit analysis of cloud computing versus desktop grids. In Parallel & Distributed Processing, 2009. IPDPS 2009. IEEE International Symposium on (pp. 1-12). IEEE.
Mahdevan, S. (1997). Monte Carlo Simulation. Reliability-Based Mechanical Design (pp. 123-146). New York: Marcel Dekker, inc.
Marinković, M., Čavoški, S., & Marković, A. (2014). Application of Cloud-Based Simulation in Scientific Research. Handbook of Research on High Performance and Cloud Computing in Scientific Research and Education, 281.
Marković A, Barjaktarović-Rakočević, S. & Čavoški, S (2005). Spreadsheet models in stock valuation. Management – časopis za teoriju i praksu menadžmenta. 10(38), 26-33.
Marković, A., & Čavoški, S. (2005). Primena ADD-in programa u finansijskoj spreadsheet simulaciji. Info M, 4(13), 32-37.
Metropolis, N., & Ulam, S. (1949). The Monte Carlo method. Journal of the American statistical association, 44(247), 335-341.
Radenković, B., Stanojević, M., & Marković, A. (Eds.). (2010). Računarska simulacija. Faculty of Organizational Sciences and Faculty of Transport and Traffic Engineering.
Mell, P., & Grance, T. (2009). Effectively and securely using the cloud computing paradigm. NIST, Information Technology Lab. Retrieved from http://gat1.isoc.org.il/conf2010/handouts/Yesha_Sivan.pdf
Poole, C. M., Cornelius, I., Trapp, J. V., & Langton, C. M. (2012). Radiotherapy Monte Carlo simulation using cloud computing technology. Australasian Physical & Engineering Sciences in Medicine, 35(4), 497-502.
Schaffer, H. E. (2009). X as a service, cloud computing, and the need for good judgment. IT professional, 11(5), 4-5.
Slook, B. (2009). Cloud Architecture and the Need for an Architectural Perspective Bobs Technology Briefs. Retrieved October 10, 2013, from http://bslook.wordpress.com/2009/04/27/cloud-architecture-and-the-need-for-an-architecture-perspective/
Tor-Morten, G. (2012). Cloud computing and context-awareness: A study of the adapted user experience. Lecture Notes in Computer Science, 6762, 427-435.

CASE STUDY

INCITING PHYSICAL ACTIVITY AMONGST YOUTH USING MODERN TECHNOLOGIES

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***Abstract**: Technology is a double-edged sword: it contributes to sedentary leisure-time activities (e.g., playing sedentary computer games), but can also be used to incite physical activity and influence exercise behaviour. For years, people have been relying on pedometers, accelerometers, and heart rate monitors as their source of motivation. Global positioning system (GPS), geographic information systems (GIS), interactive video games, and persuasive technology could also be added to the list of recent technologies and approaches which were used for that matter. Additionally, some experts firmly believe that clinicians should rely on Internet-based physical activity interventions with aim to incite and positively affect exercise behaviour. Modern technologies could influence behaviour of the population, especially youth. This paper introduces the urge for mobilizing youth through sports and technologies. In attempt to achieve that key objective, people should be involved in everyday physical activities, but not necessarily brought to sports fields - instead sports should be brought closer to people. The vision is to challenge people's everyday activities with the sportive ones. Binding on a local level, global orientation shall be developed towards decreasing a negative trend of youngsters' illness, increasing an atmosphere of sport for all. This paper is a result of the cooperation between Faculty of Organizational Sciences and the National Olympic Committee of Serbia on conducting a 2013 case study dedicated to the incite of physical activity amongst youth by using modern technologies.*

***Keywords**: Modern technologies, youth, exercise, physical activity, sport, health promotion, mobile application*

1. INTRODUCTION

Nations around the world are growing into an inactive unhealthy population. Inactivity and passivity represent the main reasons for the obesity issues among the population of age 15-30.[1] The lack of time and small economic incomes often represents crucial excuses why people rather choose to stay at home and live sedentary lifestyle instead of practicing sports. It is important to learn how to perceive sport as a positive habit starting early in childhood days, otherwise this unhealthy behaviour would become a habit not easy to be treated. Encouraging citizens to practice and to be physically active as much as possible through a number of possibilities and activities is perceived as a common task. It is scientifically confirmed that daily physical activity secures a number of healthy and social benefits, while the populations' well-being is increasing. Making different sport disciplines part of a daily lifestyle in children's life, reflects a positive memory, habit and affection towards the active youth.[2] Taking for example the Olympic values as values which could easily be implemented in every aspect of human lives; we have to rethink what the possibilities are and how to strategically start resolving this very common global problem starting from the local level. Global aim in tackling physical inactivity is devoted to finding an efficient tool, best practice or experience. Young people today live in a world characterized by dramatic cultural, economic, social and educational differences; individual circumstances depend largely on where a person is born and raised. More than 800 million adults (where two-thirds of them are women) still lack basic literacy skills; at the other end of the spectrum, the use of information and communication technologies (ICT) is skyrocketing. On one hand, we are living in such era of modern technology where ICT plays an active role in everyday life. On the other hand, we have sport as a very efficient tool in promoting any idea and mission, and in addition, modern technologies as probably the most common instrument in today's families.

[1] According to the National and European Youth Low, people from 15 – 30 are considered to be youth.
[2] Epicgenius user (2014) "Sport industry", Wikipedia, Retrieved from http://en.wikipedia.org/wiki/Sport_industry (visited: Apr. 2014 at 14:35).

2. PROBLEM IDENTIFICATION

Defined by numerous studies, Bauchard and Shephard suggested that physical activity refers to “any form of movement of skeletal muscles resulting in a substantial increase over the resting energy expenditure. Under the broad rubric we consider active physical leisure, exercise, sport, occupational work and chores, together with other factors modifying the total daily energy expenditure.”[3]

Formal organization of traditional sports is being pushed by nowadays trends, modern technologies and virtual reality. Physical education is a key component of high quality education and integral part of lifelong learning.[4] Not being physically active lowers the quality of education supported with negative health effects.

Current physical education curriculum does not provide experience necessary for personal and social development, which resulted in free time usually occupied by modern technologies and unhealthy lifestyle. In other words, physical education does not always succeed to promote healthy lifestyle and to motivate children and youth to practice sports in their free time. Following global and European trend, over 72% of youth in Serbia described physical education classes like monotonous and boring. Considering previously mentioned use of modern technologies, interesting results showed that students believe modern technologies could contribute towards improvement of physical education classes and extracurricular activities in their free time.[5]
According to the results of the latest Eurobarometer[6] survey on sport and physical activity, 59% of European Union citizens never or seldom exercise or play sport, while 41% do so at least once a week. Northern Europe is more physically active than the South and East. 70% of respondents in Sweden said they exercise or play sport at least once a week, just ahead of Denmark (68%) and Finland (66%), followed by the Netherlands (58%) and Luxembourg (54%). At the other end of the scale, 78% never do so in Bulgaria, followed by Malta (75%), Portugal (64%), Romania (60%) and Italy (60%).

The survey shows that local authorities in particular could do more to encourage citizens to be physically active. While 74% of respondents believe that local sport clubs and other providers provide sufficient opportunities for this, 39% think their local authorities are not doing enough.

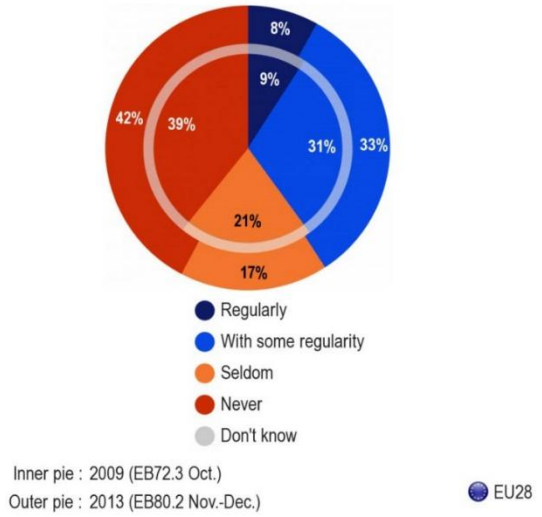

Figure 1: How often do people exercise or play sport?

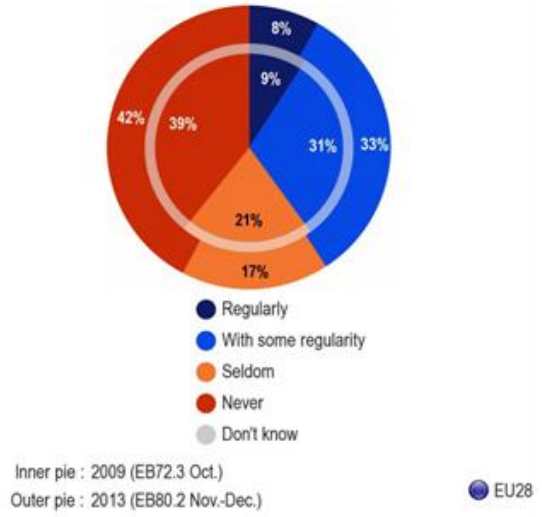

Figure 2: How often do people engage in other physical activity such as cycling from one place to another, dancing, gardening, etc.?

[3] Seefeldt, V., Malina, R.M., Clark, M.A. (2002) „Factors affecting levels of physical activity in adults“, Sports Medicine, Volume 32, Issue 3 (p. 143-168), Michigan, USA.
[4] European Commission (2005), “Young people's physical activities and sedentary lifestyles" (p. 10-93), European Commission's Directorate-General Communication, Brussels, Belgium.
[5] Ministry of Sport and Education, Research Sport center of Serbia and National Olympic Committee of Serbia (2008), “Report: Study of current situation of school sport in educational institutions in Serbia” (p. 3-19), Institute for Education Quality and Evaluation, Belgrade, Serbia.
[6] Eurobarometer survey was carried out for the European Commission by the TNS Opinion & Social network in the 28 Member States between 23 November and 2 December 2013. Nearly 28 000 respondents from different social and population groups took part in the poll. The survey follows comparable surveys conducted in 2002 and 2009, and will contribute to providing data to support the development of policies to promote sport and physical activity.

On the other hand, the results of this survey are compatible with number of studies which shown that recent technological progress completely changed habits of youth.[7] Considering following information (Figure 1), another big problem regarding physical activity of children and youth is obesity.

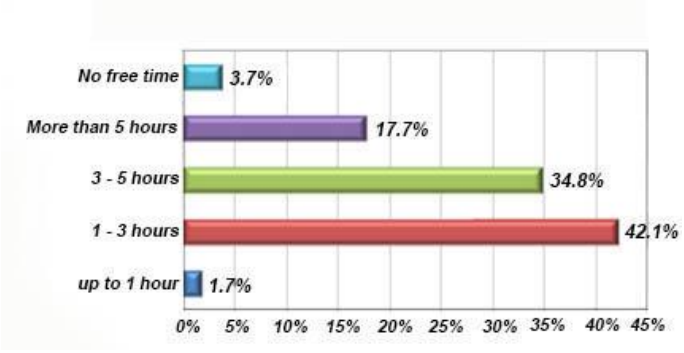

Figure 3: Free time of high school students in Serbia.

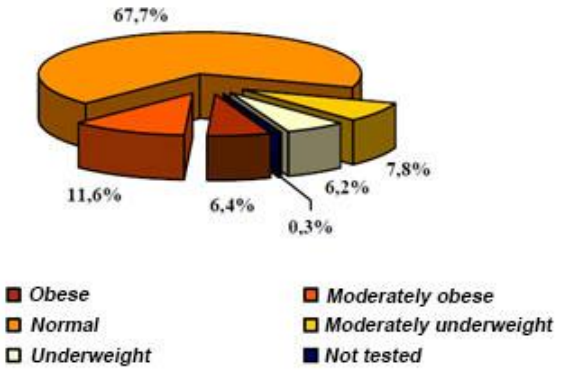

Figure 4: Percentage of children and youth (7-19 years old) by weight categories.

According to the study of health of Serbian citizens in 2006, two thirds of children and youth aged 7-19 were ideal weight (67.7%). Almost one fifth of youth (18%) were medium obese, which is an increase comparing to 2000. (Figure 3). Also, the number of underweight children (6.2%) decreased comparing to year 2000. (8.4%). Increased number of moderately obese and overweight children, caused by bad diet habits and lack of physical education presents significant health issue.

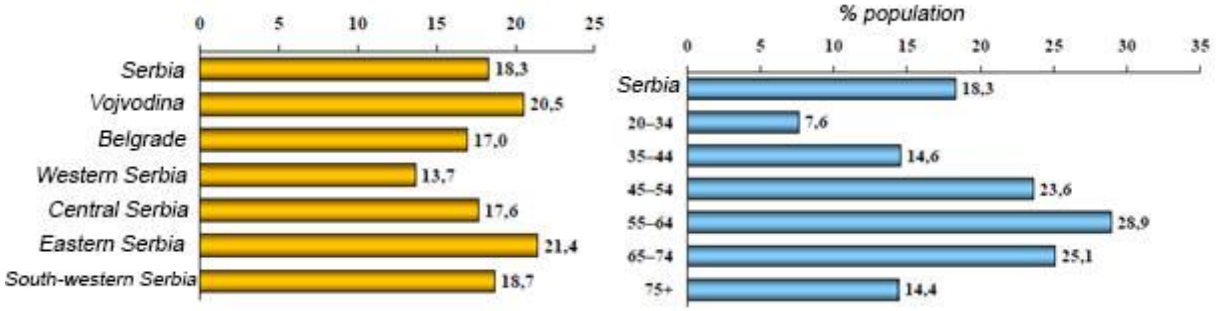

Figure 5: Percentage of overweight population regarding age and geographical region.

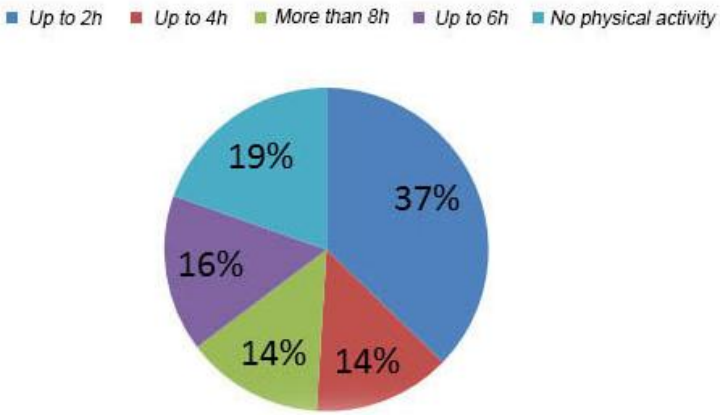

Figure 6: Physical activity of children and youth (15-25 years old) in hours per week.

The results of the Eurobarometer confirm the need for measures to encourage more people to make sport and physical activity a part of their daily lives. This is crucial, not only in terms of an individual's health, wellbeing and integration, but also because of the significant economic costs resulting from physical inactivity. The Commission is committed to supporting Member States in efforts to encourage the public to be more active. We will implement the recently adopted Council Recommendation on health-enhancing physical

[7] European Commission, (2009-2013), Eurobarometer survey (p. 20-193), European Commission's Directorate-General Communication, Brussels, Belgium.

activity and move ahead with plans for a European Week of Sport. The new Erasmus+ program will also - for the first time - provide funding for transnational initiatives to promote sport and physical activity.

3. RECOGNIZING THE NEGATIVE TREND VIA GLOBAL SPORTS INDUSTRIES

Several reports establishing a link between a lack of physical activity and health problems have been published all throughout Europe.

These studies show that health threats, such as chronic sicknesses, obesity, posture problems and also a reduction of the cognitive processes can be linked to physical inactivity. Especially young people´s lifestyles have shown a growing trend towards increasing sedentariness coupled with an inadequate diet. This combination of critical factors motivated the partnering organizations to propose a project, using physical activity and education, to promote an active, healthier way of life. The design of the activities has been originally developed for the German-Dutch EUREGIO project named GKGK.[8]

Particularly the age group of children and adolescents should be paid special attention to, as it is in the young years that the foundations are laid for a healthy lifestyle. Therefore play, sports and exercise should be conveyed and encouraged during youth in order to install a lifelong healthy lifestyle.

Numerous investigations have shown that it is far more cost effective and promising to invest in preventive measures by conveying and imprinting a physically active lifestyle, than the treatment of health problems – especially obesity.[9]

Sport as a physical activity is often in a shadow of elite sport. Matter of fact is that sport represents crucially important activity area in ones' life. Being committed to physical activity at early age, is influencing future development of healthy behaviour. Improving school sport is vital, therefore different examples of good practices from all over the globe following below.

Great Britain is an example of highly developed support to talented children and youth, as well as to talented sportive pupils. Their high - schools are running special educational program as a support for young athletes (*Junior Athletes Education – JAE*), but they also have a specialized colleges (*specialist schools*) as a support to talented young people in general.

Since 1994 Australia is developing a national program for identification of sportive talented youth, which has similar to the previous example, strong basics in educational system. Referring to the required annual students' tests for school's sport record, Talent information system has been upgraded while data could be used to grade talent of pupils for specific sports.

Taking into consideration these examples, researches which are done in the field of Serbia emphasize dimension that requires attention. More than half of the schools in Serbia don't meet the required needs for delivering the classes of physical education, specifically sportive halls and equipment.[10]According to this study, 36.5% of schools in Serbia doesn't have a required size of the sportive hall, while 48.5% has the small one (dimension less than 450 m2). Sportive hall that meet all required and proposed needs have only 15% of schools in Serbia, but still 107 schools are missing equipment. Positive impact of physical education is barely impossible, mainly due to the uneven and weak material and spatial conditions, followed by discriminatory valued work of teachers in sport. Abovementioned study presented one positive fact, too. Relying on statistics, pupils in Serbia are significantly more interested to practice sport and physical activity, compared to their generations in other European countries.

4. MODERN TECHNOLOGIES AND SPORT

Complex cultural situation in which young people are struggling to find direction in their lives or simply to survive, to improve their living conditions, and to develop their identities has been given various names.

[8] ENGSO Youth (2010), "Healthy Children in Sound Communities" (p. 2-14), ENGSO Youth, Berlin, Germany.
[9] World Health Organization (2007), "Nutrition, physical activity and the prevention of obesity" (p.17-33), WHO Publications, Copenhagen, Denmark.
[10] Ministry of Sport and Education, Research Sport center of Serbia and National Olympic Committee of Serbia (2008), "Report: Study of current situation of school sport in educational institutions in Serbia" (p. 3-19), Institute for Education Quality and Evaluation, Belgrade, Serbia.

Some call it the information or informational age, while others prefer the term technoculture1 or techno-capitalism, global media culture, or simply globalization, referring to the dialectic process in which the global and the local exist as "combined and mutually implicating principles". [11]Labels such as post-industrial, virtual and cyber society are also in use. The idea behind all these terms is that across the globe, ICT are playing a central role in young people's lives and in society at large.

Europe's youth are growing up in a connected world of internet access, mobile phones and electronic interactivity. Sport remains the most effective means for youth engagement and participation. Efficient use of media is the infrastructure for reaching and engaging youth today, where numerous studies from inside and outside of Europe document how young people are using various media sources as outlets to participate, share knowledge and – more generally – engage in societal matters.

The ubiquitous trend of using the Internet and mobile devices has imposed the IT solution as a logical realization mode of the project of integration of youth and modern technologies with aim to encourage physical activity. This will be the most effective approach to bring the services closer to our target group - **youth**, physically active and inactive individuals and groups. Even in our environment, youth is a group that is above average computer literate, i.e. they are regular Internet users, accustomed to finding, ordering and purchasing products and services through all networks. By comparison, the research shows that students often use computer, as 62.26% of students use computers on daily basis, and 23.13% of them use them several times a week.[12] The percentage of students who do not use the computer for more than one week is 11.6%, while the percentage of those who use the computer a few times a month is just 6.96%.

The development of the third and fourth generation of mobile technologies allows the appearance of new devices which successfully combine two important characteristics of mobile Internet: mobility and quality connection to the Internet. There is an increasing number of mobile phone apps for various platforms (Android, Windows Phone, iOS, Firefox and others) that are dedicated to monitoring of personal athletic performance (e.g. Sports Tracker, MapMyRun, CardioTrainer, iFitness, RunKeeper, etc.). A commonly used approach is relying on the embedded functionalities of the phone, such as GPS, which determines your current location on the map, accelerometer, which determines the speed of your movement, then, the mobile data transfer and the like. In recent years, another interesting approach is the use of wireless sensor networks bondable with smart mobile devices for the purpose of continuous monitoring and control of physiological human functions in sports. Good information for us is that our students have expressed great confidence in the computer and information technology (see Figure 3).

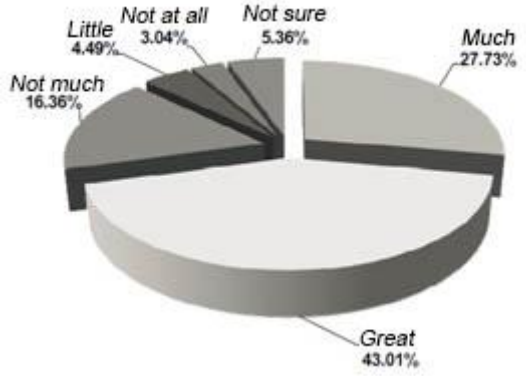

Figure 7: Confidence of students in computer and information technology.

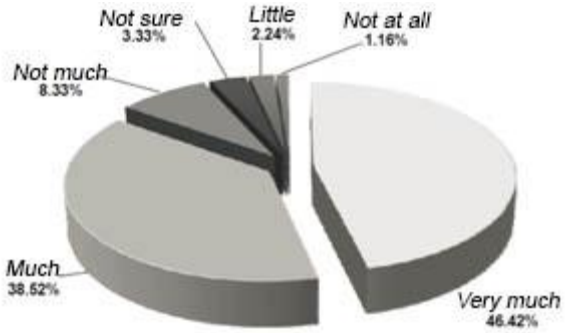

Figure 8: Students' opinions about how computers and ICT can contribute to the modernization and improvement of education process.

Also, 45.94% of students strongly believe that the future of education lies in information technology, and 29.93% of them greatly believe so, 10.22% somewhat believe so, 6.74% do not believe so and 7.17% of students are not sure about it.

[11] United Nations' Department of Economic and Social Affairs (2003), "Youth and Information and Communication Technologies (ICT)", World YOUTH Report (p.21-143), United Nations publication, New York, USA.
[12] Milovanović, K., Milosavljević, V., (2004), "Research regarding attitudes of children in primary school about adoption of ICT resources in teaching and studying" (p. 1-43), Microsoft Software d.o.o. and Unasoft, Belgrade, Serbia.

5. TARGETED COMMUNICATION AND CAMPAIGNS

Reflecting on increasing the influence of physical education, every improvement of macro and micro long-term oriented interests towards creating systematically healthier nation and youth with clear sport oriented habits should have certain support from country where solution is proposed and realized. Engaging institutional support, but also media and industrial sector is obligatory in order to achieve high level of influence and to meet needs of the community in general.

Authors have identified good practices from European level to regional and national examples that combines modern technologies, young population, community and strong partnerships follows: **European Week of Physical Activity NOW WE MOVE campaign[13] (Europe), Fotomarathon (Germany), We Run Belgrade, the MUZZEUM project[14] (Serbia)**. All share a specific or general common goal of enhancing physical activity among nowadays population for a better and healthier future.

6. INFLUENCING THE REGION

The previous examples from Serbia have not focused on the integration of modern technology to mobilize the youth at the institutional level, with aim to make them like an active and healthy live. The projects were instead mainly focusing on training and adapting sports fields and facilities (tennis courts, mini pitches, multi-purpose courts, jogging track, gym and outdoor, etc.). Projects such as the "Paths of health" (2006), and "Let's improve sport in Vojvodina" (2010) of the Provincial Department of Vojvodina and local governments were directed precisely to this problem. A similar example is the action "What do you train?" (2009), launched by Coca-Cola Hellenic and the Coca-Cola Company with the organization ADFOR - Children's Forum, with the active support of the Ministry of Youth and Sports and the number of partners such as the Institute for Sport, sports Association of Serbia, National Office, Ada Ciganlija and UNICEF, with the aim to motivate those young people who were previously uninterested and insufficiently active to take an active role and play sports.

The study of the situation in educational institutions in Serbia in connection with school sport (2008), which the Ministry of Youth and Sports conducted jointly with the Institute for Quality Education and the Olympic Committee of Serbia, has led to significant results on the situation of school sport. The most popular sport in schools is volleyball, which is the most abundant of the extracurricular, sports activities. A total of 36.2 percent of schools do not have volleyball as an extracurricular activity; 75.7 percent of schools do not have athletics, which is a basic sport; furthermore, 89.6 percent of schools do not even have gymnastics as an extracurricular sports activity. Less popular sports activities, such as aerobics, karate, chess, archery or rowing, almost do not exist as extracurricular activities - this practice is present in between 0.2 and 0.8 percent of schools. Young people are most active at the age of 15-18, when they are involved in school and club sports and system activities (school competitions - School Olympiad, an annual National School Championships, youth sports leagues in the system of national associations). When it comes to educational profiles, the most active students are the ones from the Faculty of Sport and Physical Education, and from other faculties: FOS, the Faculty of Law, Faculty of Mechanical Engineering, Faculty of Electrical Engineering, Economics - mostly faculties who actively participate in the Student leagues, competitions among universities (University Sports Federation Serbia) and international student championships. However, all the problems related to the availability of sports facilities and sports equipment significantly hampered attempts to make youth more interested in sports, especially when it comes to the inactive part of the youth. It is therefore attempted to use modern means of communication and modern technology to approach the youth in helping them understand the need for this way of life. However, the fact that nearly 80% of respondents said they would like more information about the importance of individual exercises, healthy eating, self-training, and the like is very encouraging.[1]

7. CONCLUSION

Despite of number of studies and initiatives for raising up awareness, Eurobarometer in 2013 represented a pore picture where large proportion of adults in Western cultures are physically inactive, despite several decades of warnings and intentions about the potentially negative health consequences of a sedentary lifestyle. Weak points of the Eurobarometer can be revealed, for example the question on the existence of sport facilities should have been broadened. Even though a high percentage of people appointed that they

[13] The official webpage of the NowWeMove Campaign (2012-2020): http://www.nowwemove.com
[14] The official webpage of the Muzzeum project: http://www.muzzeum.com

had sports opportunities in their area, it would have also been interesting to find out more about the quality of the sport facility and if they offer the kind of sport that people actually want to engage in. Efforts to promote and increase physical activity so far have focused on identifying its determinants and designing interventions that might effectively empower regular physical activity. Following global trends in technology and linking them to sports, represents step forward and one of the crucial criteria in communicating and popularizing sport among youth.

Whether it is about usage of social media, mobile applications, internet services or other technological solutions in sport, implementation of such idea should contribute to healthy lifestyle among youth in general through practicing physical activity.

Support of the key stakeholders play an important role in realization of this initiative, starting with different approaches for gaining youth attention and how their interest in sport will be maintained in a long-term perspective. It continues with the importance of how such initiative will be financed and covered by media, supported by all necessary regulations. When it comes to institutional support, it should focus mainly on systematic activities (setting up the legal and formal regulations on youth sports, system software and infrastructure financing activities). University of Belgrade and National Olympic Committee of Serbia have long tradition of initiatives that are very well welcomed and strongly supported. The results and experiences (good ones and bad ones) are recommended to be used to develop specially tailored health-enhanced multi-actor-programs for the partnership of schools, sport clubs and universities on community level.
Legacy remains: developing more opportunities for all to engage in an active lifestyle in order to counteract physical inactivity and overweight/obesity.

8. WHAT'S NEXT: STUDENTS IMPROVEMENT

We have introduced to university students how global issue of inactivity is influencing the national perception, asking them for a sustainable and efficient solution(s).

Table 1: Solutions that solves problems and achieves goals

Problem	Goals	Solution
Inactive youth	Increase physical activity among youth	Interactive mobile phone sports application
Bad infrastructural condition and poorly equipped	Upgrade sports infrastructure	"I am running for school"
Increase of obesity and chronic diseases among youth	Reduce number of obese kids for 5% in next 3 years	Lectures, activities, special events

Best and unique solution introduced was a "TreninGO!" a mobile application for Android platform intended to youth, but also to general population.
According to the survey, majority of young population is not physically active, often spending less than 2 hours per week on physical activities. One of the biggest problems identified back then is that one third of the schools do not have sport halls and facilities and that the existing ones are in bad infrastructural condition and poorly equipped. On the other hand more than 50% examinees are using smart phones, and 60% of them are not familiar with the activities of the Olympic Committee of Serbia.
Through "TreninGO!" project, society will gain the chance to reach young population, and then to influence society, introducing the application through solutions that could meet and reduce above mentioned issues.

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REFERENCES

ENGSO Youth (2010), “Healthy Children in Sound Communities” (p. 2-14), ENGSO Youth, Berlin, Germany.

Epicgenius user (2014) “Sport industry”, Wikipedia, Retrieved from http://en.wikipedia.org/wiki/Sport_industry (visited: Apr. 2014 at 14:35).

European Commission (2005), “Young people's physical activities and sedentary lifestyles" (p. 10-93), European Commission's Directorate-General Communication, Brussels, Belgium.

European Commission, (2009-2013), Eurobarometer survey (p. 20-193), European Commission's Directorate-General Communication, Brussels, Belgium.

Milovanović, K., Milosavljević, V., (2004), “Research regarding attitudes of children in primary school about adoption of ICT resources in teaching and studying” (p. 1-43), Microsoft Software d.o.o. and Unasoft, Belgrade, Serbia.

Ministry of Sport and Education, Research Sport center of Serbia and National Olympic Committee of Serbia (2008), “Report: Study of current situation of school sport in educational institutions in Serbia” (p. 3-19), Institute for Education Quality and Evaluation, Belgrade, Serbia.

Seefeldt, V., Malina, R.M., Clark, M.A. (2002) „Factors affecting levels of physical activity in adults“, Sports Medicine, Volume 32, Issue 3 (p. 143-168), Michigan, USA.

United Nations’ Department of Economic and Social Affairs (2003), “Youth and Information and Communication Technologies (ICT)”, World YOUTH Report (p.21-143), United Nations publication, New York, USA.

World Health Organization (2007), “Nutrition, physical activity and the prevention of obesity” (p.17-33), WHO Publications, Copenhagen, Denmark.

APPENDIX

1. STARTING APPLICATION

- Splash screen with logo of the application (TreninGO!), “Beat yourself” motto and partner logos.
- Application **Login** via **Facebook account, Google + or e-mail,** where basic information is applied to application.
- User can see profiles of his friends, and user can invite friends to join application.

2. USER PROFILE

- **Basic information:** User profile contains **photo** (1 additional can be chosen), **name, birth, gender and location**. User can also write something in “about me” field which is limited to 140 characters.
- **Statistics:** Several statistics are available for user – **total time** user spent doing sports, **total distance**, **total amount of calories**, **amount of hamburgers** user burned doing sports (total amount of calories / hamburgers calories value) and **average speed**.
- **Badges:** Doing sports and reaching specific goals, user can win the different badges visible on his profile, which could be shared on social networks. The examples of achievements are: **first run**, **fastest time**, **7 days doing sports in a row,** but also **two weeks of inactivity**.
- **Rating:** Users can rate other users according to their activity, and rating of each user is shown on user profile and presented with stars.
- **History:** History for the user activity is available for each day, week or month.

Figure 9: Splash screen with logo of the application (TreninGO!), "Beat yourself" message and partner logos.

Figure 10: Login screen of the application.

Figure 11: Profile screen that contains information about user.

3. NEWS FEED

- **Interaction:** In a NEWS FEED **user can see activities of his friends at the moment**, **the results they achieved** or **which sport event did they sign up**. After finishing sport activity user can share result on social networks.

4. CHOOSE TRACK, TEAM AND CHALLENGE

- **Chose Track:** Map shows all the tracks and sport courts. Each track has basic information such as name, length, ground type, rating presented with stars, average time and current king who holds the best time. The king is a person who made the best result (fastest time) for past two months. Users can add different tracks, sport courts, and outdoor sport machines on their own, and they can add photos. User can also write reviews and comments about sports locations. After choosing the track, user chooses if he wants to compete with some result which could be his best time on that track, or the best time of his friend, or the fastest time on track in general. After choosing the track and starting an exercise, user can see his progress on the map, current time, and time left for beating the best result. **Hint:** There is a welcome message when user enters the track for the first time. In order to add the track, user needs to run that track, so the starting and ending point could be defined.
- **Choose your Team:** User can create a sport event on a certain location and invite people to join. Other users have YES, NO, and MAYBE available as choices.
- **Choose the Challenge:** Challenges can include various sports and exercises for users. User will have different exercises programs available, which are provided by Serbian Olympic team. Users that choose challenge option will have different written tasks each day. Some tasks might include a video or a key message from the sportsman. During the challenge and after successfully finished task, different motivational and supportive pop up messages and push notifications could appear. After finishing the challenge successfully user gets special badge.

Figure 12: Screen that shows available tracks and challenges.

Figure 13: Screen that show map with current progress.

5. CHOOSE ACTION (GOOD CAUSE)

- Users can join different campaigns where they can for instance “Run for their school”. For each kilometre that users ran or walked, they donate specific amount of money for renovation or new equipment.
- Progress line shows how much money is raised, and how much is needed for renovation.
- All the data that users generate can be seen on the website after logging in.

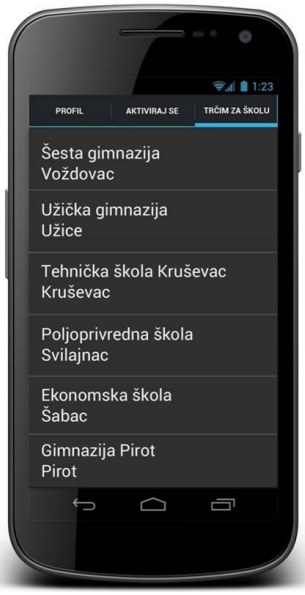

Figure 14: Screen that shows schools available for donation.

Figure 15: Screen that shows how much money is raised, and how much is needed for renovation.

ALFA BANK: DEVELOPMENT STRATEGY FOR NEW DIGITAL CHANNELS

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Abstract: *Alfa Bank is one of the leading private Russian banks. This case study provides information about strategies that Alfa Bank is implementing in battling with competition, with special focus on new digital channels, as they represent a new business model for attracting customers. The authors present an overview of Russian banking industry, banks competing on this market, as well as an overview of customer segments and popular services. There is special focus on e-banking and electronic channels that Alfa Bank is using and how their implementation has helped the bank reach the leading position among privately owned banks, with further potential for development.*

Keywords*: Alfa Bank, bank industry, competitive advantage, new business model, digital channels*

1. INTRODUCTION

Maxim, director of e-business at Alfa-Bank, was spending sunny Saturday afternoon on the porch of his favourite café with his sister Anna. She moved to America 10 years ago, graduated from university there and is now working in a major U.S. company in the field of information technology. Maxim was glad to argue with her about latest technological innovations, improved gadgets, and cutting-edge technology. They started talking about E-banking and difference between America and Russia. For Maxim, it was hard to understand why Russians are so reluctant to pay via the Internet, but he was sure that in the future electronic channels will be the best way for bank to stay competitive on Russian market.
Next day he decided to set up meeting with board of directors. He thought that company's strategy for electronic channels is not clearly defined and in the future, using these channels may be best way for company to stay competitive. However, he was not sure how the company can use and improve electronic channels. He decided to start with setting up the goals:

1. Increase number of Alfa-Klik users from 20% to 30% in 2014
2. Increase number of Alfa-Mobile users to 15% in 2014

2. COMPANY BACKGROUND

Alfa bank is the leading Russian private bank by total assets, total equity, customer accounts and loan portfolio, founded in 1990 in Moscow, where it is headquartered today. Alfa Banking Group offers a wide range of products and operates in all sectors of the financial market, including corporate and retail lending, deposits, payment and account services, foreign exchange operations, cash handling services, custody services, investment banking and other ancillary services to corporate and retail customers. Its branch network consists of 617 offices in Russia and abroad, and it includes a subsidiary bank in Netherlands, and financial subsidiaries in the United States, the United Kingdom and Cypress. The bank employs over 25.000 people and provides services to over 109.000 corporate customers and 10.6 million retail clients. Throughout its history, Alfa Banking Group has considered its reputation as its most valuable asset. For this reason it was one of the first Russian companies to publish a Social report. In 2013, Alfa Banking Group also picked up awards: "The best retail bank" by Retail Finance; "The best internet Bank in Russia" in 2013 by Global Finance; the title of the Best Russian Bank providing private banking and wealth management services in 2013 by SPEAR'S magazine. (Alfa-Bank corporate site- Corporate Profile, 2014)

Alfa-Bank Russia has a mix of Western and Russian management which successfully combines international standards of business and corporate management with deep knowledge and expertise in the Russian market. Its franchise is supported by an extensive distribution platform with multiple delivery channels, including in-person service through branches and offices, and ATMs spread across Russia and the CIS, as well as remote access through internet and phone. Alfa Banking Group has always supported charities, Russian culture, the creation and development of programs for young talent, and corporate responsibility has always been a key component in its social policy. The most valuable asset of the company is its reputation.

(Alfa-Bank corporate site- Alfa Bank Governance, 2014; Alfa-Bank corporate site- Corporate Profile, 2014; Alfa-Bank corporate site- Annual Rreport, 31.03.2014)

Alfa Bank Finance Structure

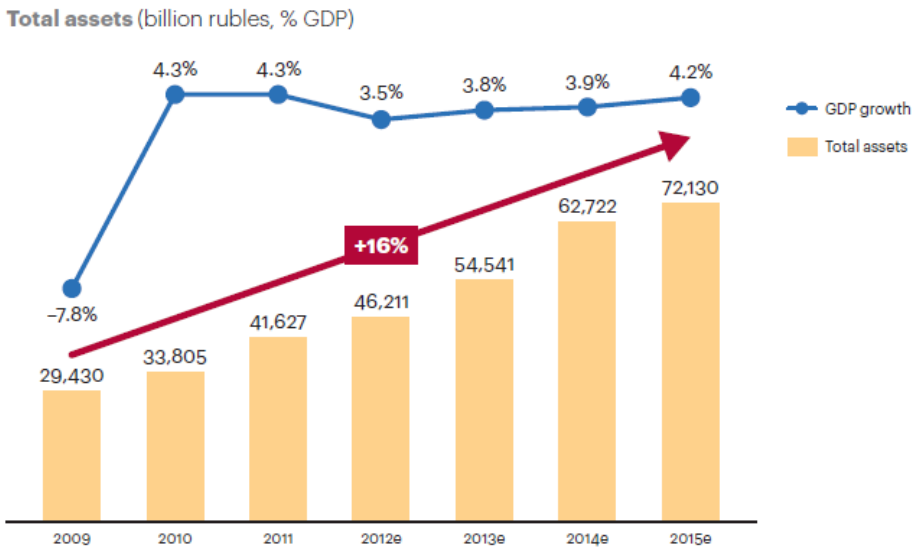
Net profit of the Alfa-Bank Russia for the period (2013) amounted to USD 900 million which is the highest reported annual profit in the history of Alfa-Bank Russia. Total equity increased by 16 % to USD 4.8 billion. Total operating profit before tax and provisions was USD 3.1 billion. High profit was driven by considerable growth in net interest income and fee and commission income reflecting excellent performance in all core business segments based on expanded customer base, portfolio growth combined with high quality of delivered services and operational efficiency. (Alfa-Bank corporate site- Alfa-Bank News, 2013)
The Alfa-Bank Russia net interest income increased by 33.5% to USD 2.3 billion in 2013 from USD 1.7 billion in 2012. The increase was mainly driven by growth in interest bearing assets, in particular retail loans. In the 2013 total assets of the Alfa-Bank Russia increased by 5.9% to USD 48.6 billion at December 31, 2013 from USD 45.9 billion at December 31, 2012. (Alfa-Bank corporate site- ABH Financial Limited, 31.12.2013)
In the funding structure of the Alfa-Bank Russia customer accounts remained stable at USD 26.7 billion as at December 31, 2013. Meanwhile, retail customer accounts increased by 17.8% to USD 14.4 billion as at December 31, 2013. (Alfa-Bank corporate site- Income statement, 11.04.2014)
As at December 31, 2013, cash and cash equivalents accounted for 12% of total assets. In addition, the Alfa-Bank Russia holds investment portfolio of highly liquid debt securities available for sale amounting to USD 2.1 billion. The Group has also access to secured and unsecured funding provided by the Central Bank of Russia. (Alfa-Bank corporate site- Annual Rreport, 31.03.2014)

3. BANKING SECTOR IN RUSSIA

Industry overview

Over the past six years, around 300 banks in Russia were taken over by large state owned or international institutions. Compared to other European countries, Russian market has grown with a CAGR of 27% from 2005 to 2010. There is even more room for growth on the Russian market, as banking sector assets represent only 75% of GDP, compared to 100% of GDP which is usual for developed economies. As shown in Table 1, growth projection is that by 2015 the market will grow by 16% compared to 2009.

Table 1: Future predictions for banking sector in Russia



With the majority of banks dominating the market being state-owned, private banks such as Alfa Bank need to find their spot on the highly competitive market by applying new business models and focusing on offering added value to their customers. There is also a trend of greater concentration by the larger banks (AT Kearney, 2013; Moody's Investor Service, 2013).

Customer segmentation

16 - 22 years old
This group includes students with first job (often part-time). They need short-term loans, money transfer services, simple forms of savings, as well as services related to tourism (purchasing insurance, multi-currency accounts, etc.), and cards. This group can be divided into youth, without special education, living outside the home, and youth with ongoing education.

25 - 30 years old
People this age are thinking about creating family, settling life, and therefore their needs are: targeted savings for purchasing houses, apartments, durable property and insurance for purchased property. Bank services popular for this group are: money transfers, opening a single account for family members, various forms of revolving credit, financial protection (insurance), account transactions via phone or internet.

28 - 45 years old
This segment includes people with established careers, steady, but still not free financial situation. Their goals are diversified: children education, family financial security and improving living conditions. Services popular for this group are long-term loans for purchasing durable goods and new houses, savings schemes for children and their parents, advices for insurance, savings and taxation.

40 - 55 years old
Goals and tasks of this group are very similar to the previous one. Representatives of this group are also supporting family and focusing on long-term products. However, a significant part of the income is spent on own and travel needs. The main features of this group are: revenue growth, reducing liabilities and pension planning.

Over 55 years old
This is the most robust and stable group of clients. Customers are characterized by the presence of large account balances. Necessary services for this group are: testamentary dispositions, financial consulting, trust capital management, operations related to tourism (purchasing traveller's checks, insurance, etc.), as well as credit cards.

Online bank users in Russia

The most active smartphone users are usually young people, as well as the more mature members of the middle class (men and women aged 23-37). They use Internet, pay and buy online more often than the others. On the other hand, in Russia, usage of e-banking depends on income. Among the users of "Alfa-Click" most customers are from the high-income group - more than 60% of all service users. The lowest percentages of users (35%) are customers from a group with income below average.

According to Alfa-Bank's research of customers, despite the active penetration of the Internet, electronic channels are still not popular in Russia. Alfa Bank has conducted research of customers who don't use e-banking. The study involved customers of Alfa-Bank and other banks, who don't use electronic services. Half of the clients (48%) had never heard of such a service as an internet bank. One fifth of these clients have the misconception about online banking and mobile banking, and only 16% of respondents have ever used online banking (mobile banking - even smaller percentage). The main reason why clients are not using electronic channels was that —there is no need to use them". This indicates that customers simply do not have enough information about electronic channels and they do not understand how and why they can use them.

There are seven segments of "non-users" of electronic channels: disinterested (25%), customers who call several reasons (25%), problem – having customers with difficulties of using/connecting to services and prefer personal contact with staff offices (12%), beginners who do not know about the possibilities of the service (12%), disloyal who are enjoying such services of other bank or are simply uninterested (10%), sceptics who do not trust to the security system of electronic channels (8%) and customers who do not have access to the Internet (8%).

E-banking in Russia

Market for electronic banking channels is increasing annually. In 2013 market volume in Russia was 15 million users, and the total amount of transactions by individuals through online banks was 591 billion rubles. In Russia, almost every large bank has an application for online and mobile banking. As shown in Table 2,

according to recent data, Alfa-Bank is positioned as the best online bank and the second ranked mobile bank in Russia.

Table 2: Internet banks rating - parameters: functionality and usability (Markswebb Rank&Report, 2014)

Ranking	Bank	Functionality	Usability
1.	Alfa Bank	A	4
2.	Bank24.ru	A	4
3.	Bank Saint Petersburg	A	4
4.	Russian standard	AA	3.5
5.	Moscow credit Bank	A	3.5
6.	Tinjkoff Credit Systems	BB+	4
7.	Svyaznoy Bank	BBB	3.5
8.	BINBANK	BBB	3.5

Ratings are indicating that the most successful e-banks, apart from Alpha Bank Online, are TCS Bank, Promsvjazj Bank, VTB 24, Bank - Saint Petersburg, Avangard, Sberbank, Russian Standard and others. TCS Bank doesn't have affiliates or branches, and all direct interactions are performed by courier. All the other activities are performed online. In 2013, this bank had more than 3 million customers. Customers have only Internet and Mobile bank at their disposal, and that's why this bank has the full suite of e-banking services and applications: full access to financial information on the card and the account, all payments and transfers and service management.

According to several publications, Promsvjazj was named as the best bank in Russia in 2013. Internet Bank PSB-Retail provides 24 hour client access to their accounts and full distant maintenance: paying bills, all the operations with cards, loan repayment and more. There are two versions of Internet Banking: informational (current account balance, deposits) and operational (full version of online banking). Bank VTB 24 offers, in addition to online and mobile banking, a service "Teleinfo" - an information service that can be used by calling a specific number. The most popular distant service in VTB 24 is internet bank. Number of users in the Internet bank "Telebank" exceeded 1.5 million users at the end of 2013. Sberbank has recently improved its services and now with large customer base is becoming leader. "Sberbank Online" is the largest Internet bank in Russia by number of active users (2.5 million people). Competitive advantage of Internet bank Sberbank is orientation on wide range of customers, including those customers that are not familiar with working with finances online. With "Sberbank Online" customers can view information on their cards, bills, statements, reports and receive mini-statements, open/close accounts deposits, make loan payments and more. There are two versions of Internet Banking in Sberbank: information and operational. (Promsvyaz Bank- Corporate site, 2014; PTB24 Bank- Corporate site, 2014; Sberbank- Corporate Site, 2014; TSC Bank- Corporate site, 2014).

4. ALFA BANK STRATEGY

The main goal of Alfa-Bank is to be the one and only bank for all customers, a part of everyday lives of Russians. Alfa-Banking Group's business model is focused on a rapid organic growth strategy, geographical expansion and further integration of business units and retaining of highly qualified staff. Main competitive advantages of company are customer focus and openness. According to research, number of customers of Alfa-Bank will increase by 13-15% in 2014. The main directions of growth are geographic expansion, strong positioning in new cities and the network development.
Main company's strategic goal is to:
• Maintain status as the leading private bank in Russia, while enhancing stability and profitability
• Set the industry standards in key areas such as customer experience, technology, efficiency and teamwork.
To achieve this, Alfa-Bank should focus on client with broad product offering for meeting customer's needs and customized approach to sales and services for target client groups. (Alfa-Bank corporate site- Annual Rreport, 31.03.2014)

5. ELECTRONIC CHANNELS OF ALFA BANK

Alfa-Bank is one of the first banks in Russia that started developing and investing in electronic channels. "Alfa-Click" appeared in 2003 as the most functional online bank in the country. In 2005, Alfa-Bank was the first to launch mobile banking in Russia. Now, Alfa Bank continues to develop its electronic channels, being one of the leaders in the Russian market and ratifying its title as the most innovative bank.

To ensure real-time innovations, department "e-business" was isolated in a separate division of Alfa Bank. And now, budget provided for electronic channels is distributed between: Operating part (IT support, 30% of total IT-budget) and Strategic part (R&D, about 70% of total IT-budget). In order to handle multiple operations, which are now carried out monthly in the Internet Bank —Alfa-Click", Alfa- Bank would have to build more offices and significantly expand the call center. On the other hand, electronic services generate a certain fee income and additional revenue of about $ 2.4 million (about 5 % of total sales of Alfa Bank). That is the main reason why Alfa Bank never stops the development of new opportunities in the electronic channels.

Every fifth customer of Alfa-Bank actively uses the Internet bank, and every twentieth mobile bank. On the other hand, the western banks have much better indicators, with every third person in the U.S. and every forth in Germany using a mobile bank. This suggests that there is room for growth with electronic channels in Russia.

Most popular “E” services among customers of Alfa-Bank are following: 1) Mobile and Internet billing; 2) Account Transfers; 3) Transfers to other customers of the bank; 4) Bank to Bank Transfers; 5) Operations with online wallet; 6) Utility Payment; 7) Online shopping.

Important part of business of Alpha Bank – is investing in security. The Bank is providing the optimum balance between comfort, mobility and safety. That is why "Alpha Click” has two-tier system of protection. That is also the main reason why Alfa Bank is in many ways ahead of competitors in terms of safety standards.

The most common way of return on investment in electronic channels for large banks is commission for the client's transaction. There are two type commissions:
• Client commission for holding payment,
• Partner commission for the reception of the payment (Alfa Bank corporate site-News, 2014; 1C: Enterprise 8, 2014; Alfa-Bank corporate site-Internet Bank, 2014; Mikhail Belov, 2013).

6. ALFA CLICK AND ALFA MOBILE

Alfa Click online bank is an innovative product developed by IBA for Alfa Bank. It is based on the IBA Internet Banking system. Alfa Click is providing its clients with a secure 24/7 access to their accounts, including deposit and card accounts, as well as deposit and loan products. Main Functionalities of Alfa Click, based on IBA report, are (IBA Group, 2014):

• Balance statement on all accounts of the client
• Detailed information on loans, deposits, and card accounts of the client
• Client account statements
• Payments for mobile services, internet and cable TV services , public utilities, and other goods and services registered in the Belarusian payment system Raschet (Payment)
• Payments for goods and services registered in the Belarusian payment system Raschet (Payment)
• Transfers between client accounts in a single currency, including loan settlements from the client's own funds
• History of payments and transfers done using Alfa Click and Alfa Mobile
• Templates for payments and transfers. A client needs to indicate payment details only once. Afterwards, it will be enough to choose a ready–made template, including the account from which the payment is made and beneficiary details
• SMS alert management : connect the service, change mobile phone number, switch off the service
• Password change
• Alfa–Bank news feed, feedback option.

Alfa-Mobile - is service that allows performing multiple banking operations, using Java-based applications that customers can download. The main functionalities are:
• getting detailed information about the accounts (available balance, recent transactions on the account, the arrears, etc.);
• paying for the Mobile operators and Internet service providers;
• making transfers between accounts (Alfa-Bank corporate site-Mobile Bank, 2014; Alfa Bank corporate site-News, 2014).

7. CONCLUSION

In order to remain competitive on the market, Alfa Bank has to find a way to retain current clients while honing an edge that makes Alfa Bank appealing to all potential customers. Maxim, director of e-business at Alfa-Bank thinks that the best way to do this is improving electronic channels. However, to do this, it is important to define strategy for electronic channels that will be aligned with the strategy of Alfa Bank, and to target potential customers that have potential to be the most frequent users of electronic channels in Russia. Also, arising question is, what is the best communication and pricing model for current services, and is there a way to improve services, based on best practise of foreign companies.

REFERENCES

ABH FINANCIAL LIMITED International Financial Reporting, Standards Consolidated Financial Statements and Independent Auditor's Report, 31 December 2013, retrieved from http://alfabank.com/f/1/investor/financial_reports/financial_statements_ifrs/ab_IFRS_audited_report_FY_2013.pdf accessed 2014

About Promsvyaz Bank, retrieved from http://www.psbank.ru/Bank accessed on April 14th 2014

About PTB24 Bank, retrieved from http://www.vtb24.ru/about/Pages/default.aspx?geo=moscow accessed on April 14th 2014

About Sberbank, retrieved from http://www.sberbank.ru/moscow/ru/about/today/ accessed on April 14th 2014

About the TSC Bank, retrieved from https://www.tcsbank.ru/about/ accessed on April 14th 2014

Alfa Bank and MUZ.RU: New Opportunities in the Internet Bank "Alfa Click", March 18th 2014, retrieved from http://alfabank.ru/ryazan/retail/internet/2014/3/18/33017.html accessed on April 12th 2014

Alfa Bank and the Company RoboForex: bonus up to 50% when replenishing through the Internet bank "Alfa-Click", retrieved from http://alfabank.ru/ryazan/retail/internet/2014/4/9/33096.html accessed on April 14th 2014

Alfa Bank Corporate Profile, retrieved from http://alfabank.com/corporate/ accessed on April 11th 2014

Alfa Bank Fact Sheet – Income statement, Balance sheet, Ratios, Business figures, retrieved from http://alfabank.com/corporate/factsheet/ accessed on April 11th 2014

Alfa Bank Governance, retrieved from http://alfabank.com/governance/ accessed on April 10th 2014

Alfa Bank Year End 2013 Results, March 31st 2014, retrieved from http://alfabank.com/f/1/investor/presentations/AB-presentation_Tchoukhlov_31032014.pdf accessed on April 14 th 2014

Alfa-Bank News: Announcement of Financial Results for 2013 — Russia, March 31, retrieved from http://alfabank.com/media/news/2014/03/31-1/ accessed on April 11th 2014

Alfa-Bank offered to corporate customers simple and convenient solution for remote banking with programs of "1C: Enterprise 8", retrieved from http://v8.1c.ru/news/newsAbout.jsp?id=9583 accessed on April 14th 2014.

AT Kearney – A Chessboard Strategy for Russia's Banking, retrieved from http://www.atkearney.com/paper/-/asset_publisher/dVxv4Hz2h8bS/content/a-chessboard-strategy-for-russia-s-banking-market/10192 accessed on April 10th 2014

IBA Group: About Alfa Click product, retrieved from http://ibagroupit.com/en/products/alfaclick/

Internet Bank "Alfa-Click", retrieved from http://alfabank.ru/ryazan/retail/internet/ accessed on April 14th 2014

Markswebb Rank&Report, 2014, retrieved from http://markswebb.ru/e-finance/internet-banking-rank/ accessed on April 11th 2014

Mobile Bank: "Alfa-Mobile", retrieved from http://alfabank.ru/ryazan/retail/alfamobile/ accessed on April 14th 2014

Moody's Investor Service - Announcement: Russia's Banking System Outlook Remains Negative, October 07th 2013, retrieved from https://www.moodys.com/research/Moodys-Russias-banking-system-outlook-remains-negative--PR_283727 accessed on April 12 th 2014

The most interesting Bank 14 October 2013, text by Mikhail Belov, retrieved from http://ko.ru/articles/25193 accessed on April 12th 2014.

ENVIRONMENT, QUALITY, UNIQUENESS, ALTERNATIVE – MIXING 4P'S AND 4E'S

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Abstract: *The case study presents marketing, communication and sales challenges and issues, faced by Slovenian startup company ZkotZ (Ltd.) which is operating on international markets. The ZkotZ (Ltd.) company was established in 2010 and is growing since. The case study is described from the stand point of Tina Šegota, Director of Marketing and Sales, and Anže Miklavec, founder of EQUA and CEO of ZkotZ (Ltd.). Today company operates on 12 markets and owns three brands. ZkotZ (Ltd.) company focuses on production and sales a variety of reusable bottles. The most valuable brand of the company is EQUA which represents reusable bottles. EQUA brand was the best selling product in Slovenian market in its category in 2011 and 2012. In Slovenian market EQUA brand quickly became a symbol not only for reusable bottles, but also for ecology, water and sustainable lifestyle. After great success of EQUA brand in Slovenian market, company's management team (three assistants) decided to develop marketing plan for entering CEE markets.*

At the time presented in the case study Tina is discussing EQUA brand development strategy for CEE markets with her CEO. Aside from them, Tina gathered a team to brainstorm about different market entry and positioning strategies. But the main issue Tina would have to face in the next six months regards development of the most appropriate strategy to successfully enter CEE markets and position EQUA as a premium brand in the reusable bottles segment. The task in front of Tina is even greater having in mind that company had been planning to launch the EQUA brand on Croatian, Hungarian, Slovakian and Czech Republic market in next the years simultaneously. So Tina needs to work hard, act fast and make quick decisions in order to create the most suitable methods and tools for entering these markets. But even though selected CEE markets are in a certain way similar to Slovenian market and have historically and politically connection, potential customers nowadays have different needs and desires in different markets. Therefore, company conducted a research and identified interesting trend - raising consciousness about negative impact of regular plastic bottles on health of customers on CEE markets. This trend appeared after customers from CEE markets started to implement more ecological and sustainable approach into their modern lifestyle. If the company does not identify correctly different customers' needs and desires, and does not incorporate mentioned values into branding, advertising and selling the EQUA bottles, the managing team is risking failure of entering CEE markets.

This case study will provide students with basic perspective of strategic marketing planning within a company. The case reflects marketing, communication and sales issues and challenges faced by Director of Marketing and Sales in an international company planning to enter CEE markets and expand its operations.

Keywords*: CEE markets, brand development, EQUA, bottles, sustainable, lifestyle*

1. INTRODUCTION

In a small modern house in the centre of Ljubljana one could get lost only by listening how Tina was smoothly switching from Croatian, Slovenian and English language. At one point Tina was answering an email in Croatian, providing information to a Slovene customer on the phone and in another second talking to her co-workers in English. It was a cloudy November afternoon just before the rain. Tina loved the smell of rain because it reminded her of the changes that will happened when she was discussing brand development strategy with Anže, founder of EQUA and CEO of the company ZkotZ (Ltd.). They were talking about different strategies: positioning, market entry, brand development etc. So, the main problem Tina would have to face in the next six months was to develop a strategy to successfully enter CEE markets and position EQUA brand as a premium brand in the segment of reusable bottles. The demand for results was very high and there was no space for mistakes nor time to waste. Tina had to work hard and think about the methods and tools for market entry that could be recycled for CEE markets. The company had been planning to launch the EQUA brand in: Croatia, Hungary, Slovakia and Czech Republic, in 2011 and 2012. Even though these markets were historically and politically interconnected, potential customers nowadays have different needs and desires.

In her position as Director of Marketing and Sales, Tina Šegota has been facing daily challenges of marketing, communication and sales since the very first day she started to work for the start-up company ZkotZ (Ltd.) two years ago. All those challenges were connected to branding, advertising and selling the EQUA bottle – a reusable plastic bottle for water which would enable people to be hydrated wherever they go.

In the beginning of the 21st century, bottled water was one of the most desired and purchased products in the world. But many countries, among them also countries from Central and Eastern Europe, have high quality tap water. The problem with regular plastic bottles emerged when customers started to implement more ecological and sustainable approach into their modern lifestyle. Today's customers started to notice a high percentage of regular plastic bottles in waste and countless studies about negative impact of different plastic moulds on their health.

Therefore, in 2010 Anže Miklavec, CEO of the company ZkotZ (Ltd.) decided to establish a new brand that would be related to ecology, water and sustainable lifestyle. Anže's team came up with an idea of reusable branded bottles for water that would be made from top quality plastic material and would represent the best alternative to regular plastic bottles which would enable customers to use tap water more frequently and save more money. The whole concept of the brand: its name, logo and slogan *For your health and nature's wealth* were carefully designed to highlight brand's mission and values and to repeatedly remind customers of two basic ingredients of the brand – ecology and water. But since EQUA brand hit the Slovenian market in 2010, it was a challenging task for the company's marketing team to launch it in Central and Eastern Europe markets and to make EQUA a premium band in the segment of reusable bottles.

> It was decided that Croatia would be the first CEE market where the company would try to launch EQUA brand. The reasons to firstly enter Croatia were numerous: it was Slovenian neighbouring country which provided cultural, historical, geographical and economical relations, and since Tina was born Croatian there were no communication problems at all. So, the choice was a little bit obvious.

Since Tina was facing a very demanding challenge, she was thinking that there had to be more than just a simple 4P's of marketing thought by numerous academic marketers for decades. While Tina was searching for most appropriate method for entering CEE markets, she came across 4E's of marketing or so called new marketing eco-system presented by worldwide advertising agency Ogilvy & Mather. The 4E's of marketing were presented as a replacement for each of the 4P's elements: from Product to Experience, from Place to Everyplace, from Price to Exchange, and from Promotion to Engagement and Evangelism. But she did not like the complete elimination of traditional 4P's, so after a careful taught, she decided that it would be the best to combine 4P's and 4E's to create a new brand development strategy for CEE markets. In the next six months she had to answer numerous questions. "What does a customer encounter while purchasing and using EQUA BPA free bottle?" While brainstorming with Anže, Tina repeated this question from her notebook. Moreover, she continued with reading the questions that were rushing through mind "how to use social media and other communication tools to present the product in a way to be seen by everybody? And with so much on the web being offered for free, how to justify the price of the product?" Tina finally concluded that "promotion isn't enough any longer. With so many communication channels, we can't just bombard people with messages and hope they'll pick them up. We have to figure out how to get customers to allow us into their attention spans. And we have to do it so unified that it would work on all CEE markets."

2. EMPHASIZE PRODUCT BENEFITS FOR BETTER CUSTOMER EXPERIENCE

EQUA's name consists of two words eco and aqua. The name stands for ecological, reusable and trendy products. In November 2011 there were only two products in the brand's portfolio: EQUA BPA free bottle 600 ml and EQUA BPA free bottle 400 ml. There were more than 20 different designs to choose from for BPA free bottles and they could be used for different purposes and at various situations: at home, in the office, during sport activities or even while having a walk through the city. On top, the bottles were very practical, light and easy to use on a daily basis. Slogan of the brand *For your health and nature's wealth* directly represents the message the EQUA BPA free bottles tent to communicate regarding health and ecology (MyEqua, 2013).

Anže decided that Tina would be the leader of the team to support entering the CEE markets. The team consisted of four people: Jana was a graphic designer; Helena provided web page support, marketing assistant Monika and Tina. On the first meeting, after team was put together, Tina was explaining the purpose of EQUA brand to her team "the first collection of EQUA BPA free bottles was designed with the desire of raising awareness about the importance of clean and safe environment and the influence it has on people's health. It also aims at showing that living a healthy and active lifestyle can be fun. But it is not just about fun, our care for nature is real so we decided to donate 10% of our net sales profit to the ecological

organizations. That way we can enable for our customers to make a contribution to better and cleaner environment." Moreover, she stressed out that "more importantly, we have to implement a special experience for a customer when using each EQUA product. It would be the best to combine EQUA's slogan and product benefits into a story."

The story of EQUA BPA free bottles

Back in the office in the middle of November 2011, the team worked constantly together for days trying to come up with the story for EQUA BPA free bottles (My Equa, 2013). After spending numerous hours talking about product benefits, potential customers and the brand, the team agreed that EQUA BPA free bottles would be presented as one of the best alternatives for regular plastic bottles. "Normally, unnecessary emissions are used for production, transport and storing of a regular plastic bottles. They are also harmful for the environment and have consequences to our health. But there are not any extra emissions used for production of tap water, which is simply the most ecological and the cheapest to drink," Tina said to the team.

While looking through the window in the office, Tina was thinking about EQUA's customers. She looked at her co-workers and said "O.K. girls, listen really carefully." Helena, Jana and Monika turned to Tina and listened to what she had to say. "Let's say that I am one of many potential customers of EQUA. I am a woman in her late twenties who mainly spends her working day in an office. My private life consists of regularly going to the gym, hanging with my friends in coffee shops, relaxing in wellness clubs, travelling and spending time with my family. So, I take care of my physique, my health and my expenses. Therefore, EQUA bottle would benefit me in many ways: I would always have a bottle of fresh tap water in the office and most importantly I would like to know that the bottles I drink from would not jeopardize my health." The team began to discuss the materials regular plastic bottles were made of and how it influenced the content of the bottle if used regularly. They agreed that the content from regular plastic bottles could become dangerous when consuming liquids from it. What makes the EQUA BPA free bottles more suitable to use is the material the bottles are made of and which does not contain harmful chemical compound BPA. Each bottle carried the "BPA free" certificate that guaranteed that consumption of the content from the EQUA BPA free bottles was 100% healthy and harmless for both human and environment.

"The EQUA bottles are meant for long-term use and are recyclable" Tina started to build the argument with her team. Since all EQUA bottles are made of high quality material Eastman Tritan™ copolyester, an amorphous copolyester derived from vegetable source, the bottles do not contain harmful chemical bisphenol A (shorter BPA). "While reading scientific papers, I came across some serious data which link BPA to changes that lead to breast and prostate cancer, allergies, and hormonal disorders. Therefore, we have to emphasize product's most outstanding features: its excellent toughness, hydrolytic stability, and heat and chemical resistance," Tina continued with the transformation of product benefits into the story for customers. "If I continue with my perspective as a potential customer, I would like to have a bottle that I could fill with hot and cold liquids, wash in a dishwasher and most importantly have it as an accessory wherever I go. For me it is important to put a statement out that I take care of the environment by not contributing to plastic waste because I drink from only one bottle all the time. This bottle is eco-friendly, it has a nice design that suits my style, it reminds me to drink water whenever I look at it and moreover, it is my new trendy accessory which fits into my bag," Tina concluded with her story.

Tina's co-workers agreed to the description they had just heard and the discussion continued with the descriptions of other potential customers: men, teenagers, pregnant women, young mommies and their children. At the moment there are more than 20 different bottle designs (see Figure 1) for both product sizes (400 ml and 600 ml). It was decided that the main story of EQUA BPA free bottles would unite the preservation of health and environment by emphasizing multiple situations where one could use the bottles. "The experience behind the EQUA BPA free bottles is in customer's wish to use the bottle as frequently as possible because one is taking care of his or her health and environment. The moment when a customer drinks from the EQUA BPA free bottle, he or she also influences life of others by contributing to better and cleaner environment for future generations. And this is the statement we want EQUA's customers to give to others," Tina added at the end of the meeting.

Figure 1: The most popular designs of the EQUA bottles

3. PROVIDE ENGAGEMENT IN EVERYPLACE

In CEE markets a discount group buying was really popular. Therefore, Tina saw an opportunity to firstly enter Croatian market by offering the product nobody knew through the biggest discount promotion website in Croatia – www.kolektiva.hr. “For EQUA the discount promotion represented the most suitable tool to reach the customers who are willing to buy a product for at least 50 % off. This will provide us with instant feedback and sales results” Tina explained her decision. Anže was very supportive of her decision since this would provide his team with instant feedback of what else could be changed in the presentation of the product. When presenting the product for the first time, it is of big importance to choose the most appealing images. Therefore, Kolektiva promotion had been prepared for two weeks. The images selected had to reflect the story of the product. In November and December 2011 it was hard to catch sunny days to take good pictures, but Jana was doing her best. As a graphic designer, she was in charge of all visual material of the product and she decided to portray happiness of EQUA’s customers. Tina loved that about her because she could relate to any customer and portray it in the best possible way (Company Report 2012).

At Monday morning in the middle of December 2011 the team gathered in a room with all material they prepared to launch the product in Croatian market (Moja Equa, 2013). Each member of the team had a mug full with coffee on the table and Jana started with the presentation of numerous photos of the product. “Since Croatian customers would be introduced to the product for the first time, it is of big importance to select the images which reflect its usage,” Tina interrupted Jana’s presentation. But there was no room for panic, since Jana did just that – she planned numerous photo shootings in detail to enable the representation of both the usage of the EQUA BPA free bottles and happiness of the customers. She presented numerous photos reflecting happy and smiling people using the product in various situations – at work, in school, during the workout, outdoors, in a coffee shop. “I knew I could trust your instincts. You did a great job,” Tina said to support Jana’s work from the past two weeks. Later the turn of presenting her work came to Monika, marketing assistant, who did a research of the Croatian market. This was not so hard for her, since she spent most of her life in Croatia and she could understand people’s lifestyle and preferences. She did a research of the market and discovered that Croatians like colourful and vivid pictures. Therefore, it was decided the most colourful designs would be used to present the product on the discount website due to the lack of promotion space offered (see Figure 2).

Figure 2: Presentation of EQUA's discount offer on www.kolektiva.hr

"It is true that a photo is worth a thousand words, but when introducing a product for the first time, it is essential to describe product's quality, purpose and customer benefits," Tina said to the team. For the past few days she was working on the structure of the text to have all features as a story (exposition, climax, resolution) and was planned to guide a reader towards the purchase. The exposition introduced the problem of plastic waste and excessive financial costs connected to bottled water. The climax introduced the EQUA BPA free bottles as the best alternative for regular plastic bottles which were essential core of both the problem of plastic waste and costly bottled water. Furthermore, consumers' benefits were expressed through the problematic of bisphenol A. Since EQUA bottles are BPA free, the product was presented as a healthy and environmentally friendly reusable alternative bottle suitable for everyday use. "But the most important details of the product were communicated in the resolution of the text. Here a potential customer will be introduced to variety of product's features which emphasize the benefits of using the product," Tina was explaining the structure of the text. "In the resolution of the text we reveal that the material the bottles are made from is top quality material that enables more than just drinking water from the bottle. It also enables hot drinks like coffee, tea or hot chocolate and cold and freezing drinks. EQUA BPA free bottles come in two sizes: smaller bottle holds 400 ml and bigger holds 600 ml, right? So, a potential customer can choose the size of the bottle that would satisfy his or her daily hydration intake: a smaller bottle is suitable for children since it is lighter and easy to hold, it suits smaller bags women like to carry around and it best suits bottle-holder in a car. A bigger bottle is more suitable for those who are in constant need for hydration like athletes and pregnant women, those who work in offices and do not have a constant supply of the water and to those who go hiking or travelling where water supply is limited," Tina went on with the explanation.

Jana's photo material and parts of Tina's text provided Helena with the material to put on EQUA's web page www.myequa.com (see Figure 3). Helena used the assistance of Monika and her good writing skills to launch the web page only 3 days before presenting the product to the customers by Kolektiva. The web page also featured links to EQUA's Facebook, Flickr, LinkedIn, Twitter and other social media channels where customer could engage with the team. Nonetheless, Tina liked that idea so she put the links to the EQUA's webpage and Facebook in the sidebar of Kolektiva's offer to furthermore encourage consumers to contact the team to get additional information of the EQUA and its products (Kolektiva.hr , 2013).

Christmas time was approaching very fast and Anže decided to give the team well deserved holidays. "See you in 10 days," he concluded the meeting in which the team showed him that everything was ready for launching the product. "We will start with the discount action in the beginning of January 2012 because we will have lots of work. So it is important for you to rest and enjoy time with your family and friends. In the beginning of the next year we will have a blast," he added.

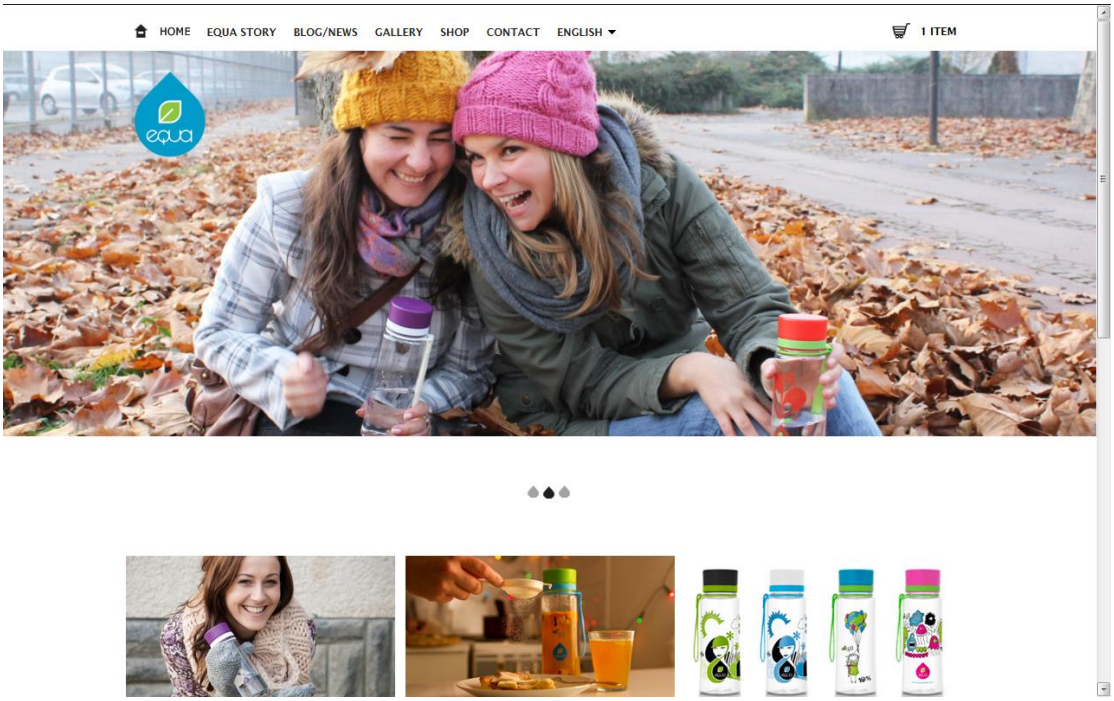

Figure 3: EQUA's web page (www.myequa.com)

And it was really a blast. Tina and her co-workers returned to the office on January 2nd, but all the preparations from 2011 were not forgotten. "It is time to go live with EQUA," Tina said at the beginning of the meeting were the support for market entry was discussed. It was decided that Monika would provide the support for social media channels and that she would answer all the questions customers would ask. Jana would support Monika with visual material and Helena would provide constant support for the web page and web shop.

Launching of the product happened on January 9th 2012 and in four days it reached enormous proportions. More than three thousand coupons offering one EQUA bottle for 50 % discount price were sold and after the offer customers were asking for more information about the product and where to buy it (Company Report, 2011). The EQUA BPA free bottles, with their appealing designs, became all consumers talked about on Facebook and at the same time encouraged each other to purchase it. Numerous buyers referred to the brand's official Facebook page EQUA Hrvatska to access additional information about the brand itself, its products and the story about bisphenol A. Consumers engaged in the communication by sharing numerous posts on their private Facebook pages and in private messages (EQUA Fan page, 2013). They recommended the product and, most importantly, they posted numerous pictures of themselves or their family members and friends using the product (see Figure 4). The team awarded customers' loyalty and was stunt by the reaction of their fans welcoming new fans.

"The result of this feedback was not only the proof of the successful communication strategy, but more, consumers' feedback resulted in increasing sales results in online store available on www.myequa.com," Helena presented results from web shop on the meeting the team usually had every Monday morning. "Moreover, we managed to do search engines optimization, advertise on Facebook and we invested a small amount of finances to Google AdWords," Tina briefly explained Helena's support in the launching process. "That enabled us to be seen everywhere in connection to online media," Tina added.

Figure 4: Consumer's engagement in EQUA Hrvatska Facebook page

4. TRANSFORM THE PROMOTION INTO ENGAGEMENT

Since online media played a big role in EQUA's brand launching story on the Croatian market, Anže wanted to hear how EQUA brand will caught people's attention in offline media. Anže added that "the results are outstanding but now we have to work even harder because not all people saw the product. We also have to promote EQUA in lifestyle magazines and we do not sufficient financial support for advertising."

Tina's analytical thinking helped her prepare for this, days ago when she was sitting in her office on Friday afternoon and was thinking about the results that team would have to present to Anže on Monday. Tina knew that the next step should be presenting the product to Croatian journalists. Several questions were on her mind "But how should we do it? Should we hire an advertising agency for PR or deal with journalists on our own? If we do it on our own, how could we get the journalists to love the product so much that they would write about it?" Tina was thinking while sitting in the dark. She left the office with these questions tangling her mind for the whole weekend.

On Monday, Tina came prepared with the answer, and started the meeting with explaining Anže following "we will face another challenge and do PR with all the help and knowledge we have *in the house*." "That means there is no need for help from an advertising agency and that we will take *do-it-yourself* approach in contacting Croatian journalists and try to make them love our product," she explained her decision. Anže stressed important fact "the only affordable financial investment in PR would be the bottles which could be compensated for the coverage." So, the Tina faced additional challenging questions: how to make journalists like and use the product, and how to present the product as a lifestyle accessory? But she was thinking very fast trying to recover some of the ideas she got during the weekend.

It was decided to communicate with *the message in the bottle*. The communication strategy had four steps. Firstly, the team had to choose the total of 20 editors-in-chief of lifestyle magazines and journalists covering the topics of health, trendy lifestyle and fashion. Secondly, the bottles with the most appealing designs for women were checked against all faults and prepared to be sent in special post-boxes. Thirdly, in each bottle was inserted a special personalized message for the receivers. The message described the product very briefly (no longer than two sentences) and offered a refreshing recipe of a delicious fruit smoothie that could be consumed from the EQUA bottle for breakfast or snack. And finally, the recipes were chosen carefully to include only exotic fruits (strawberries, pineapples, kiwi, and mango), because the team wanted the bottles to be presented as an exotic item in the market.

The packages for journalist were prepared in the next two days and sent out, but there was no place for rest for the team. Social media communication, web shop sales and production of visual material were constant ongoing processes in the office when Anže presented Tina with the next challenge. He showed up in her office in the middle of the week in January 2012 asking her "how will you justify the price of the EQUA BPA free bottles?" He continued putting the pressure on Tina by saying "if I were a customer, why would I buy the EQUA bottles for approximately 10 €, if I could drink tap water form regular plastic bottles which I get for free when buying bottled water for 0,60 €?" Tina looked out of the window; it was snowing that day, and knew she also had to prepare for that question. She asked Anže to give her one day to think it through and after Anže left her office, she looked at Ogilvy & Mather presentation of 4E's. The word *exchange* was tangling her mind for the rest of the day because she had to cope with very challenging question.

5. EXCHANGE THE BENEFIT FOR THE PRICE

The final element of 4P's of marketing included the price of a product. "A price is always a big problem: for a seller it is always too low and for a customer it is always too high," Tina taught. Since the price of a single EQUA bottle was promptly calculated and presented by Anže, Tina had to come up with the special preposition how to present product's price to the consumer. The EQUA bottle in a store would cost 9,95 € including VAT. A single bottled water could reach a price from 0,60 € to 4 €. "In consumer's mind it is cheaper to buy bottled water. The benefit for a customer is very simple – he or she would pay for the water and later on reuse its plastic bottle until it is not appropriate for further use," Tina was thinking out loud trying to figure out the way a potential customer would think. "I would also be outraged if one would offer me a plastic bottle overpriced by 150%. But I have to change this mind-set," she was determined to come up with the solution.

Tina started to think about the word *exchange* and what it meant in connection to the price, consumers, marketing and market economy. She invited Monika to join her in the office on Tuesday morning and they discussed the economic situation in Croatia. Monika said that her market research showed that "Croatians are very price sensitive. The economic situation in the country was not at its best and the country's GDP and average salary are lower in comparison to Slovenia." There was also a currency issue, since Slovenia adopted EURO in 2007 and Croatia is still in the process of negotiation for European Union membership for 2013. Therefore, there will be additional expenses with customs, transport and sanitary inspections that would influence the price. "But our customers will not understand this. They want to buy a cheap product no matter the problems we are facing now," Monika stressed Tina. After Monika exited the office Tina started to calculate the price. Taking into consideration all the costs, she entered Anže's office and started to present her solution.

"Anže, the price of the product in Croatian market should be lower than in Slovenia. The best psychological price one would pay for one EQUA bottle in a store would be 69,90 HRK for bigger bottle and 59,90 HRK for smaller bottle," Tina presented her calculations. Anže was not quite satisfied with the result because in Slovenia the price did not differ among sizes and when recalculated, Croatian customers would pay 0,65 € less than customers in Slovenia. "And if we take in consideration that Croatian VAT is higher than Slovenian VAT for 4 %, we lose lots of money," Anže expressed his dissatisfaction. Tina agreed with him but went on explaining that "Croatian market is double the size of Slovenian market which consequently means more quantities sold. And in the future if Croatia becomes a member of EU, all expenses will be transformed into profit." Anže give it a taught but he repeated to Tina the question from yesterday: "how will you justify the price of the EQUA BPA free bottles to potential customers?"

Tina was determined to explain the process. Firstly, the exchange Ogilvy & Mather were talking about would be expressed through the story of EQUA bottle. This is a key element when it comes to justifying the price of the product. "The main question is what a customer would benefit from the EQUA and we already emphasized that in our story," Tina stressed. "We delivered the story through all our communication channels and moreover, we already hinted the price when we offered 50% off on Kolektiva. So, I think our customers will not be so surprised to see that they would have to pay approximately 10€ for the EQUA bottle". Moreover, the added value of saving money when drinking tap water would be additionally stressed on the brand's webpage and social media communication channels. "We calculated that half a litre of bottled water is up to 255 times more expensive than half a litre of tap water. And I think that if we stress this information strong enough using every communication tool available and affordable to us, we can provide even additional economic benefit for our customers," Tina concluded with her explanation and Anže seemed quite happy with her answer.

6. WINDOW INTO THE FUTURE

Tina was aware that all CEE markets are not the same. EQUA brand entered Croatian market successfully, but Hungarian, Slovakian and Czech market were still to be entered:

> *The time was flying fast and it was already second Friday in February 2014. Tina set behind her table and looked at the picture of her team she kept on her desk. She was not needed to be reminded that there were still three more markets for EQUA brand to enter which could be so diverse that all effort put in Croatian market might not provide the company with desired results. April was approaching with the goal for EQUA to enter CEE markets and it was really difficult to try to repeat Croatian market activities in other markets. After all, Tina and her team did not know the language nor had personal insights into customer preferences for CEE markets. Tina used her knowledge from Marketing Management, Integrated Marketing Communication, Marketing Strategy and Human Resources Management class*

she had taken back at Faculty of Social Science, University of Ljubljana. She knew that market entry strategy depended on the decisions regarding hiring some help, but she was still illusive because she was struggling with the decision to hire some local advertising agency or an intern for each market. "If I only had more time to hire marketing assistants like Monika to provide some quality insights into CEE markets," she taught. "That would help me solve all question I have been struggling with: how to provide experience to customers, how to justify the price of the product and how to successfully deliver the news to local journalists," Tina left the office with that taught occupying her mind. She turned off the lights and locked the door of the office, since there was nobody behind her. All of her co-workers left for a drink in a small pub in the centre of Ljubljana where they usually hanged out after work. And Tina decided to join them, since a glass of premium wine would be a welcome distraction from all unanswered questions. She locked them in the office, at least till next Monday.

REFERENCES

Company Reports (2010, 2011, 2012). EQUA bottles, Source: Company

Moja Equa (2013). Priča sa Hrvatskog tržišta, Available on: http://mojaequa.hr/ (Accessed on April 21st 2014)

MyEqua (2013). Our Story, Available on: http://myequa.com/equa-story/ (Accessed on April 20th 2014)

MyEqua (2013). Certificates for DROP bottles, Available on: http://myequa.com/certificates-drop-bottles/ (Accessed on April 20th 2014)

Kolektiva.hr (2013). Originalne EQUA bočice za vodu i napitke, Available on: http://www.kolektiva.hr/equabottle.html (Accessed on April 19th 2014)

Equa Fan page (2013). Available on: https://www.facebook.com/EquaBottles (Accessed on April 19th 2014)

DESTINATION BRANDING
THE CASE OF BELGRADE - A FRIENDLY EUROPEAN CITY

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Abstract: *This paper investigates the perception of Belgrade from perspective of people living in Serbia. The results show that promotion has not been as successful as hoped, and that Belgrade is still not seen as a modern city among the respondents. Quantitative survey has been applied with 458 respondents. The findings have identified Belgrade as the European city with three main characteristics: friendly, exciting and hedonistic city. Furthermore, positive and negative aspects of the city have been explored. Based on the results, we recommend framework for future development of destination brand identity. This study should contribute to researchers and practitioners working in the field of city destination branding.*

Keywords: *Belgrade, destination branding, residential perspective, friendly city, Europe.*

1. INTRODUCTION

There is a growing interest of exploring the nature and meaning of branding destination among practitioners and academics. The competitiveness among cities will increase in the future and brand experts should understand how to transform knowledge about corporate or product branding into place branding. (Ashworth and Kavaratzis, 2009). Recent studies have identified that the well-being and satisfaction of different stakeholders (residents, government, visitors, investors, entrepreneurs and media) have strong influence on the image of a city or place in general. (Riza et al., 2012; Baker and Cameron, 2008; Damnjanovic et al., 2009).

However, local people may be an important factor when distinguishing and selling a city as a destination brand. According to (Freire, 2009) local people or residents of the place are the crucial element of destination brand identity. Recent study by (Merrilees et al., 2012) also underlined residents as important stakeholders in the branding context, since residents perceive the city brand as a place to live. Moreover, local people may also be important providers of word-of-mouth promotion and place branding externally to visitors perception (Garrod et al., 2012).

Only few studies have examined the city branding of Belgrade. They are two strategies developed by city authorities, which support development of tourist strategy for Belgrade city in 2008 and 2011 (Eric et al., 2008; Vasovic and Alimpic, 2011). Previous study by (Bursac, 2006) has examined the brand identity of Belgrade among three respondents group: residents, visitors and city representatives. However, further investigation is needed in order to understand brand identity and brand image of city of Belgrade that will be a starting point for an improved brand positioning in the future.

2. SCOPE

Belgrade is described as a vibrant metropolis of 1.6 million residents situated in Southeastern Europe, on the Balkan Peninsula. The city is located at the confluence of two large rivers – the Danube and the Sava. It is the third largest city on the Danube (after Vienna and Budapest) and the fourth largest city in Southeastern Europe (after Istanbul, Athens and Bucharest) (Hirt, 2009).

Belgrade has received many interesting international awards that prove its potential as an attractive tourist destination. In March 2006, Financial Times declared Belgrade the “City of the Future in Southern Europe”, which was the outcome of the competition for foreign and direct investments (Stupar and Hamamcioglu, 2006). Moreover, in 2011 and 2012, Belgrade was promoted as one of the top ten travel destinations on Earth according to famous online tourist guide Lonely Planet, with the following explanation: “It is an interesting city that's full of hedonism, passion and finesse”. Recently, at the Summit of city leaders held in Dublin in July 2012, Belgrade was awarded a prize in the category of "Best Cities", and Belgrade The city mayor at the time, Dragan Djilas, received Manager of the Year Award by Europe Business Assembly.

This study aims at explaining the current Belgrade brand identity and image from citizens‟ perspective and provide directions of destination branding strategy. In particular, it is about the way Belgrade should be marketed in the future and what it will be able to offer to the internal and external stakeholders.

The three main research questions of this study are as follows: What are the main elements of the current brand identity of the city of Belgrade from residents‟ perspective? What are the positive and the negative brand associations regarding Belgrade? How can we apply obtained knowledge to Belgrade‟s promotional message in the future?

3. METHODOLOGY

Quantitative research was undertaken in June 2012 with a range of 458 local people. A questionnaire was created based on previous studies about destination branding (Oliver, 2005; Popesku et al., 2010). The survey was published and distributed electronically to residents in order to identify and analyze their attitudes and opinions about the city of Belgrade. The questionnaire was initially face-to-face tested among 20 participants, and after being modified, it was sent to several mailing lists and social networks. The form was composed of general questions regarding age, sex, and occupation, as well as statements related to city branding aspects. A number of questions was based on a five-point Likert scale with respect to the level of agreement with the stated characteristics of Belgrade, along with two open-ended questions asking respondents to provide first impression for the word “Belgrade” and to suggest suitable communication slogan for Belgrade as a tourism destination. Obtained data were analyzed using SPSS 17.0 statistical software. The study also included qualitative research methodology using summative content analysis which involves counting and comparisons, usually of keywords or content, followed by the interpretation of the underlying context.

4. ANALYSIS AND RESULTS

The aim of the survey was to explore and identify brand identity of city of Belgrade from the perspective of its residents, Serbian people. Thus, our surveyed sample is consisted of 97% of citizens of the Republic of Serbia, with 72% of all respondents residing and 11% living temporarily/occasionally in Belgrade. Gathered pool consists of 273 female (60%) and 185 male (40%) respondents. Respondents were mostly students (67%), followed by employed (25%) and unemployed people (5%).

Several aspects of Belgrade were analyzed: geographical level of familiarity with Belgrade, main characteristic of the city, positive and negative attributes regarding living, doing business, infrastructure, culture, economy, and leisure, as well as first associations when hearing the word “Belgrade”.

Results show that Belgrade is known regionally, in Europe (81% of respondents), while 13% of the surveyed people claim that people outside of Europe, around the globe, are also familiar with Belgrade and its key values and characteristics. This distribution should be carefully considered, since Belgrade, as the capital of Serbia, should be famous worldwide.

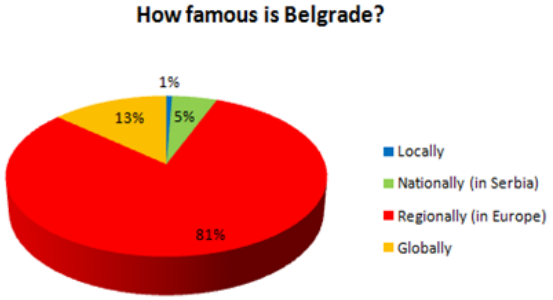

Figure 1. Level of familiarity with Belgrade

As for the main characteristic of the city, 33% of respondents stated that Belgrade is a friendly city. Next most frequent choices were exciting city (26%), hedonistic city (17%) and perspective city (13%). What is interesting is that two fewest chosen features are related to the aspects of modernity and safety of the city of Belgrade.

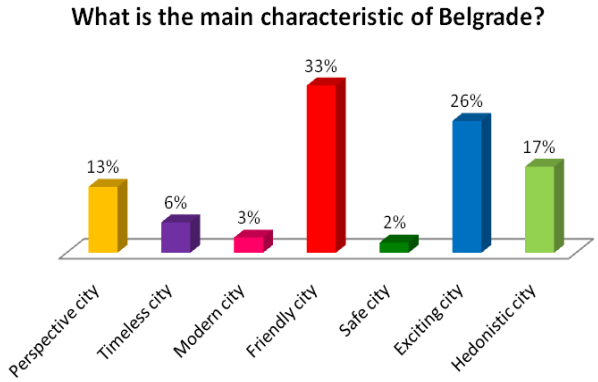

Figure 2. Main characteristics of Belgrade

Word association has been used in marketing to ensure that proper message is conveyed by names or adjectives used in promoting products. Therefore, the purpose of this type of question was to identify the main experience, through first word association test, of Belgrade among its residents. This question was open-ended and obtained answers were categorized in certain groups according to similarity among them. The most frequent answers (18%) were related to *"capital, metropolis, big city"* group. Having in mind the fact that Belgrade is one of the largest cities in Southeastern Europe and the main regional center in the Balkans, this answer is completely expected. It is not surprising that significant percentage (16%) of respondents answered that their first association belongs to the group of words *"my city, home, friends and family"*, since they either live or have spent time in Belgrade and thus, experience Belgrade as their hometown. Some authors (Tadic, 2010) claim that Belgrade's nightlife has spontaneously become the city brand, and evidential group of respondents (13,5%) is consentaneous with it. Having in mind that Belgrade is located at the confluence of two large rivers - the Danube and the Sava, and that many happenings take place on the rivers or by their side, a quite frequent (11%) answer *"rivers"* is not surprising. Eventually, a group of answers *"Kalemegdan, Pobednik"* was also common (10%). What is noteworthy is that in (Bursac, 2006), citizens also declared Kalemegdan fortress, Knez Mihailova Street, Republic Square, Skadarlija Street and confluence of the Sava and the Danube to be the most representative places in Belgrade.

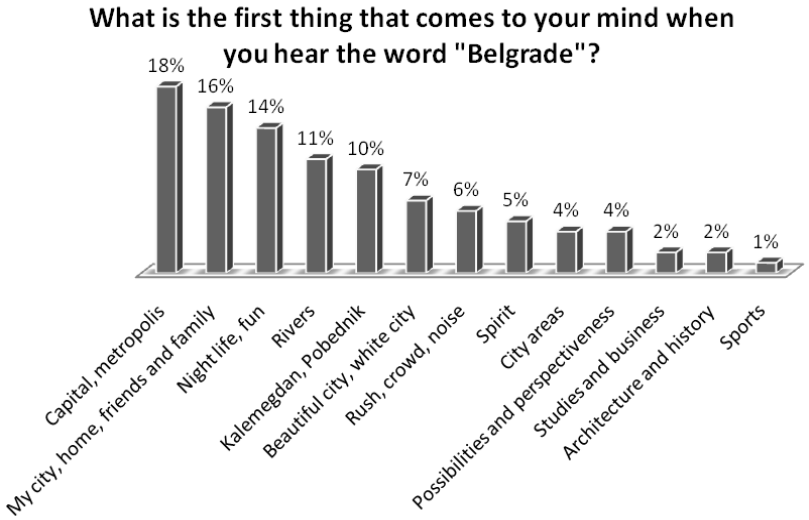

Figure 3. Brand perception of Belgrade

Summing up and analyzing all statements about Belgrade, conclusion about positive and negative elements has been created using summative content analysis. Namely, Belgrade has a lot to offer (European city, desirable tourist destination, hedonistic way of life and warm and friendly local people). Nevertheless, it is a metropolis and hence, has certain adverse aspects (inadequate promotion, poor traffic system, low standard of living and unclean city). What is encouraging is that all detected negative characteristics can be amended if adequate branding strategy is developed.

Table 1. Positive and negative elements of Belgrade

NEGATIVE ASPECTS	POSITIVE ASPECTS
INADQUATE PROMOTION City authorities do not promote Belgrade in a good manner. Negative image in world media.	**EUROPEAN CITY** Well-connected to other European metropolis. Regional center.
POOR TRAFFIC SYSTEM Poor public transportation system. Traffic jams.	**DESIRABLE TOURIST DESTINATION** Offers unforgettable experience. Good place for living. Rich history. Visitors gladly come back.
LOW STANDARD OF LIVING Lower standard of living in comparison to other European capitals. Not a city of glamour.	**HEDONISTIC WAY OF LIVING** Diversified fun content. Great nightlife. Tasty food and drinks. Good shopping and wellness.
UNCLEAN CITY Polluted city. Unclean and poorly maintained city.	**WARM AND FRIENDLY LOCAL PEOPLE** Pleasant and hospitable citizens. Citizens are proud of their Belgrade. City of future. City of youth.

5. TARGET CUSTOMERS

It is important to understand target customers from foreign countries who have visited Belgrade in order to create better image of the city in the future. According to the latest data from Belgrade Institute of Information and Statistics, annual turnover in 2013 was increased by 13% (put in numbers, 638.179 visitors), comparing to the 2012. Domestic tourists are up by 4% (120.778 visitors), and foreign visitors by 15% (517.401 visitors). Total number of overnights in 2013 is 1.409.037, which is an increase by 5% comparing to the results in 2012. Overnights of foreign tourists (1.016.739) is increased by 11%. Most off the foreign visitors in 2011 came from Slovenia (74.674), Montenegro (66.636), Germany (48.159), Croatia (50.625), Bosnia and Herzegovina (65.960), Italy (38.105), Romania (30.628), Bulgaria (28.054), Greece (26.400), Austria (25.245), Russia (25.236), Poland (21.548) and Turkey (19.196). In December 2013, number of foreign tourists has increased by 24% (40.889), comparing to December 2012. Number of overnights is up by 6%, comparing to same period last year (86.122), and overnights of foreign tourists is up by 15%. The most numerous visitors came from Slovenia, Croatia, Bulgaria, Bosnia and Herzegovina and Germany. According to the information from Belgrade Institute of Information and Statistic in 2013, the rising markets are Turkey (increase by 72%), Greece (increase by 36%), Russia (increase by 32%), Bulgaria (increase by 28%) and Poland (increase by 21%), which further create the initial pool of target customers for the future.

6. LIMITATIONS AND FURTHER RESEARCH

When interpreting the results of this study, a number of limitations must be considered. To start with, it is only focused on citizens, mostly on young people. Thus, results provide perception of residents as one target group that is considering destination branding. Further research should be directed on investigating different

target groups, examples being visitors and city representatives, since it will create valuable comparative analysis when identifying the brand identity and image of the city of Belgrade.

7. CONCLUSION

Throughout the paper the best necessary potentials of the city"s identity and city"s branding creation were investigated in order to understand what residents" perspective about city of Belgrade is like. Thus, both positive (European city, desirable tourist destination, hedonistic way of life and warm and friendly local people) and negative (inadequate promotion, poor traffic system, low standard of living and unclean city) elements of brand identity were identified. Belgrade possesses rich historical and cultural heritage, favorable geographical position, hospitable citizens and a lot of potential for a successful brand image. Kalemegdan fortress and Pobednik monument are among the top attractions of the city of Belgrade, as well as rivers and several more sights. Residents believe that the exciting nightlife, so called "spontaneous brand of Belgrade", is still among the best-known characteristics of Belgrade.

Vision of Belgrade identity (a.k.a. desired brand image) is showing positive city identity with integrated marketing communication strategy of the product destination portfolio (see Figure 4). What is valuable in these results is that positive elements could be used in future communication with external stakeholders and target groups. Nonetheless, adequate communication strategy and product destination portfolio towards interested parties should be developed in order to improve current brand image of the city. In that sense, it would be interesting to create portfolio offers that are customized for specific target groups, i.e. foreign tourists, diaspora, investors and media. We propose the city branding framework for long-term strategy that is to be further developed in the future studies. Our framework for city branding was created following the previous research study (Balakrishnan, 2008), which includes strategic destination branding model. More precisely, the author analyzed the creation of the country image for Dubai, a star in the east, and used the feedback for the improvement of the destination branding identity.

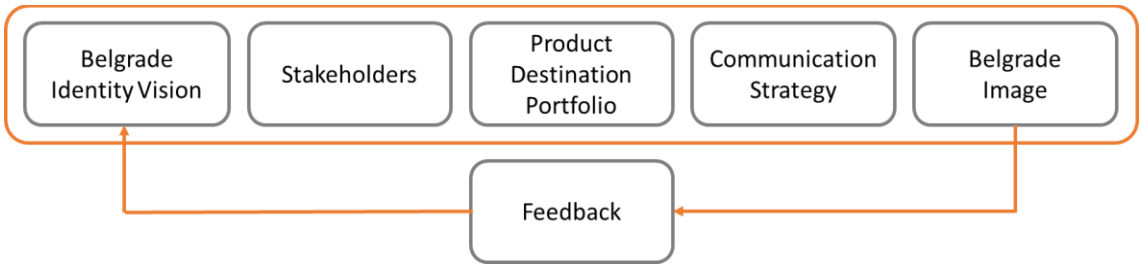

Figure 4. City branding framework for Belgrade

Furthermore, this research identifies inputs and necessities for developing branding strategy of the city of Belgrade, with an important emphasis on the inclusion of the perspectives of all stakeholders. Overall suggestion for the improvement of the current identity of the city of Belgrade is to establish a cooperation between city authorities on one side, and independent marketing and branding consultants on the other side. This setting would enable smooth definition of the key city identity elements, as well as creation and implementation of the adequate branding strategy based on the future vision of all city stakeholders. Our findings support the perspective that city branding should convey both the intention of city authorities and the experience of people (Zhang and Zhao, 2009). Based on the observations of the study, authorities of the city of Belgrade should provide a proper branding of this impressive city, as a friendly European city, with an aim of including the attitudes and beliefs of its residents, and exceeding the expectations of its visitors and other stakeholders.

REFERENCES

Annual report: Increased number of tourist arrivals in 2013, http://www.tob.rs/en/news.php?id=757, accessed on April 4, 2014

Ashworth, G. and Kavaratzis, M. (2009), Beyond the logo: Brand management for cities, Brand Management, 16(8), 520-531

Baker, M. J and Cameron, E. (2008), Critical Success Factors In Destination Marketing, Tourism and Hospitality Research, 8(2), 79-95

Balakrishnan, M. S. (2008). Dubai – a star in the East: a case study in strategic destination branding. Journal of Place management and Development, 1(1), 1753-8335
Belgrade Institute of Informatics and Statistics, https://zis.beograd.gov.rs, accessed on April 10, 2014
Blic, online daily newspaper, http://www.blic.rs/Vesti/Beograd/332558/Na-Samitu-gradova-lidera-u-Dablinu-nagradjeni-grad-Beograd-i-gradonacelnik-Djilas, accessed on July 12, 2012
Bursac, B. (2006), Identifying and Creating the Identity of Belgrade, Master thesis, University of arts In Belgrade Université Lyon 2, Belgrade, Serbia, http://www.academica.rs/academica/Bursac_Identifying-and-Creating_2006.pdf, accessed on May 5, 2012
Damnjanovic, V., Kravic, M. and Razek, T.A. (2009), Tourism Branding Strategy of the Mediterranean Region, International Journal of Euro-Mediterranean Studies, 2(1), 99-120
Eric, D., Popesku, J. and Zecevic, B. (2008), Tourist development strategy of city of Belgrade, Institute of Economic Sciences, Belgrade
Freire, J. R. (2009), „Local people" a critical dimension for place brands. Journal of Brand Management, 16(7), 420-438
Garrod, B., Fyall, A., Leask, A. and Reid, E. (2012), Engaging residents as stakeholders of the visitor attraction, Tourism Management, 33, 1159-1173
Hirt, S. (2009), City profile Belgrade Serbia, Cities, 26, 293-303
Lonely Planet, http://www.lonelyplanet.com/serbia/belgrade, accessed on July 21, 2012
Merrilees, B., Miller, D. and Herington, C. (2012), Multiple stakeholders and multiple city brand meanings, European Journal of Marketing, 46(7), 1-25
Oliver, M. (2005), Southampton City: Image Research 2005, Interim summary research report, Mindset Research Ltd, Bristol.
Popesku, M., Damnjanovic, V., Novcic, B. and Premovic, M. (2010), Serbia as Brand – Internal Perspective, 3rd Annual EuroMed Conference of the EuroMed Academy of Business, Business Development Across Countries and Cultures, Nicosia, Cyprus, ISBN: 978-9963-634-83-5, 877-894
Riza, M., Doratli, N. and Fasli M. (2012), City Branding and Identity, Procedia - Social and Behavioral Sciences, 35, 293-300
Serbia Report, http://www.serbia.travel/download/WTTC_Serbia_Report.pdf, accessed on April 4, 2014
Statistical Yearbook of the Republic of Serbia 2012, Tourists" arrivals and nights by countries of origin, https://zis.beograd.gov.rs/index.php/2013-12-03-10-50-11/2013-11-04-10-15-34/summary/22-publici/10-b-gr-d-u-br-2012-uriz.html, accessed on April 14th 2014
Stupar, A. and Hamamcioglu, C. (2006), Chasing the Limelight: Belgrade and Istanbul in the Global Competition, Spatium, 27-33
Tadic, P. (2010), Serbia: Creating a Brand, Osservatorio Balcani e Caucaso, Belgrade
Vasovic, D. and Alimpic, Z. (2011), Development strategy of city of Belgrade, Urbanism Institute of Belgrade and PALGO Center, Belgrade
Zhang, L. and Zhao, S.H. (2009), City branding and the Olympic effect: A case study of Beijing, Cities, 26, 245-254

THE ROAD TO SUCCESS: WHAT SHOULD AUTOGARANT DO?

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Abstract: *Purpose of this paper is to inspire students and all other interested parties to think strategically and try to find best possible ways to restructure and improve business of a company, on the example of Serbian mid-size enterprise. Autogarant Ltd. was established in 1992, and after 22 years of successful business is official car dealer for 9 vehicle brands, has over 50 employees, 3 modern car showrooms and service workshops equipped with state of the art technology. Now, the company seeks for a new ways to strengthen existing business and form new business pillars in order to secure stable future growth.*

Keywords*: Automotive industry, new business pillars, strategy, improving sales performance, vehicles*

1. INTRODUCTION

In 1992 entrepreneur from Čačak decided to open a car service workshop in his hometown. He hoped that sometime in the future, that same car service workshop will emerge from small workshop to serious company in the area of automotive industry. After 22 years, that is exactly what Autogarant stands for - modern automobile retail center which includes retail showrooms and various workshops and other business units that are needed in order to provide top quality after sales services to end customers, with over 50 employees. With clear vision and great business decisions directed to growth and development, mainly through dealership contracts, Autogarant represents successful medium sized company with annual turnover of over 5,000,000€ and annual profit of over 100,000€.

However, if he wishes to continue with this steady growth and taking into account that primary activity of Autogarant is car sales and car dealership, it is necessary to devise a business strategy that will adequately mitigate and take advantage of decline in new cars sales. This negative trend of sales volume is not noticed only on Serbian market, but also throughout European car markets. Situation in automobile industry is far from ideal both for manufacturers and car dealers, so new strategies for adapting to existing trends are needed. Beside car market negative trends, emerging local competition and increased differentiation among buyers are also influential external factors that should be taken in consideration. With turbulent environment and limited resources, Autogarant must come up with an effective long-term business strategy which will bring more new clients or even markets, increase turnover and profit and, eventually, ensure the leader`s position for the company.

Question that arises for owner and GM of Autogarant is - how to increase the sales of existing portfolio (9 car brands) and which target groups should we focus in our marketing activities? On the other hand, is it possible to expand the scope of business and enter some new markets which company currently does not operate and how?

2. ABOUT COMPANY

Autogarant Ltd. was established in 1992, as a small car workshop for repairing all types of cars. This family business was successful since its foundation and was trying to constantly improve itself since the beginning. First major business expansion was becoming official car dealership for Fiat and Lancia cars in the territory of Western Serbia, after signing contract with Delta Automoto Ltd. After just two years, Autogarant Ltd. has become a leader in sales of new Fiat vehicles in this market, and maintained that position until today. In 2004 new car showrooms for Fiat and Lancia vehicles were opened. That same year the company has become official car dealer for Alfa Romeo vehicles.

Within the new business centre there is a showroom, service workshop, unit for painting works, spare parts store, car wash unit, and tire workshop for all the vehicles within the Fiat Group.

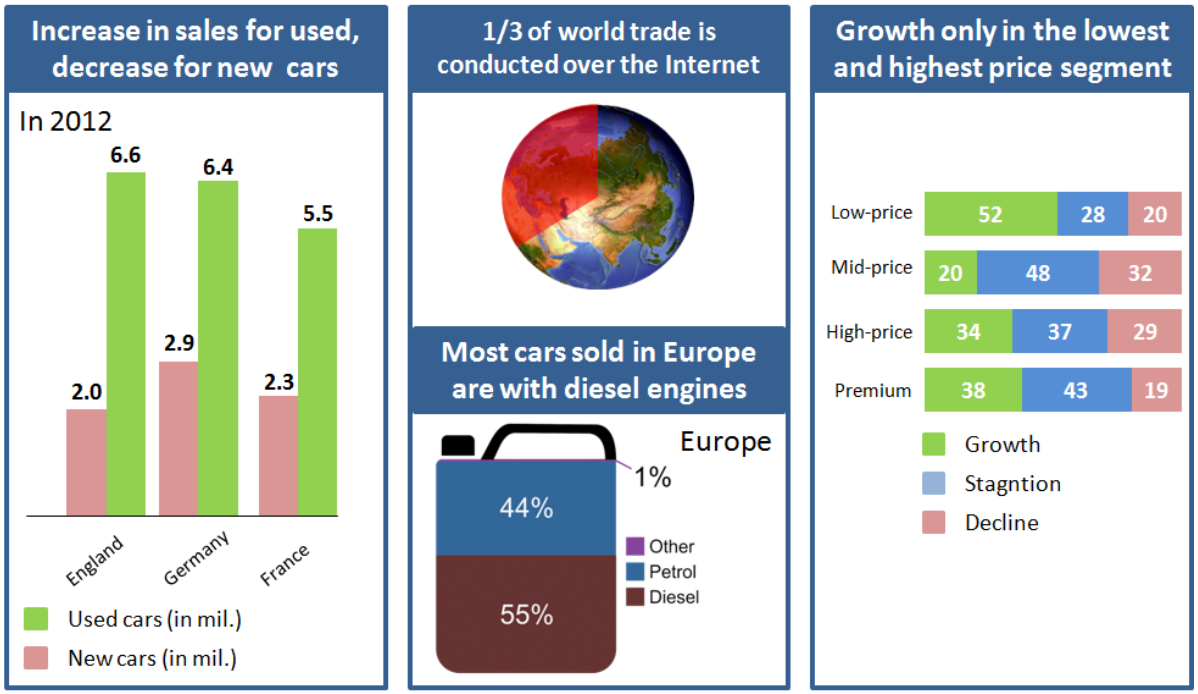
During 2007, new retail canter (showroom) was opened – Autogarant HONDA. After becoming official dealer of Honda cars, company continuously achieved remarkable results in the Western Serbia market.

All retail centres and business units are equipped with the state of the art technology, equipment and computer devices in order to provide high quality sales, and after sales services to the clients. In 2007 and 2008 there were significant improvements of after sales services. During 2009 Autogarant Ltd. has become official dealer for BMW and MINI vehicles. After this step vehicles portfolio was significantly increased, especially after dealerships for Dodge, Chrysler and Jeep vehicles were opened in 2012.

Summed up in a nutshell Autogarant Ltd. today is official car dealer for 9 car brands, it has 50 employees, 3 modern car showrooms, and several service workshops equipped with state of the art technology.

3. VEHICLE MARKETS OVERVIEW AND TRENDS

In this section we will look at the automotive industry of Europe, but also our country (Serbia) and comment some of the trends that we thought are interesting.



Source: European Automotive Survey 2013 – Earnst &Young; The European Used Car Market Report 2012 - BCA

Figure 1: Trends in Europe

As it is illustrated on the graphs above, on the three biggest markets in Europe, number of used vehicles sales significantly higher than the new vehicles sales. The predictions are that this trend will continue and that difference will be even higher in the years to come. As a result, car producers and dealers are suffering crisis and are constantly trying to adapt to these trends and prevent further drop in sales.

Some of the measures taken by them are: lowering production costs, technologies innovation (new materials, motors with lower fuel consumption, lower CO2 emission), they are using opportunities provided by government legislations concerning ecology, investing into promotional activities etc.

Interesting fact is that the largest number of vehicles sold on the European market has diesel engines. This is data that greatly differs from other markets, for example in Japan in 2012, less than 1% of vehicles sold have diesel engines (ICCT, 2013). Fact that should be taken into consideration is that one third of world trade is conducted over the internet.

As it can be seen on the graph above, largest growth is in low-price and premium car segments. This is very important data while defining product portfolio and marketing plans (Ernst and Young 2013).

As it is already said biggest growth in automotive industry is recorded in the segment of used cars. Regarding that we analyzed history of this segment since the year 2000.

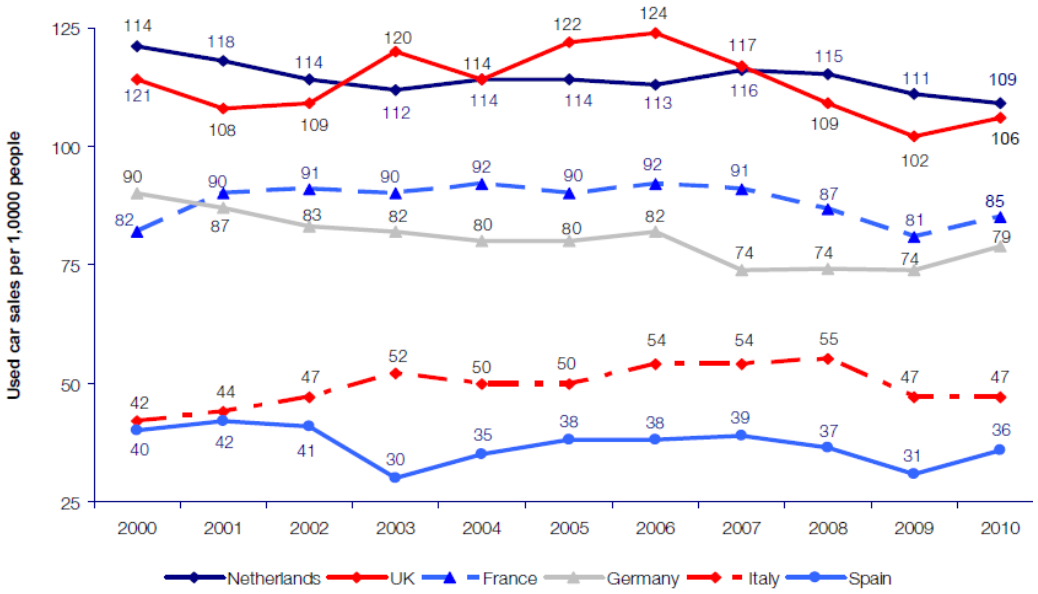


Figure 2: Used car sales per 1,000 people

On the graph above you can see used car sales per 1,000 people per year, in the largest European markets.

- France"s used car sales per 1,000 people rose from 82 to a peek of 92 in 2004 and again in 2006, dropping back to 85 per 1,000 people in 2010;
- Germany showed a steady drop in used car sales per 1,000 of the population, from 90 in 2000, to 74 in 2007 to 2009 – recovering 79 in 2010 as Germany"s used car volumes rose 420,000 units to 6.43 million last year;
- Italy, one of the „laggards", in terms of used car sales per 1,000, moved from 42 in 2000 to a healthier 55 by 2008, dropping back to 47 in 2009 and 2010 – less than half of the UK"s and Netherlands" performance for this key indicator.
- Spain"s used car sales per 1,000 people has fluctuated over the past 10 years, reaching low of 30 and 31 in 2003 and 2009 respectively – recovering to 36 in 2010 as used car volumes rose by 250,000 units. Nevertheless, Spain remains firmly at the foot of the EU 15 used car sales per 1,000 people.
- The United Kingdom"s used car sales per 1,000 of the population fell from a high of 123 in 2006 to 102 in 2009 – recovering to 106 in 2010, narrowing the gap with the Netherlands which took over top spot for this indicator in 2007 (BCA, 2012).

Thing that can be drawn as a conclusion, is the fact that in all countries, number of used vehicles sold significantly decreased during the economic crisis that has hit the entire automotive industry. After recovery of the European economy, since 2009, and 2010 steady growth was recorded within all states, and continued in later years. As it is already mention, now we have a situation where the number of used vehicles sales significantly exceeds the number of new vehicles sales.

If we look at the Serbian used car market, all of the trends are in line with current trends in the European market. In 2012 ratio of used vehicles and new vehicles sales was 5:1 in favour of used vehicles. The reason for this is, among other things, reduced purchasing power of the end consumers.

Result of this is expansion of this type of trade, and consequently an increase in the number of retailers, which can be divided into three groups. On one side we have the classic traders (selling cars on their car lots), the car dealers (in addition to the business with the new cars, they perform import and sale of used cars), as well as individuals that are importing vehicles for their own use.

4. COMPETITION

On the new car market, competition in Serbia is very strong. Given that there are over 60 authorized dealers, in this section we will look at the most important ones. In the first place it should be noted competitors covering an area of Western Serbia in similar segment cars.

One such company is Autočačak Ltd. established in 1991. The company was initially engaged in the sale and servicing of cars and it is the first private company which during 90s had a signed contract for the sale and servicing of Zastava vehicles. Later, on May 7 in 1996 the company became the general distributor and importer of Škoda vehicles on the territory of former Yugoslavia and in the next nine years Autočačak sold approximately 25 000 cars. The company still records significant sales of Škoda cars and represents Autogarant"s biggest competitor.

Another competitor is the Auto Centre Manik Ltd. which also has its headquarters in Čačak. AC Manik - ACM Ltd. is an authorized dealer and service centre for Audi vehicles. In addition to selling all models of Audi program, the company owns and service vehicles, and is well equipped with the latest technology and qualified staff. In addition to selling new vehicles, the company also sells used vehicles which give them a significant competitive advantage.

Next is Jevtović Ltd. an authorized dealer and service provider for Mercedes-Benz and Mitsubishi Fuso vehicle. This company has the most modern facilities and equipment for servicing vehicles in western Serbia and this represents their primary business. Because of the high quality service facilities and brands in portfolio, also represents an influential competition to Autogarant.

In addition to regional competitors, there are car dealers from all over Serbia, which represent significant direct competition when it comes to new car sales. On the other hand, as can be seen from the previous section, even more significant competition (although indirect) are the sellers of used cars, a lucrative segment which records significant growth on European car markets.

5. TARGET GROUP PROFILES AND DESCRIPTIONS

At first, B2B (A.) and B2C (B.) segments are separated, and further segmentation within these segment is applied in order to identify generic target groups.

A. Business to business segment:

1. Managers choice – includes management of successful international big and medium sized companies which operates on territory of Serbia. They search for quality, prestigious and premium price company"s vehicles. Management and GMs belong to the upper class and perceive car as status symbols and want to make a good impression, both within the company and externally, when interacting with business partners. Further these companies highly appreciate the quality and brand of the car, and their fleet must properly communicate and represent the values of the company. Furthermore, companies that belong to this segment usually have a clearly defined communication strategy that also prescribes the image of the company"s fleet for management .This is the premium segment, which means it is willing to set aside more money for top quality. Therefore, in order to attract this B2B target group and differentiate our offer from the competitors, it is necessary to propose certain benefits and after sales content. Company cars are used on a daily basis (trips to work, meetings, and business trips), so in addition to attractive terms of sale, both comfort and performance of the vehicle should also be emphasized.

Key values: status, top quality, brand

2. Salesman staff choice – also includes big and medium sized companies, but they need vehicles for operational staff, not management, usually employed in the sales or distribution sectors. The staff of the company needs practical and economical vehicles for performing basis activities. These companies mainly have already established and developed distribution network, which require a lot of fieldwork. Therefore, an employee of the company most of his working time spends in the company"s vehicle and has high daily transport mileage (such as staff employed in sales, supervisors, etc.). It means that besides price, as the main purchasing factor, fuel consumption, maintenance costs and warranty period represents also important factors. Further it is crucial to offer reliable cars with the right ratio of price and quality and to achieve a long-term cooperation by offering adequate after-sales services.

Key values: price, fuel consumption, warranty period

B. Business to consumers segment:

1. Premium segment – employed individuals over 30 years old with high income (over 1000€ per month) who belong to upper middle and high class. They are willing to invest more money into purchase of a high quality car which will properly represent their status in society. Beside basic need or transportation, when purchasing new car, they also consider various needs such as need for possession of expensive goods or well-known car brands and emphasize their higher status in society. Similar to Managers choice segment, this segment also perceives car as a sign of prestige.

Key values: status, high quality, premium price

2. Value segment – includes buyers who belong to middle class with average and above average income (from 400€ to 1000€). Their funds for purchasing new cars are limited, so for the money they tend to invest in car purchase, they seek to maximize the value they get, in return. This segment is extremely price-sensitive, thus price represents the primary criteria for purchasing vehicle. Beside price, low fuel consumption and low maintenance costs are also highly appreciated.

Key values: price, fuel consumption, maintenance costs

3. Family segment – includes employed married couples with small and underage children which look for practical and economical vehicles. Car is usually used in variety of purposes, from the daily commute during weekdays, the longer journeys during weekends and transport of the children. Therefore family segment particularly regards vehicles that are safe, comfortable (with usually five doors), spacious, and multifunctional, but also economical in terms of price and fuel consumption. They are also interested in accessories, such as additional safety gear like parking cameras, sensors, and locking system.

Key values: safety, comfort, practicality

4. Urban segment – mainly represented by younger population up to 45 years, which live in big cities and very often use cars urban environment where availability of parking spots is always an issue. Therefore, they look for small (usually 3 doors) and modern vehicles with low fuel consumption, suitable for everyday town rides and in price range of the given class. Beside this, we may further differentiate buyers which values characteristics and accessories such as attractive design and “green” technologies (eco-friendly technology such as reduced CO2 emission, engine modes for fuel saving etc.). This segment also includes youth population up to 25 years, who usually do not possess enough funds, so it is the parents who buy them cars. Further, beside price they also consider and appreciate customization options (if existing, like unique paint jobs, loud audio systems and other characteristics that will attract attention and make them stand from the crowd). Finally, they follow trends and they are not loyal to one particular brand and prefer to experiment with car brands.

Key values: practicality, design, accessories

5. Off-road segment – a specific niche market embodied through drivers who use car in special conditions and surroundings such as rural and off-road drive. They want strong, durable and safe vehicles which can be relied on and adapt to any weather or terrain unfavourable conditions. Cars must have excellent performances, to be safe and well equipped with additional gears for every kind of situations. Beside transportation need, these buyers also love to enjoy the feeling of ride and to test the limits of their cars.

Key values: performance, safety, accessories

6. TASKS

Based on the data given in the case study it is necessary to provide answers on following questions. Do not forget that the point of the case is to apply strategic thinking on Autogarant Ltd. possible future actions and not on the company"s analysis.

1. How to improve the business performance and sales volume of new cars (existing portfolio)?
    a. Which strategy would you propose to Autogarant owner and GM?
    b. Taking into account identified target groups (section 4), create a marketing strategy for the chosen target groups (choose one or more, it is up to you) for whom you think has a biggest potential.

2. Which new segments/markets would you recommend to Autogarant to enter in order to create new business pillars?
    a. Which strategy would you use when it comes to penetrating new segments/markets? Explain the strategy and necessary prerequisites for implementing the chosen strategy?

The accent is on your ideas, so feel free to propose creative but also realistic strategies. Every answer must have valid arguments and chosen strategies must aim to upgrade Autogarant position on market and bring additional profit to company.

REFERENCES

International Council on Clean Transportation (2013), European Vehicle Market Statistics Pocket Book, Available at: http://www.theicct.org/european-vehicle-market-statistics-2013 [Accessed on April 15th 2014]

Ernst and Young (2013), European Automotive Survey, Available at: this link [Accessed on April 14th 2014]

McKinsey & Company (2013), The Road to 2020 and Beyond: What"s Driving the Global Automotive Industry, Available at: this link [Accessed on April 12th 2014]

University of Buckingham (2012), The European Used Cars Market Report, Available at: http://www.british-car-auctions.co.uk/Global/UK/latest_news/BCA_Used_Car_Market_Report_2013_v2a.pdf [Accessed on April 11th 2014]

European Automobile Manufacturers Association (2013), The Automobile Industry Pocket Guide, Available at: http://www.acea.be/uploads/publications/POCKET_GUIDE_13.pdf [Accessed on April 9th 2014]

CREATIVE MARKETING STRATEGIES H&M VS ZARA

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Apstract: *We live in a time when globalization is an inevitable process. Globalization is characterized by a high degree of complexity. With a population of enterprises is relevant strategic approach to globalization of business. We talk about the highly integrated and electronically networked global economic system. Due to the fact that the international division of labor is becoming a central determinant of future economic development of each country, the knowledge in the field of international marketing are becoming a necessity in every business organization on the global market. Globalism, viewed as a business philosophy, based on an integrated, standardized system where people buy, sell, and share common products, services and ideas .*

Keywords: *strategic marketing, brand, finance, competition, Zara, H&M*

1.INTRODUCTION

Fashion is more than just a designer's whim. Fashion is a reflection of a given time, socially, politically, economically, and artistically. The changing styles show just as much about history and the time period as any history book. It reflects on what people think, what they valued and how they lived. Fashion is a statement, a way of living. Fashion is used in different ways such as clothing, culture, religions etc. (Wikipedia, 2013.)

The fashion industry is now one of the biggest industries in the world.The world clothing and textile industry (clothing, textiles, footwear and luxury goods) reached almost $2,560 trillion.

- The world childrens wear market is expected to reach beyond $186 billion in 2014, marking a 15 percent increase in five years.
- The world bridal wear market is expected to reach almost $57 billion by 2015.
- The world mens wear industry should exceed $402 billion in 2014.
- The world womens wear industry is expected to pass $621 billion in 2014.

American households spend, on average, $1,700 on apparel, footwear, and related products and services. In addition, a large number of people (4,2milion people) are employed in the fashion industry, the majority of the population, fashion is one of the hobbies and areas of interest.

2. STRATEGIC MARKETING

Strategic marketing is the process by which managers formulate and implement marketing strategies, in order to achieve the goals set in the given environmental conditions and the company .To marketing managers develop marketing strategies and manage them, according to (Filipovic V., Janicic R., 2010) they must concentrate on several marketing tasks including:

- Analysis of market opportunities and constraints;
- The choice of target markets;
- Development of the marketing mix;
- Analysis of internal factors, strengths and weaknesses of marketing and the company as a whole.

2.1. THE PROCESS OF STRATEGIC MARKETING

Strategic marketing involves the decisions and actions that are the result of :

a) analysis of the current situation;
b) development of new strategies or modifications to existing ones;
c) elaboration of the program of action for their implementation;

d) evaluate the effects of application .

2.2. MARKETING STRATEGIES FOR THE FASHION INDUSTRY

Fashion marketing techniques apply many of the same marketing strategies that large and small businesses use. Fashion marketing includes market research, advertising and promotion. Research gathers information about the market for a particular brand or product. Advertising helps generate sales, and promotion increases brand or product awareness.

Fashion marketing strategies based on the Internet:

Fashion Blogs

A big part of the online community includes blogs and social networks.

Online advertising

These strategies include creating online versions of printed magazines, banner ads, photos and articles about the brand.

Online interactive fashion show

It is possible to organize a series of small interactive show, with a series of image model where viewers can click on the picture to see more information about the layout, or even buy the product.

Marketing strategies fashion shows

Fashion show - organizing fashion shows is a classic marketing strategies in fashion, which provides a formal presentation of the production program selected public.

Press Release - fashion managers use the press release for publication of certain activities of a given brand. Statement delivered by the media and is one of the classic ways of informing the public about the intentions of the company.

Digital Media – They are used for research and promotion. The amount of information available to research pertaining to, and the possibility of two-way communication is the main advantage of using this strategy for promotion .

Product placement - This strategy involves techniques where the fashion products of a given brand promoted through television programs, broadcast and film or engaging public figures.

The choice of brand ambassador - Present influential people in the targeted group of potential customers who participate in the popularization of fashion products (David, F. (2013).

2.3. CREATIVE FASHION MARKETING STRATEGY

Viral marketing - viral marketing strategy in the fashion industry can be very effective, due to the effect of trust in the user that is advertising .

Guerrilla artwork - This is a strategy that includes the recent collaboration with artists in the creation of murals, graffiti and similar examples of street art, which the company addresses the street culture of their customers.

Strategy word-of-mouth - relies on effective communication brand values and beliefs of the company, which must be clearly communicated and accepted by the company to be properly transferred to customers.

3. H&M

In 1946 the company's founder Erling Persson was on a trip to the United States and came up with the business idea of offering fashionable clothing at attractive prices. In 1947 he opened his first shop Västerås, Sweden "Hennes", which exclusively sold women's clothing. "Hennes" is Swedish and means "for her" and/or "hers". In 1968 the hunting apparel retailer MauritzWidforss was acquired, which led to the inclusion of a menswear collection in the product range and the name change to "Hennes&Mauritz" (H&M). H & M Hennes&Mauritz AB comprises six independent brands: H&M, COS, Monki, Weekday, Cheap Monday and & Other Stories.

H&M is are tail that is looking to provide consumers with fashionable, high-quality clothing at the best price possible. They offer “fast-fashion”clothing, in other words from runway tracks in record time, and sell Europeanin fluenced clothing in the American market. Additionally, H&M carries clothing in avariety of categories including women‟s casual, men‟s business, children‟s wear, footwear and accessoriesThe company is the second largest clothing retailer in the world, and actively engages in E- retailing. H&M is also economically, socially, and environmentally sustainable (H&M, 2014).

3.1. H&M PERFORMANSE

Financials

The revenue chart started in 2004 at about $10 million, and has risen to about $16 million in 2008. Their profit margin dropped significantly from about 14.7% in 2004 to about 12.9% in 2005. Each year after that, the profit margin in creased again and is basically stabilized again at about 14.7% in 2008. From 2009 when the profit was $118 million, they increased the profit at $150 million in 2013.
H&M"s growth target is to increase the number of stores by 10–15 percent per year, and at the same time increase sales in comparable units.

Recent Expansions

H&M had started theirglobal expansions earlierthan Zara, so theyhavehad alonger time period ofsuccess in the performancearea. An articlein Business Week (2002) states that in theirfirst attempt at international expansion, H&M opened astorein London in 1976.When this article was written in 2002, H&M was leading the market versus its major competitors, Gap and Zara. According to the author, (Capell.K, Khermouch.G (2002) HIP H&m Business Week,(3807) 106-110), by the end of 2002, the company had plans to increase their number of stores to 844, which would have been an increase of almost 75% from 1996-2002. H&M opened 190 new stores in 2005, 2,325 stores at the end of 2011 and 2,629 stores at the end of August 2012, 2014 there are 3,200 stores in 54 countries.

The strong pace of expansion continues into 2014 with a planned 375 new stores net. The highest rate of expansion will be in China and the US. There is also great potential for expansion in other markets such as Russia, Germany, Italy and Poland.

Online expansion

H&M"s shop online is available in 10 European markets and the US. The easily navigated digital store is fully mobile-adapted since January 2013 and already very popular with our customers. Roll-out of shop online to other markets of the H&M Group will follow.
COS, Monki, Weekday and Cheap Monday offer sales online in 18 European markets while & Other Stories is available online in 10 European markets.
The online market is constantly growing and mobile shopping through the use of smart phones and tablets has become increasingly common. 64% of consumers are interested in scanning products with smart phones to get more information while 76% of consumers are interested in instant offers via smart phones for things they were already looking for. Additionally, popular mobile apps include mobile coupons, store information, mobile self-checkout and digital receipts.

Current Marketing Strategy-H&M

Current strategies that H&M are marketing to its consumer are thro ughamobile marketing campaign to promote the latest collection. In doing this mobile marketing strategy consumers receive SMS coupons, mobilebannerads placed on major portals and media sites.
To help gain customer traffic in the storeH&M has also used celebrities such as Karl Lagerfeld, Roberto Cavalli, ReiKawakubo, and Jimmy Choo to help increase sales. One of the major ad topics that H&M may market is the Fashion Against Aids campaign. The specific collection featured t-shirts, tank tops, and hoodeds weaters designed by Designers Against AIDS (DAA) and by several music artists including Rihanna, Timbaland, and Ziggy Marley. Nearly 25% of the sales from this collection went to HIV/AIDS prevention projects (Wikipedia, 2013).

Introduction

Zara"s history begins with the owner company, The Inditex Group.Inditex Group is a large company based out of Spainrunning around one hundred stores dealing with textile design. Inditex operates over 4,350 stores worldwide with brands like Massimo Dutti, Bershka, Oysho, Pulland Bear, Zara, ZaraHome, Uterque, and Stradivarius (Zara,2014).

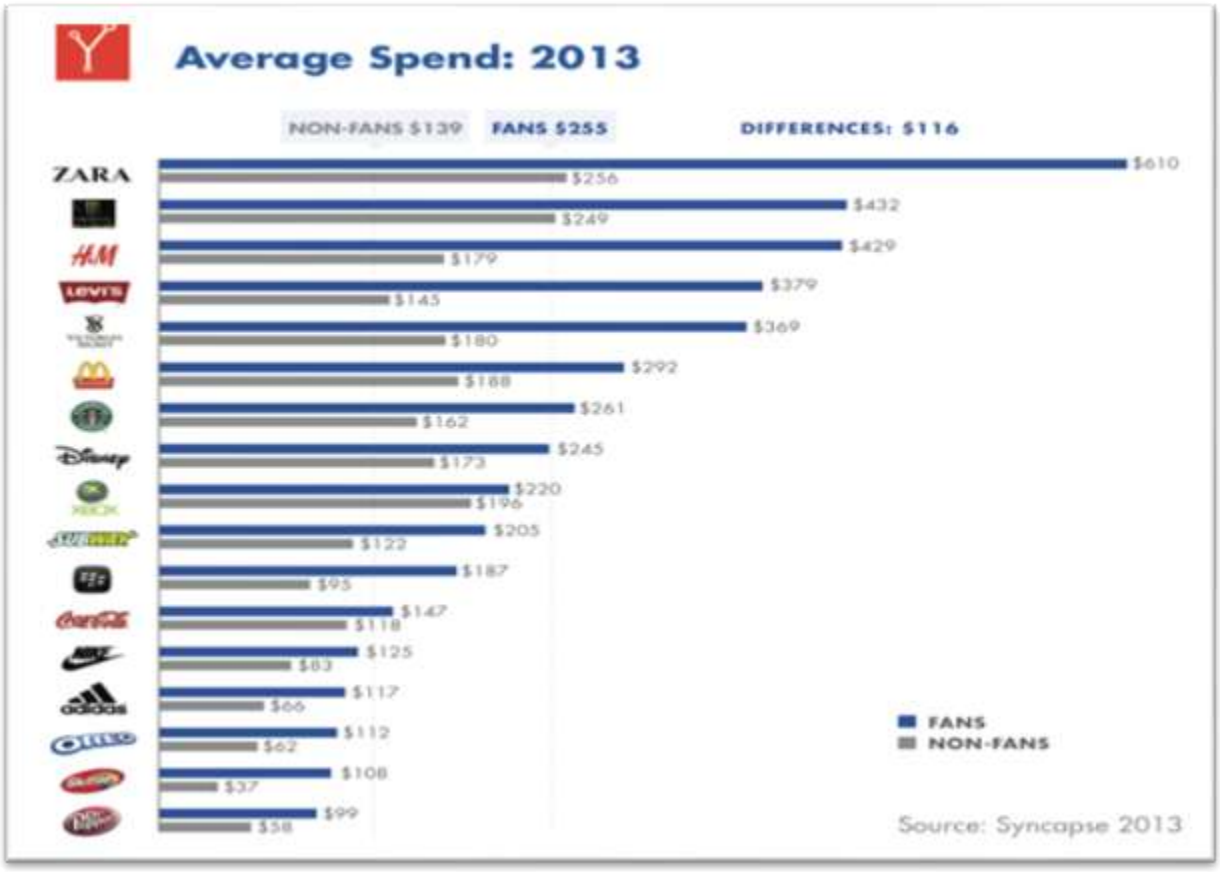
The company was found in the year 1963 by Amanico Ortega Gaona and by the year 2005 its holding group Inditex became world's fastest growing manufacturer of fashion clothing that was both affordable and trendy. It has over 2000 stores all over the world and plans to make that number double by the year 2011. The success story of Zara is based upon its business strategy that fostered creativity, innovation and flexibility in its business model and that is what differentiated Zara from it competitors and provided it with an edge and competitive advantage both at a local as well as at an international level. The very first shop of Zara was opened in the year 1975 in the city of Spain which is to date the home and central location to its headquarters.

3.2. ZARA PERFORMANCE

Financials

As Zara emerged from the company Inditex, this report includes some financials about Inditex. Their revenues started in 2004 with about $8 million and steadily roseto about$15 million in 2008. Inditex"s profit margin started off somewhat low in 2004 at 11.6%, and peaked in 2007 at 13.3%. In 2008, their profit margin is back down at 12.1%. In 2013, Inditex"s sales rose by 4.9% from the previous year to 16.72 billion euros ($23 billion), said Spanish textile titan Inditex, owner of global fashion brand Zara, Amancio Ortega.

Asia accounted for 20.4 percent of the company"s sales, overtaking its domestic market Spain at 19.7 percent, where consumer spending has plunged due to a double-dip recession that has left one in four people out of work. But despite stressing “strict control of operating expenses,” Inditex said business costs rose as it coped with a net 331 new store openings and higher sales in the year. Net profits edged up by 0.6% from the previous year to 2.38 billion euros in 2013 (Capell,K. (2008)



Recent Expansions

Zara"s parent company,Inditex, opened 448 new stores in 2005, By 2010, their global total was expected to bealmost 5,000 stores. The group boasted a worldwide empire of 6,340 stores in 87 markets at the

end of its 2013 business year,Zara now operates in 86 countries across the globe, in every continent, with total of 1,770 stores.
As one of the leading brands in the fashion industry, company profitability and growth is of course important. At the beginning of 2013, Inditex reported a 22% increase in their earnings as they expanded in many emerging markets such as China, India, and Indonesia as well as the online retail.
So far in 2006,Zarahas expanded cautiouslyin the United States, with only19 stores. At 2013 they include only 45 US stores. Meanwhile, their biggest competitor, H&M, has 91 stores in the US, which is still cautious (Zara, 2014).

Online Expansion

As the world is now becoming digital, many marketers initiate the digital marketing campaign. Many companies now engage actively to promote their products on social media like Facebook, Twitter, YouTube, or Instagram. Not wanting to be a laggard, Zara also created its own Facebook page, Twitter account, YouTube, and also Instagram accounts. More than 16 million people —likell Zara„s FB page and more than 300 hundred people followed Zara on Twitter, thousands of people also subscribed to Zara„s channel on YouTube. Unfortunately, it is not enough. Despite its availability on social media, Zara is not utilizing using these social media to do advertisements; therefore, these accounts are not really productive or useful for the company (Ghemawat, P., Nueno, J. L. (2012).

Current marketing strategy ZARA

The company„s vision as stated on the website:

“Zara is committed to satisfying the desires of our customers. As a result we pledge to continuously innovate our business to improve your experience. We promise to provide new designs made from quality materials that are affordable”.

Long-term Objectives
The company states on their website the following as their objectives in the long-term:

1.Save energy, the eco-friendly store:
They are implementing an eco-friendly management model in their shops in orderto reduce energy consumption by 20%, introducing sustainability and efficiency criteria. This management model sets out measures to be applied to all processes, includingthe design of the shop itself, the lighting, heating and cooling systems and the possibility of recycling furniture and decoration.

2.Produce less waste and recycle:
Zara recycles their hangers and alarms, which are picked up from their shops and processed in to other plastic elements. This is an example of their waste management policy. Millions of hangers and alarms are processed each year and both the cardboard and plastic used for packaging are also recycled.

3.Their commitment extends to all their staff, increasing awareness among the team members:
The Company holds In-company awareness campaigns and specific multimedia-based training programs to educate their staff in sustainable practices, such as limiting energy consumption, using sustainable transport and modifying behavior patterns.

4.Use ecological fabrics, organic cotton:
Zara supports organic farming and makes some of its garments out of organic cotton(100% cotton, completely free of pesticides, chemicals and bleach). They have specific labels and are easy to spot in the shops.

5. Use biodiesel fuel:
Zara„s fleet of lorries, which transport more than 200 million items of clothing a year, use 5% biodiesel fuel. This allows them to reduce their CO emissions by 500 tons. We can see from the objectives that Zara is aiming to be an environmental-friendly company. It is their top priority at least until the year 2020.

H&M SWOT Analysis

Strengths

- Leader in Global market (2nd)
- Affordable & high quality clothing
- Fast-fashion
- Throw-away fashion
- Strong presence in multiple markets (Women, Men,Kids…)
- Celebrity endorsements
- Strong social media presence
- Price does not effect quality
- Company website and blog

Weaknesses

- Brand awarenss of individual apparel brands sold in stores
- Fit is not consistent due to variety of manufacturers and supplies
- Customer service

Opportunities

- Promote current sustainability practices
- Increase word of mouth in both temale& male audiences
- Online market including social media
- Mobile Marketing

Threats

- Secondary competitors such as Express, Charlotte Rouse
- Primary competitors: Forever 21, Topshop, Urban Outfitters, Zara

Marketing mix

The 4Ps of H&M:

1.Product:
H&M"s business concept is to offer fashion and quality at the best price. Quality also means that the products must be manufactured in a way that is environmentally and socially sustainable. All goods are labelled with their country of origin. Prints on H&M"s goods shall not cause racial, sexual, political or religious offence.
2.Price:
The price strategy of H&M is designed based on their customers needs which is low price and high fashion. In fact, this is the one of the biggest challenges for H&M.
They combine fashion and cheapness by two steps: first, H&M outsources the production to countries where the labour cost is much lower. Second, the company also conduct strict cost control plan.
3.Place:
There are over 3200 H&M stores all over the world. The store is located in prime locations of the area with high concentration of visitors. Because the inventory for H&M is refreshed everyday (H&M, 2014), direct command is important for correct adjustment in more than 3200 stores. Besides stores, H&M starts to launch online sale in several areas. It was suggested that well-known fashion retailers have advantages of their brand to attract customers(Marciniak and Bruce, 2004). Therefore it is beneficial to take the initiative to launch online shop. And This step could satisfy online customers and complement the shortcomings of store sale.
4.Promotion:
H&M"s target customers are young women who want more fashion cloth at low price. Young people have plenty access to information. A multi-channel promotion strategy including advertising, internet

promotion, sales promotion was adapted by H&M. These multi-channel strategy increases the exposure of H&M. They promoted through Fashion outlets (i.e.magazines,blogs,retailer web sites). H&M hired celebrities in their campaigns.
The promotional actions of H&M focus on the two features. It is easy to find the posters of H&M are in fashionable style and always with the price of the clothes. On H&M"s website, price is put at obvious position. Although Zara and Gap, H&M"s main competitors, put the price online, they usually put it small. On the contrary, advertising of H&M always highlights the low price to build awareness of their low price (Capell,K., Khermouch,G. (2002).

4. CONCLUSION

In conclusion, Zara and H&M have much to accomplish internally and externally as companies. To be fully established as a brand both companies will need to alter some of the aspects they have already created to be where they are at today. Both brands are well known in certain are as of the world and have formed a strong brand identity. To keep growing each company will need to make some adjustments and some compromises so consumers are more exposed to the fashion brands. H&M has already formed are cognizable name in the U.S. by having selective advertisements and a strong apparel line. If the company wants to continue to be adominant trendy company then implementing the marketing plan that wehave come up with may help to spread the name to more consumers.To make a mark on the U.S. market, Zara has many changes that need to take place in order to do this. Both companies have astrong brand identity; they just need to be introduced in a different manner so consumers are aware of the irexitence. Both apparel companies have the ability to spread in the U.S and be highly successful. It is a huge risk, but it will not damage the name or the price to make their products available to more people.

REFERENCES

Capell,K. (2008) Zara Thrives By Breaking All the Rules. *BusinessWeek*, (4104), 066. Retrieved from htto://www. academic search.com

Capell,K., Khermouch,G. (2002) HIP H&M.*BusinessWeek*, (3807), 106-110. Retrieved from htto://www. academic search.com

David, F. (2013). Strategic Management: Concepts and Cases. New Jersey: Pearson International Edition.

Filipović V., Janičić R. (2010), „Strateški marketing", FON, Beograd,

Ghemawat, P., Nueno, J. L. (2012). ZARA: Fast Fashion. Harvard Business Journal

H&M, 2014 Retrieved from www.hm.com

Wikipedia, 2013 Retrieved from http://en.wikipedia.org/wiki/H&M

Wikipedia, 2013 Retrieved from http://en.wikipedia.org/wiki/Zara_(retailer)

Zara, 2014 Retrieved from www.zara.com